Health and Communicable Disease in West Khasi Hill District, India

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

Original Research Article

ABSTRACT

Aims: To analyse spatial patterns in the distribution of major communicable diseases in West Khasi Hills District.
Study Design: Random sampling technique has been used to collect household data. It has been purpossively selected 28 villages. The criteria selecting this villges are that they are close to the uranium mining site. Around 719 households from these 28 villages were covered for the present study.
Data collected from households have been analysed for each village separately. Data are calculated in excel and for frequencies are used in SPSS software. Separate layers of data have been mapped for each of the demographic parameters for which the household information has been collected through a structured household schedule canvassed through an interview method. Mapping technique has been employed on a GIS platform to get a comprehensive demographic picture of each of the sample villages in each of the distance zone.
Place and Duration of Study: West Khasi Hills District, Meghalaya, N.E. India between 2009 and 2011.
Methodology: Data for the present researchhas been collected from a number of villages located around Domiasiat village which is the locus of the proposed uranium mining. The health conditions

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and the disease prevalence in the area around this village have been assessed by collecting useful information from households in 28 villages selected on the basis of distance criterion.

Results: A study of the morbidity pattern reveals the dominance of communicable diseases as reported by the respondents. The types of sicknesses recorded during the survey shows that the most prevalent type of sickness is malaria that afflicted more than 45.27 percent adult males, 41.20 percent adult females, and 33.18 percent children of the population interviewed. Diarrhea/dysentery affected 32.03 percent of the children, 29.62 percent of the adult males and 28.93 percent of the adult females. Prolonged cold/cough afflicted 27.57 percent of children and 26.52 percent of adult male and 26.12 percent of the adult female population. Respiratory problem accounts for 6.29 percent of children, 4.31 percent of adult females and 3.84 percent of the adult male population. Thirty persons contracted tuberculosis, of which 1.12 percent of adult female, 1.03 percent of adult males and 0.30 percent of the children population. Skin diseases are found among an insignificant 2.63 percent of children, 2.44 percent of the adult male and 2.34 percent of the adult female population.

Conclusion: Morbidity pattern in the study area reveals a clear dominance of communicable diseases which afflicts the children much more than the adults.

ABBREVIATIONS

AIDS   : *Acquired Immune Deficiency Syndrome*
ADD   : *Acute Diarrhoeal Disease*
ANM   : *Auxiliary Nurse Midwifery*
ARI   : *Acute Respiratory Infection*
ASHA   : *Accredited Social Health Activist*
BARC   : *Bhabha Atomic Research Centre*
BD   : *Bacillary Dysentery*
BNRC   : *Board of Research in Nuclear Sciences*
BPL   : *Below Poverty Line*
CD   : *Community Development*
CGI   : *Corrugated Galvanished Iron*
CHC   : *Community Health Centre*
DAE   : *Department of Atomic Energy*
DHS   : *Directorate of Health Service*
DMHO   : *District Medical Health Officer*
EF   : *Enteric Fever*
FUO/PUO : *Fever of Unknown Origin*
GIS   : *Geographic Information System*
ICSSR   : *Indian Council of Social Science Research*
ILI   : *Influenza Like Illness*
ML   : *Malaria*
MS   : *Measles*
NFHS   : *National Family Health Survey*
NGO   : *Non-Government Organisation*
NSSO   : *National Sample Survey Organisation*
PCI   : *Per Capita Income*
PDS   : *Public Distribution Scheme*
PHC   : *Primary Health Centre*
Pn   : *Pneumonia*
RCC   : *Reinforced Cement Concrete*
TB   : *Tuberculosis*
UCIL   : *Uranium Corporation of India Limited*
VH   : *Viral Hepatitis*
WC   : *Whooping Cough*

1. INTRODUCTION

The study of health and disease is not only important to medical practitioners but also to the social scientist including geographers. Prevalence of diseases has a spatial dimension when viewed in its environmental and social context that brings the issue closer to a geographical scrutiny for the benefit of better management, preventive as well as curative, of health of people at large. The present study is expected to provide valuable insights into the problem of disease prevalence patterns in the study area which can be profitably utilized by the health department in its efforts to frame policies, the doctors in treating the patients in localized conditions and NGOs working for creating awareness among people in specific areas regarding better health among the public.

