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SOCIO-DEMOGRAPHIC AND ENVIRONMENTAL CORRELATES OF LEPROSY: A HOSPITAL BASED CASES CONTROL STUDY

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ABSTRACT

Introduction: Worldwide, India alone contributes approximately 50% of Leprosy cases. The Natural history of Leprosy has still many gaps about causation of Leprosy. There are very few studies focusing on all possible factors that might be associated with Leprosy.

Materials and Methodology: Hospital based case-control study was carried out in Outpatient department. Interviews of 76 cases of Leprosy and 152 Age and Sex matched Non-Leprosy Controls were taken exploring Demographic, Socio-Economic, Environmental and Behavioural factors to elucidate association with Leprosy.

Results: In Univariate analysis, Residing in Rural and Urban-slum area, lower education, low per capita monthly income, Extended family, unsafe water for domestic purpose, presence of animals in house/yard, unhygienic habit of sewage disposal, frequent bathing in open water bodies, working barefooted were associated with Leprosy. Presence of BCG scar was found to reduce the risk of Leprosy. In the final model of Binary Logistic Regression analysis, presence of BCG scar and higher per capita monthly income were found to be protective for Leprosy whereas family history of Leprosy and frequent bathing in open water bodies were found to be risk factors for Leprosy.

Conclusion: BCG vaccine might provide some degree of protection against Leprosy. Protective effect of higher per capita income emphasizes that economic development itself will help us to reduce the burden of Leprosy. Association of Frequent bathing in open water bodies with Leprosy might indicate the role of environmental factors in transmission of Leprosy.

Key Words: Leprosy, Case-control study, Environmental factors, Socio-demographic factors

INTRODUCTION

Leprosy is a chronic infectious disease caused by Mycobacterium Leprae. It mainly affects peripheral nerves. Leprosy is known for kind of disability and deformity it causes, which results in associated stigma and discrimination in the society. The number of new cases detected during the year 2011, as reported by 105 countries were 2,19,075; of which 1,27,295 (58%) were from India. The registered prevalence globally at the beginning of 2012 was 1,81,941 out of which India contributed 83,187 cases (46%).[1,2] So, India is still contributing half of the burden of Leprosy in world. If we analyze data of last two decades, the

decline in ANCDR (Annual New Case Detection Rate-the proxy indicator of Incidence rate) has been very slow for last five to six years.[3]

The probable reasons for this halt are (a) The concept of Elimination of Leprosy was based on Prevalence rather than Incidence (ANCDR). (b) Overwhelming thought that MDT (Multi Drug Therapy) itself will eradicate Leprosy. (c) As the number of cases decreases, the level of suspicion about that disease also decreases. (d) Long incubation period ranging from as short as 9 months to as long as 20 years.[4] (e) Transitional phase of the programme: from vertical to integrated programme from high burden to low burden. (f) Knowledge gap in Natural History of Disease

The aim of the present study is based on the last reason mentioned in the above list. Poor socio economic status,[5] food shortage,[6] less education, poor housing,[7] family history,[8] and many environmental factors[9] have been found to be associated with Leprosy. Studies have also shown the survival of M. Leprae in soil.[10] Very few studies have been carried out taking in to account all these factors and finding their independent association with Leprosy.

MATERIALS AND METHODOLOGY:

As the incidence rate of Leprosy is very low (ANCDR of India: 10.35 per 100,000 population),[2] Case control study would be the most appropriate study to fulfill the objectives of the study. For feasibility, hospital setting has been chosen.

Study Design: A hospital based Density type case control study with Matching for Age and Sex.

Study Setting: Out Patients Department (OPD) of Department of Skin and Venereal Diseases (VD) in New Civil Hospital, Surat (NCHS) which is a Tertiary Level Government Hospital in South Gujarat region.

Selection of Cases: Leprosy patients who were diagnosed by Skin specialist at Department of Skin and Venereal Diseases in New Civil Hospital, Surat on the basis of one or more of the following criteria: (i) typical skin lesion/s with loss of sensitivity; (ii) enlargement of one of the major nerves with loss of sensitivity. Cases were enrolled when they came to the Skin OPD for taking their monthly MDT Blister Pack.

Inclusion criteria for Cases: Cases were included if (a) No history of having taken the Multi Drug Therapy Blister Pack/s in the past. (b) Willing to participate and willing to give written consent. (c) Subjects less than 18 years of age were included only if reliable parent (mother or father or guardian) was accompanying with the subject and the parent was willing to participate and willing to give written consent for the subject.

Selection of Controls: Patients coming to OPD of Skin and VD Department of NCHS for skin problems / skin diseases other than Leprosy.

Inclusion criteria for Controls: Controls were included if (a) Willing to participate and willing to give written consent. (b) Subjects less than 18 years of age were included only if reliable parent (mother or father or guardian) was accompanying with the subject and the parent was willing to participate and willing to give written consent for the subject

Two controls were selected for each case. These two Controls were selected by matching with their respective Case for sex and age ± 5 years i.e. controls were first matched for the sex and then they were selected for the case for which their age was either same as that of Case or not less than 5 years the age of Case or not greater than 5 years the age of Case.

Assumption: We assumed that all those patients with skin problems / skin diseases other than Leprosy who came to OPD of Skin and VD Department of NCHS, came from the same source population as that of Leprosy patients and Controls might have also come to OPD of Skin and VD Department of NCHS had they developed Leprosy.

Sample Size: Having Family history of Leprosy has been found to be the most important risk factor for development of Leprosy, so this factor was taken to calculate the sample size. To determine the exposure level of this factor among controls, pilot study was carried out. Out of 10 controls interviewed, 1 (10%) having the family history of Leprosy. Taking the same (10%) as Expected frequency of Family History of Leprosy in control group, at desired Confidence Level of 95 %, Power of 80 %, Case-Control ratio of 1:2 and the smallest worth detecting OR (odds ratio) of 3; the sample size came out to be 71 Cases and 142 Controls calculated by Open Epi software using Fliess method. With expectation of some non response, we targeted to take 75 cases and 150 controls.

Study period: from September 2011 to February 2012 when the target sample size was reached.

Sampling technique: Convenience sampling All the leprosy patients coming to OPD of Skin and VD Department of NCHS for taking their monthly MDT Blister Pack and fulfilling the inclusion criteria of the study were enrolled as the cases in the study until desired sample size of 75 was achieved. Sex and Age matched controls were enrolled and interviewed within 30 days of interviewing the corresponding cases.

Study Tool: A pre-tested standardized semi-structured questionnaire was used. (The questionnaire was standardized by doing piloting for 10 cases and 10 controls.)

Because of long and variable incubation period (ranging from as less as 2 years to more than 20 years), cases were asked for risk factors in the form of three scenarios.

Scenario-I: Cases were asked about the probable risk factors within last 5 years of initiation of signs and symptoms of Leprosy;

Scenario-II: Cases were asked about the probable risk factors within last 5 to 10 years of initiation of signs and symptoms of Leprosy and

Scenario-III: Cases were asked about the probable risk factors 10 years before the initiation of signs and symptoms of Leprosy.

Controls were also asked about the probable risk factors in the same scenarios corresponding to the time of onset of symptoms of leprosy in the matched case. For example if the Case had onset of symptoms of Leprosy 4 years before the time of interview, the control was also asked about the probable risk factors 4 years before the time of interview.

Data Collection: Data was collected in OPD of Skin and VD department of NCHS from the patients during Morning OPD hours (9 am to 1 pm). All the study participants were asked about Demographic factors like Age, Sex, Family size, etc; Socio-economic factors like Religion, Caste, Years of education (and Level of Education), etc; Environmental factors like Source of water for Drinking purpose, Source of water for Domestic purpose, Type of Floor, etc; Behavioural factors like Habit of Sewage Disposal, Frequency of Changing bed linen, Sharing bed mattress or covering sheet with others, etc. At the end of the questionnaire there were questions about Family history in Leprosy and if found positive then relationship of the study participant with that family member. After end of the interview each study participant was examined for BCG scar on left arm. In case of females, a female Nurse was accompanying the interviewer while examining for presence of BCG scar in the female study participant.