In strict conventional sense the present study falls under the domain of medical geography that studies geographical aspects of disease ecology by obvious association between health and physical and or cultural environment. Medical geography ventures in understanding the influence of geographical factors on health of human population with the aim to recognize the law of the geographical distribution of human diseases. World Health Organization defines Health as "…a state of complete physical, mental and social well-being and not merely an absence of disease or infirmity..." and also includes the ability to lead a "…socially and economically productive life" [1]. Disease ecology is a rapidly growing discipline that offers new approaches and insights for understanding emergent biological threats to natural populations and

provides valuable insights into problems of health and health management of human population. The present study aims at identifying geographical patterning in the incidence of major communicable diseases in the West Khasi Hills District. The attempt here is to map the prevalence pattern of major diseases and to identify endemic areas of those few diseases, particularly water-borne diseases which are linked to the quality of water available or used for domestic consumption.

The West Khasi Hills, District covering an area of 5247 Sq. km is the largest district in Meghalaya. There are 6 community and rural development blocks in the district. The district has 5 Community Health Centres, 16 Primary Health Centres, one District TB Centre and 64 Sub-Centres, which are fully functional. The climatic condition in the Southern and Northern region is warmer compared to the cooler temperature in the central region. The warmer region has the prevalence of malaria, diarrhoea and leprosy and temperate region has more prevalence of cold and cough, and in the summer season cases of gastro extents in semi-epidemic form occurs [2].

A crucial factor regarding the selection of the problem is the fact that the study area falls under the proposed uranium mining zone by Uranium Corporation of India Limited (UCIL). Health concerns arising out of radioactive materials are a major concern in the study area and have led to various protests. In such a scenario it becomes highly essential to understand the prevailing health scenario in the study area for many reasons. The most important reason is whether the health problem in the area will be further exacerbated with mining. More harm than good is the end result in such a scenario. On the other hand, health infrastructure that is proposed along with other infrastructures (some already made) can help in mitigating the incumbent health concerns provided new health problems are avoided. Thus, although the present study does not deal with health problems arising out of radiation, it will help in preparing a background knowledge base that can be used to judge future achievements. The selection of the problem, i.e., investigation of communicable diseases in West Khasi Hills is therefore not only highly appropriate but timely as well.

As the health depends on nutrition and nutrition depends on income, this study will examine the interrelationship between them. Since the incidence of diseases in the area is dependent on the availability of health facility and physical environment this study analyses the impact of these factors on the health of the population in the study area. Thus, due to the geo-environmental conditions, socio-economic character and contemporary events, the present study is concerned with *Health and Communicable Disease in West Khasi Hills District*.

The broad objectives placed before the research are:

1. To analyse spatial patterns in the distribution of major communicable diseases in West Khasi Hills District;
2. To identify and map endemic areas of diseases related to specific environmental characteristics in West Khasi Hills District;

2. METHODOLOGY

Data for the present study has been collected from a number of villages located around Domiasiat village, which is the locus of the proposed uranium mining. The health conditions and the disease prevalence in the area around this village have been assessed by collecting useful information from households in 28 villages selected on the basis of distance criterion. The household data has been collected through a structured schedule canvassed through personal interview. The location of each household and the villages are taken by GPS point. The entire area around the core village is divided into three zones on the basis of distance from the village, viz., 0 km to 5 km, 5 km to 10 km and 10 km to 30 km. The villages within 5 km range include Mawthabah, Nongbahjynrin, Nongtnger, Rangkhiat, Domiasiat, Mawiawlang, Phlangdiloin and Umdohlun. The villages within 5 to 10 km distance range are Langpa, Rngimawpat, Phudumiep, Mawphanrang, Umjarain, Nongtynniaw, Mawjai, Mawpat, Umsaw, Lawsiej and Mawhianrnga and the villages between 10 to 30 km distance range are Dirang, Ranikor, Rilang, Lamjew, Maweit, Mawmarin, Mawnar Umsohiong, Nongdhar and Nongumbi.

The villages were identified with respect to: Population characteristics particularly dominant occupation/economic activity using Census information Health infrastructure and amenities available using Census information.

Households were selected on a random basis as per the following principle: all households if the total number is less than 25; 80% households if

the number is 25 to 50; 50% households if the total exceeds 50.

Random sampling technique has been used to collect household data. It has been purposively selected 28 villages. The criteria selecting this villages are that they are close to the uranium-mining site. Around 719 households from these 28 villages were covered for the present study. The total populations of the 28 villages are 4489 out of which 2238 are males and 2251 are females.

The village schedule was so designed to collect information on a host of issues especially on locational characteristics and co-ordinates, number and type of educational institutions, number and types of health institutions, Government establishments, local NGOs and their focused areas, business establishments, communication facilities, transport, recreation facilities, religious centres, irrigation facilities, main occupation of the people etc.

Respondent information was obtained on key aspects such as ethnic background, age- sex characteristics, educational qualification including drop out, main and subsidiary occupation, income (monthly), indebtedness, type of house including number of rooms, type of family, marital status, household gadgets etc.

All the data are calculated in excel and SPSS software is used for calculating the frequencies.

The health status of the people was mapped with respect to type/frequency of known diseases. The data has been collected and analysed for all the villages using census information on number of households, household size, settlement size, trend in population growth, sex ratio, occupational structure, amenities available etc.

Patterns have been identified for each demographic parameter separately for the villages. Spatial variation in demographic structure has been analysed through a series of maps prepared on a GIS platform using appropriate cartographic methods.

Data collected from households have been analysed for each village separately. Separate layers of data have been mapped for each of the demographic parameters for which the household information has been collected through a structured household schedule canvassed through an interview method. All the

information has been placed on a GIS platform to arrive at a synthesis. Mapping technique has been employed on a GIS platform to get a comprehensive demographic picture of each of the sample villages in each of the distance zone.

3. RESULTS AND DISCUSSION

3.1 Location

The present study has been undertaken in the West Khasi Hills District of Meghalaya, India. This district was specifically chosen with the idea of bringing to light the different communicable diseases existing in this region (Fig. 1). The District is the largest in the state with a geographical area of 5247 square kilometres. It lies in the central part of the state, situated between 25°10' and 25°51' N latitudes and between 90°44' and 91°49' E longitudes [3].

According to Mukherjee (2002) found out that the highest proportion of diarrhoea disease of 39.18% against the state average of 20.57% has been observed in the Nongstoin Block of West Khasi Hill district. Interestingly the lowest value of proportion for the same disease was also observed in the adjacent block Mawshynrut (7.11%). In fact just one third of the C.D. Blocks had diarrhoeal disease percentage lower than the state average of 20.57% [4].

The selected villages are located near the Bangladesh border, so it is lower in altitude, the topography is gentle and the climatic condition is warmer and humid. The climatic condition is highly conducive for the spread of communicable disease for example malaria.

3.2 Demographic and Socio-economic of the Villages

It is found from the survey that the entire zone suffers from lack of most essential infrastructure and social amenities. The zone is devoid of much essential health infrastructure like Sub PHC, PHC, doctors, nurses and medicines. Though majority of the villages have tap water facility, it is largely inadequate and the villagers rely on local sources like rivers, ponds and wells. Communication facility like post office, telephone, is available only in few villages. Electricity too is found only in a few villages. Accessible roads are available to all villages, but the condition of the road is extremely bad.

Most of the surveyed villages are small in size. The sex ratio in a majority of the villages is largely in favour of the females. Married