Data Entry and Analysis: Data entry was done in Microsoft Excel Sheet 2003. Some of the preliminary analysis was done with the help of MS excel 2003. Graphs were prepared in MS excel 2003. At first, Univariate analysis was conducted in Epi Info 3.5.1.0 software using Chi square & Odds Ratio along with 95% Confidence Interval for categorical variables and Student's t-test for continuous variables as statistical tests for association. All possible interactions were assessed. All the explanatory variables were entered in to the Multiple Logistic Regression model using Backward Step wise Elimination method in SPSS 16.0 software. The explanatory variables were step-by-step removed from the model based on their significance level i.e. explanatory variables with higher p value were removed from the model followed by lower values until all the explanatory variables in the model have the p value < 0.05. Both the Univariate and Multivariate analyses were conducted for three scenarios as data has also been collected for three scenarios.

Ethical Consideration: Study was approved by Human Research Ethics Committee (HREC) of Government Medical College, Surat. Study participants were included in the study only after written informed consent was obtained from them. Participants were given the choice whether to take part or not in the study.

RESULTS

The median age of cases and controls is almost same with corresponding range. The proportion of Males and Females is also the same in both the groups. This makes cases and controls comparable for the present study.

Table 1: Age and Sex distribution of Cases and Controls

	Cases	Controls
Age-Median (Range)	31.5 (10-73)	32.5 (10-71)
Sex-Male/Female	61/15	122/30

Table 2: Univariate Analysis showing association of different factors with Leprosy in Scenario I

Name of the variables	Cases (n=76) (% or M ± SD)	Controls (n=152) (% or M ± SD)	p	OR (95 % CI)
Age#	34.99 ± 14.50	34.72 ± 14.63	0.9	-
Female Gender	15 (19.7%)	30 (19.7%)	1	1.00 (0.50 - 2.00)
Family Size#	7.22 ± 4.93	6.15 ± 3.80	0.07	-
Area settings*				
Non Slum Urban	29 (38.2%)	82 (53.9%)	0.003	1
Urban Slum	19 (25.0%)	42 (27.6%)		1.28 (0.64-2.54)
Rural	28 (36.8%)	28 (18.4%)		2.83 (1.44-5.55)
Original State of Residence outside Gujarat	54 (71.1%)	87 (57.2%)	0.04	1.84 (1.02 - 3.31)
Non Hindu Religion	8 (10.5%)	15 (9.9%)	0.88	1.08 (0.43 - 2.66)
Backward Caste $$	33 (43.4%)	55 (36.2%)	0.29	1.35 (0.77 - 2.37)
Years of Education#	5.26 ± 4.52	7.21 ± 4.37	0.002	-
Per Capita Monthly Income in thousands (Current)	1.244 ± 0.782	1.763 ± 1.312	0.0017	-
Extended Family##	39 (51.3%)	52 (34.2%)	0.01	2.03 (1.16 - 3.55)
Food shortage	17 (23.4%)	14 (9.2%)	0.006	2.84 (1.32 - 6.14)
Unsafe source of water for Drinking purpose	14 (18.4%)	15 (9.9%)	0.07	2.07 (0.94 - 4.53)
Unsafe source of water for Domestic purpose	19 (25.0%)	18 (11.8%)	0.01	2.48 (1.21 - 5.07)
Floor made up of Sand or Mud	45 (59.2%)	61 (40.1%)	0.007	2.17 (1.24 - 3.79)
Household crowding	55 (72.4%)	99 (65.1%)	0.27	1.40 (0.77 - 2.56)
Had animals in the house/yard	34 (44.7%)	39 (25.7%)	0.004	2.35 (1.31 - 4.19)
Unhygienic habit of Sewage disposal	46 (60.5%)	61 (40.1%)	0.004	2.29 (1.30 - 4.02)
Changing bed linen >=2 weekly	26 (34.2%)	44 (28.9%)	0.42	1.28 (0.71 - 2.30)
Sharing bed mattress/bedstead	26 (34.2%)	40 (26.3%)	0.22	1.46 (0.80 - 2.64)
Involved in Fishing	14 (18.4%)	18 (11.8%)	0.18	1.68 (0.79 - 3.60)
Bathing Open water bodies daily or Weekly**	25 (32.9%)	22 (14.5%)	0.001	2.9 (1.50 - 5.59)
Worked barefooted	30 (39.5%)	40 (26.3%)	0.04	1.83 (1.02 - 3.28)
Worked in agriculture	32 (42.1%)	47 (30.9%)	0.09	1.63 (0.92 - 2.88)
Family History of Leprosy	15 (19.7%)	6 (3.9%)	0.0001	5.98 (2.22 - 16.15)
BCG Vaccine given	19 (25%)	83 (54.6%)	0.00002	0.28 (0.15 - 0.51)

*Chi-square for Linear trend was use; # Unpaired Student's t – test was used; ** As compared to Monthly or occasionally; ##As compared to nuclear family; $$As compare to general cast

Table 3: Univariate Analysis showing association of different factors with Leprosy in Scenario II

Name of the variables	Cases (n=76) (% or M ± SD)	Controls (n=152) (% or M ± SD)	p	OR (95 % CI)
Age#	34.99 ± 14.50	34.72 ± 14.63	0.9	-
Female Gender	15 (19.7%)	30 (19.7%)	1	1.00 (0.50 - 2.00)
Family Size#	7.46 ± 4.83	6.56 ± 4.33	0.16	-
Area settings*				
Non Slum Urban	21 (27.6%)	65 (42.8%)	0.004	1
Urban Slum	14 (18.4%)	36 (23.7%)		1.20 (0.55-2.65)
Rural	41 (53.9%)	51 (33.6%)		2.49 (1.31-4.72)
Original State of Residence outside Gujarat	54 (71.1%)	87 (57.2%)	0.04	1.84 (1.02 - 3.31)
Non Hindu Religion	8 (10.5%)	15 (9.9%)	0.88	1.08 (0.43 - 2.66)
Backward Caste $$	33 (43.4%)	55 (36.2%)	0.29	1.35 (0.77 - 2.37)
Years of Education#	5.26 ± 4.52	7.21 ± 4.37	0.002	-
Per Capita Monthly Income in thousands (Current)	1.244 ± 0.782	1.763 ± 1.312	0.0017	-
Extended Family##	40 (52.6%)	58 (38.2%)	0.04	1.8 (1.03 - 3.14)
Food shortage	26 (21.1%)	15 (9.9%)	0.02	2.44 (1.13 - 5.24)
Unsafe source of water for Drinking purpose	14 (18.4%)	15 (9.9%)	0.07	2.07 (0.94 - 4.53)
Unsafe source of water for Domestic purpose	19 (25.0%)	18 (11.8%)	0.01	2.48 (1.21 - 5.07)
Floor made up of Sand or Mud	45 (59.2%)	61 (40.1%)	0.007	2.17 (1.24 - 3.79)
Household crowding	55 (72.4%)	99 (65.1%)	0.27	1.4 (0.77 - 2.56)
Had animals in the house/yard	34 (44.7%)	39 (25.7%)	0.004	2.35 (1.31 - 4.19)
Unhygienic habit of Sewage disposal	46 (60.5%)	61 (40.1%)	0.004	2.29 (1.30 - 4.02)
Changing bed linen >=2 weekly	26 (34.2%)	44 (28.9%)	0.42	1.28 (0.71 - 2.30)
Sharing bed mattress/bedstead	26 (34.2%)	40 (26.3%)	0.22	1.46 (0.80 - 2.64)
Involved in Fishing	14 (18.4%)	18 (11.8%)	0.18	1.68 (0.79 - 3.60)
Bathing Open water bodies daily or Weekly**	25 (32.9%)	22 (14.5%)	0.001	2.90 (1.50 - 5.59)
Worked barefooted	30 (39.5%)	40 (26.3%)	0.04	1.83 (1.02 - 3.28)
Worked in agriculture	32 (42.1%)	47 (30.9%)	0.09	1.63 (0.92 - 2.88)
Family History of Leprosy	15 (19.7%)	6 (3.9%)	0.0001	5.98 (2.22 - 16.15)
BCG Vaccine given	19 (25%)	83 (54.6%)	0.00002	0.28 (0.15 - 0.51)

*Chi-square for Linear trend was use; # Unpaired Student's t – test was used; ** As compared to Monthly or occasionally; ##As compared to nuclear family; $$As compare to general cast

Table 2, Table 3 and Table 4 shows the univariate analysis of association of different factors with Leprosy in Scenario I, Scenario II and Scenario III respectively. The Univariate analysis shows that Area setting, Original state of residence, years of Education, Per capita monthly income, type of family, Food shortage, Source of water for Domestic purpose, type of Floor, presence of ani-mals in or around house, unhygienic disposal of excreta, frequent bathing in open water bodies, working bare footed, working in Agriculture were significantly different in cases than in con-trols. But, because of these factors might be inter-racting with each other or might confound one another, so Multivariate analysis was performed.