population is more than the unmarried population. The size of households in all the villages is relatively small. The age distribution of population shows a high ratio of child population. Christianity is the chief religion in all the villages. Almost all the households have their own land. Economically however all these villages are very poor. The main occupation of the population is agriculture and daily wagers constitute a significant livelihood option. Literacy rate is relatively good but educational level is poor as a response to lack of educational infrastructure. All the villages used kerosene as sources of energy and electricity facility is confined to a few villages only. Wood is the main sources of domestic fuel in all the villages. The types of houses constructed in the villages mostly consist of tin/CGI sheet roof while a few houses were made of thatch or concrete roofs. Domestic animal is found in almost all the households of those villages. Use of modern gadgets is extremely limited in most villages.
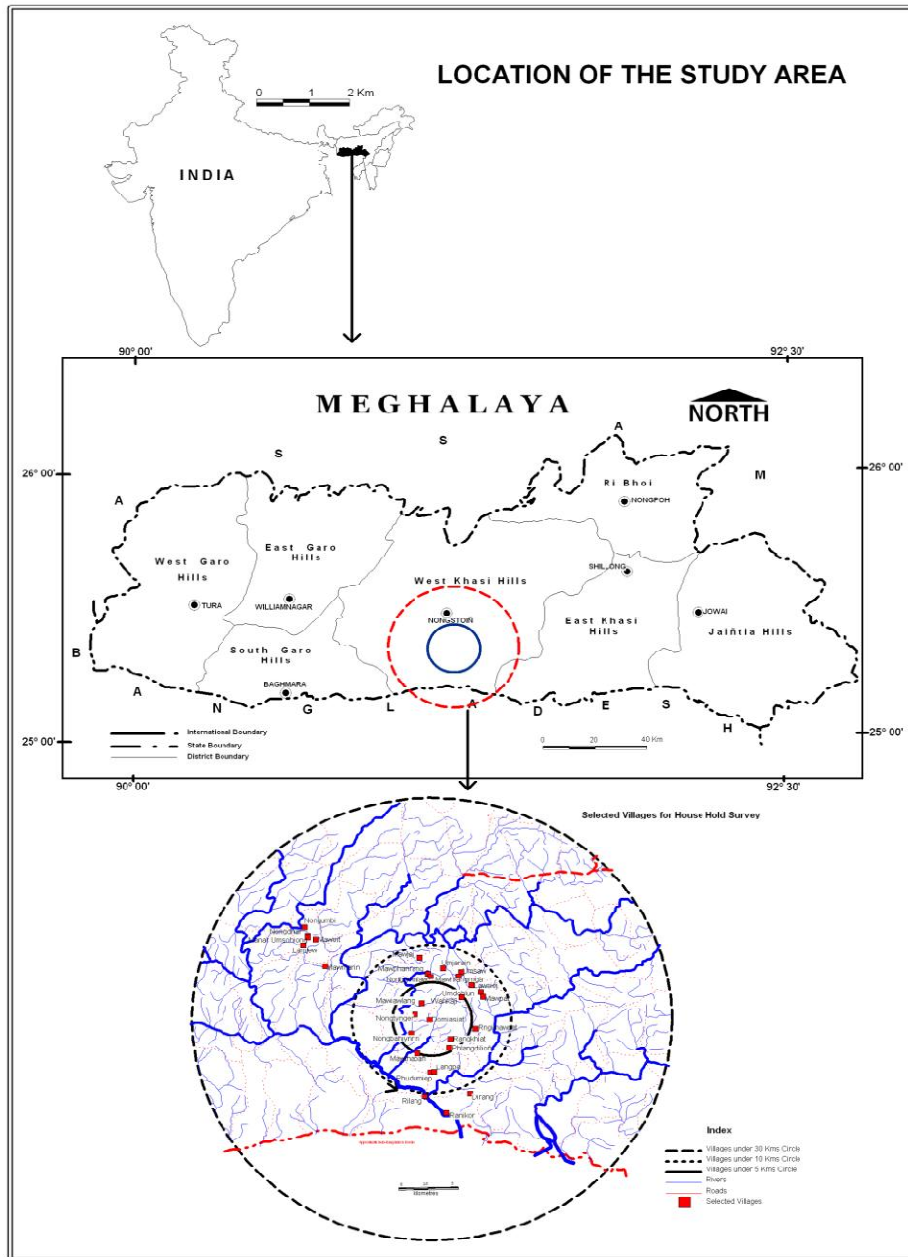

Fig. 1. Location of the study area

3.3 Incidence of Communicable Disease

The present study makes an effort to find out the number of diseases affecting the households in a year, types of diseases in a year and also the percentage of population affected by diseases. This helps to get a brief idea about the diseases which arise in the study area. After the disease burden is established the study then finds out the relationship between disease, PCI (per capita income) and calorie consumption. The disease burden should decline as the PCI and calorie consumption improve i.e., there is an inverse relationship. The present chapter looks into this relationship too.

3.4 Disease Frequency

There are six types of communicable diseases suffered by the population in the study area. These diseases are respiratory, prolonged cold, tuberculosis, malaria, diarrhoea and skin related diseases. Table 1 shows the number of different diseases suffered by the population at household level in the preceding one year. It is also showed the distribution of different combination of diseases suffered by the people of the study area.

It is clear from the table that 30.45 percent of households suffer from only one disease. In this category malaria dominates with 20 percent of the households suffering from it. About a quarter of all households reportedly suffered from two diseases that have thirteen combinations. These combinations of diseases are malaria and prolonged cold, malaria and diarrhoea, respiratory and malaria, prolonged cold and diarrhoea, malaria and skin related disease, respiratory and diarrhoea, respiratory and prolonged cold, respiratory and skin related disease, diarrhoea and skin related disease, tuberculosis and malaria, tuberculosis and diarrhoea, prolonged and tuberculosis, and tuberculosis and skin related disease. Malaria and prolonged cold are the two diseases suffered by more than 5 percent of households. Again about 23 percent of the households suffered from three diseases. The combinations of these three diseases are prolonged cold, malaria and diarrhea; respiratory, prolonged cold and malaria; respiratory, malaria and diarrhea; respiratory, tuberculosis and malaria; respiratory, malaria and skin related disease; respiratory, prolonged cold and diarrhea; respiratory, diarrhoea and skin