Table 4: Univariate Analysis showing association of different factors with Leprosy in Scenario III

Variables	Cases (n=76) (% or M ± SD)	Controls (n=152) (% or M ± SD)	p	OR (95 % CI)
Age#	36.31 ± 13.73	36.26 ± 14.01	0.98	-
Female Gender	14 (19.4%)	28 (19.9%)	0.94	1.03 (0.50 - 2.10)
Family Size#	8.14 ± 4.30	7.98 ± 6.63	0.85	-
Area settings*				
Non Slum Urban	6 (8.3%)	38 (27.0%)	0.0006	1.00
Urban Slum	8 (11.1%)	21 (14.9%)		2.41 (0.74-7.89)
Rural	58 (80.6%)	82 (58.1%)		4.48 (1.78-11.29)
Original State of Residence outside Gujarat	50 (69.4%)	84 (59.6%)	0.16	1.54 (0.84 - 2.82)
Non Hindu Religion	7 (9.7%)	14 (9.9%)	0.96	0.98 (0.38 - 2.54)
Backward Caste $$	31 (43.1%)	54 (38.3%)	0.5	1.22 (0.68 - 2.17)
Years of Education#	5.31 ± 4.63	7.16 ± 4.36	0.0045	-
Per Capita Monthly Income in thousands (Current)	1.274 ± 0.791	1.764 ± 1.323	0.0043	-
Extended Family##	45 (62.5%)	68 (48.2%)	0.048	1.79 (1.001 - 3.20)
Food shortage	12 (16.7%)	20 (14.2%)	0.63	1.21 (0.56 - 2.64)
Unsafe source of water for Drinking purpose	32 (44.6%)	37 (26.2%)	0.007	2.25 (1.24 - 4.09)
Unsafe source of water for Domestic purpose	36 (50.0%)	39 (27.7%)	0.001	2.62 (1.45 - 4.72)
Floor made up of Sand or Mud	62 (86.1%)	90 (63.8%)	0.0007	3.51 (1.66 - 7.45)
Household crowding	53 (73.6%)	89 (63.1%)	0.13	1.63 (0.87 - 3.05)
Had animals in the house/yard	46 (63.9%)	66 (46.8%)	0.02	2.01 (1.12 - 3.60)
Unhygienic habit of Sewage disposal	65 (87.5%)	94 (66.7%)	0.001	3.5 (1.60 - 7.65)
Changing bed linen >=2 weekly	30 (41.7%)	50 (35.5%)	0.38	1.3 (0.73 - 2.33)
Sharing bed mattress/bedstead	31 (43.1%)	46 (32.6%)	0.13	1.56 (0.87 - 2.80)
Involved in Fishing	20 (27.8%)	27 (19.1%)	0.15	1.63 (0.84 - 3.16)
Bathing Open water bodies daily or Weekly**	34 (47.2%)	33 (23.4%)	0.0004	2.93 (1.60 - 5.36)
Worked barefooted	47 (65.3%)	63 (44.7%)	0.004	2.33 (1.29 - 4.19)
Worked in agriculture	47 (65.3%)	71 (50.7%)	0.04	1.85 (1.03 - 3.33)
Family History of Leprosy	13 (18.1%)	5 (3.5%)	0.0003	5.99 (2.04 - 17.57)
BCG Vaccine given	17 (23.6%)	74 (52.5%)	0.00006	0.28 (0.15 - 0.53)

*Chi-square for Linear trend was use; # Unpaired Student's t – test was used; ** As compared to Monthly or occasionally; ##As compared to nuclear family; $$As compare to general cast

Table 5: Final Model of Binary Logistic Regression Analysis using Backward Stepwise Elimination (Likelihood ratio) method in Scenario-I, II & III

Significant Variables in the final models	Scenario I		Scenario II		Scenario III	
	B(S.E.)	aOR (95% CI)	B(S.E.)	aOR (95% CI)	B(S.E.)	aOR (95% CI)
Presence of BCG Scar	-1.24# (0.34)	0.29 (0.15-0.56)	-1.22# (0.33)	0.30 (0.15-0.57)	-1.19** (0.34)	0.31 (0.16-0.60)
Monthly Income$	-0.52** (0.18)	0.59 (0.42-0.85)	-0.55** (0.18)	0.58 (0.41-0.82)	-0.47**(0.17)	0.63 (0.45-0.88)
Family History of Leprosy	1.33* (0.54)	3.79 (1.31-10.94)	1.43** (0.54)	4.17 (1.45-11.99)	1.38*(0.59)	3.99 (1.24-12.79)
Bathing Open water bodies##	1.36**(0.47)	3.89 (1.55-9.78)	1.19**(0.37)	3.27 (1.58-6.81)	1.03**(0.34)	2.81 (1.45-5.44)
Extended Family	0.78* (0.33)	2.17 (1.14-4.11)	-	-	-	-
Constant	-0.10(0.38)	-	0.18 (0.33)	-	0.002 (0.35)	-
Model Parameters	Scenario I		Scenario II		Scenario III	
Cox and Snell R²	0.21		0.20		0.19	
Nagelkerke R²	0.29		0.27		0.26	
Model χ²	52.49# (df=5)		40.66# (df=4)		43.89# (df=4)	

* p < 0.05; ** p < 0.01; # p < 0.001; $Per Capita current monthly income in thousand; ##Bathing in open water bodies Weekly or Daily

Multivariate analysis

Multivariate analysis shows that there are four factors which are consistently associated in all

the three scenarios with p value < 0.05 for each variable. The highest strength of association was for 'Having Family history of Leprosy' with an aOR of approximately 4.00*. BCG was found protective with an aOR of approximately 0.30*. In final model, another factor which has been found to be significantly associated with Leprosy is 'Economic status' with an aOR of approximately 0.60* i.e. there is decrease in odds of developing Leprosy by 0.6 times with each one unit (1000 Rs) increase in Per Capita Monthly Income. No single environmental variable was significantly associated in the final model. However, one behavioural factor 'Bathing in open water bodies frequently' was constantly found to be significantly associated with Leprosy in all the three scenarios with an aOR of 3.89, 3.27 and 2.81* in Scenario-I, II and II respectively. For exact values of aOR and their 95% Confidence Intervals refer Table 5.

DISCUSSION

Multivariate logistic regression analysis in the present study shows that BCG vaccination was found to reduce the risk of Leprosy with aOR of 0.30, thus giving the vaccine effectiveness of about 70 % with 95 % CI of 40 % to 85 %. This finding is similar to meta-analysis conducted on case control studies showing the effectiveness of BCG vaccine of about 58 % with 95 % CI of 47 % to 67%.[11] Effectiveness of BCG vaccines in preventing Leprosy indicates that it can provide a good tool (in addition to available MDT) that will help us to reduce the overall incidence rate of Leprosy or at least maintaining the control that we have achieved. Better understanding of the mechanism of BCG vaccine by which it protects against Leprosy can lead us to develop a more effective vaccine against Leprosy.

The present study finds that the risk of Leprosy reduces with each 1 unit (1000 Rs) increase in per capita monthly income with aOR of 0.60 i.e. it will reduce the risk by 40 % with increase in per capita monthly income of 1000 Rs and vice versa there is increase in the risk of developing Leprosy by 1.67 times with each one unit (1000 Rs) decrease in per capita monthly income. This finding is similar to one ecological study by Kerr-Pontes et al in North-East Brazil reported the relative risk of 1.67 for leprosy in areas with high level of poverty.[12] It is important to note that we have considered current per capita monthly income of study participants assuming that there has not been any drastic change in

their economic class. Though poverty has been found to be associated with leprosy since long, we need to look at the links in between the relationship of Leprosy and poverty. These links might be nourishment, immunity and / or increase exposure to conditions that increase risk of getting leprosy.

Relationship of Leprosy with poor economic condition clearly establishes the fact that Leprosy cannot be abolished by mere early detection and treatment with highly effective drugs (with the added assistance from moderately effective BCG vaccine). If we really want to accomplish the vision of eradication of Leprosy, there is a need to focus on overall economic development of community i.e. achieving that level of economic status for all individuals that will render them to achieve some conditions or behaviour which reduces the chance of the infection and/or chance of transformation of infection in to disease. The economic status has direct bearing on the kind of environment in which the individuals live in and the kind of services the individuals avail to maintain the "positive health" to battle against the leprosy. However, to improve the overall economic status of the community requires high level of political commitment and this will go a long way in reducing the burden of infectious diseases along with leprosy in India.

This study found adjusted odds ratio of approximately 4 for a factor 'positive family history for leprosy' indicating that odds of developing leprosy is 4 times higher in those with 'positive family history for leprosy' compared to those who do not have such positive family history. It is the only factor that has been consistently associated with the occurrence of leprosy in various studies whether conducted in the past or present. A case control study done by George K et al. found that the persons with intra-household contact with leprosy have a higher risk of acquiring leprosy compared with those who did not have similar history with a RR of 2.5.[13]

Significant association of 'positive family history for leprosy' with occurrence of leprosy in current study reconfirms the age old finding but actual quantification of risk is difficult to assess because of limitations like duration of exposure not taken in the present study, dynamic nature of people and genetic susceptibility not been studied in this research (which can modify the immunity in a way that ultimately translates the infection to actual disease).[14]

In this study, we observed the relationship of these Leprosy cases with their one or more family member having Leprosy in past or present. It was found that majority had first degree relationship (father in 7 cases, mother in 2 cases, brother in 1 case and sister in 1 case – 11 out of total 15 cases). This is also true for controls in which 2 out of five Cases (who gave positive family history of Leprosy) had first degree relationship (Father in 1 case and Sister in 1 case). Of these 15 cases having family history of Leprosy, 3 have history of more than one family member having Leprosy in past or present. Before we conclude that the cases who gave positive family history of Leprosy case, actually acquired the infection from them, we cannot deny the role of another factor 'genetic susceptibility to Leprosy' which might have been similar in these family members. Positive family history of Leprosy among 15 out of total 76 cases i.e. 20 % of cases tells that there are some other factors playing role in transmission of M. Leprae among community members.

Although many environmental factors have been implicated to be potential source of infection,[9] in this study the only environmental factor that has been found to be significantly associated with Leprosy after adjusting for all possible confounding variables, is the bathing frequently in open water bodies with an aOR of 3.89, 3.27 and 2.81 in Scenario-I, II and III respectively. There are some studies indicating the importance of water as the potential source of infection or reservoir for occurrence of Leprosy. A case-control study done by Kerr-Pontes LRS et al. found similar findings with an aOR of 1.77.[15] One another study done in Indonesia used PCR for detecting M. Leprae in water samples from the water sources used by villagers daily, found that prevalence of leprosy among the people using PCR-positive water for bathing and washing was significantly higher than that among the people who used PCR-negative water.[16] In a study carried out way back in 1982 found Acid Fast Bacilli in water of lake situated nearby the colony of Leprosy patients.[17]

Though above findings suggest the role of contaminated water as an important source for the transmission of Leprosy, we need to carry out further research in this aspect with other possible sources of Leprosy infection as well as cause effect relationship between exposure and infection. Nonetheless, we cannot omit this relationship because it was found to be significant in this study even after adjustment for most of the con-founders. This again indicates the importance of economic development with the provision of tapped water supply at each house that might eventually reduce the frequency of individuals who go for bathing in open water bodies.

CONCLUSION & RECOMMENDATIONS:

As family members of Leprosy case are at higher risk of developing this condition, nearby health functionaries should be familiar with such families. A system should be worked out to keep watch on family members of these households in the form of follow up examination of Family Members at periodic intervals so as to detect Leprosy early in them.

Association of Leprosy with poverty indicates that we need to execute variety of welfare activities and pro poor schemes effectively for uplifting the economic standards of under privileged people.

Improving the BCG coverage especially in endemic areas for Leprosy will help to prevent some cases of Leprosy.

Behavioural issues like bathing in open water bodies reflects poor standard of living. If one oversimplifies and considers lower standard of living as a conducive environment for keeping the Lepra bacilli survived in the vicinity, health promotive measures like General awakening among the people regarding personal hygiene and environmental sanitation and provision of Safe water supply at the door step of each house might reduce further exposure to this probable risk factor and might result in to further reduction of this disease.

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