related disease; prolonged cold, malaria and skin related disease; malaria, diarrhoea and skin related disease; prolonged cold, diarrhoea and skin related disease; tuberculosis, malaria and skin related disease; and tuberculosis, diarrhoea and skin related disease. Prolonged cold, malaria and diarrhoea are the three diseases affecting more than 15 percent of households. Furthermore more than 5 percent of the households suffer from 4 diseases. The combination of these four diseases are respiratory disease, prolonged cold, malaria and diarrhea; prolonged cold, malaria, diarrhoea and skin related disease; prolonged cold, tuberculosis, malaria and diarrhea; respiratory, prolonged cold, diarrhoea and skin related disease; respiratory, tuberculosis, malaria and diarrhea; and tuberculosis, malaria, diarrhoea and skin related disease. Respiratory problem, prolonged cold, malaria and diarrhoea are the four diseases suffered by more than 2 percent of households. Finally there is only one percent of household suffering from five diseases. The combinations of five diseases are respiratory problem, prolonged cold, malaria, diarrhoea and skin related disease. It is also found from the table that about 15 percent of households suffered from no communicable diseases. These households might suffer from non-communicable diseases not included in the analysis. Significantly over 30 percent households reportedly suffered from multiple cases (more than three types) of communicable diseases and only 15 percent households were free from any communicable diseases during the reference period. These figures reveal the high burden of communicable diseases suffered by the people in the study area.

Regarding variation in multiplicity of communicable diseases, Table 2 shows that a majority of 57 percent of its households in Mawiawlang village reported no case of communicable diseases. Mawthabah, Langpa, Lamjew, Maweit and Mawmarin are the villages where 50 percent of their households suffered from only one disease. Mawnar Umsohiong is the village where 50 percent households suffered from two diseases. Rngimawpat, Umjarain, Nongtynniaw and Mawjai suffered from three diseases among 50 percent of their households. 36 percent of households in Mawhianrnga village suffered from four diseases. In Nongtynniaw 4 percent households suffered from five types of communicable diseases.

Table 1. Sample villages: Number and distribution of diseases suffered in households

No of diseases	% Households	Distribution of diseases in percentage
0	14.88	
1	30.46	20.1(M) 3.3 (R) 2.7(D) 2 (PC) 1.3(TB) 0.7(S)
2	24.20	5.1(M, PC), 4.7(M,D),4(R,M),3.3(PC,D),1.8(M,S),1.5(R,D),0.9(R,S),0.9(R,PC),0.8(D,S),0.4(TB,M),0.1(TB,D),0.1(PC,TB),0.1(TB,S)
3	23.50	15.7(PC,M,D),1.9(R,M,D),1.8(R,M,D), 1.1(R,M,S),0.7(R,PC,D),0.7(R,D,S), 0.4(PC,M,S),0.2(R,TB,M),0.2(M,D,S), 0.2(PC,D,S),0.1(TB,M,S),0.1(TB,D,S)
4	5.98	2.9(R,PC,M,D),1.9(PC,M,D,S),0.4(PC,TB,M,D),0.4(R,PC,D,S)0.1(R,TB,M,D),0.1(TB,M,D,S)
5	0.97	0.9(R,PC,M,D,S)

Source: Field Survey, 2011
N.B.: R - Respiratory problem, M - Malaria, D - Diarrhoea, PC - Prolonged Cold,
TB - Tuberculosis, S - Skin related diseases

Table 2. Sample villages: Disease frequency

Village	No diseases (% of households)	1 disease	2 diseases	3 diseases	4 diseases	5 diseases
Mawthabah	0	50	33.33	16.67	0	0
Nongbahjynrin	0	80	20	0	0	0
Nongtnger	2.86	42.86	25.71	22.86	5.71	0
Langpa	5.56	50	22.22	22.22	0	0
Rngimawpat	8.33	25	16.67	50	0	0
Rangkhiat	26.67	33.33	26.67	6.67	6.67	0
Domiasiat	20	40	40	0	0	0
Mawiawlang	57.14	28.57	14.29	0	0	0
Phudumiep	11.11	48.15	22.22	11.11	3.7	3.7
Phlangdiloin	24.47	32.98	24.47	10.64	6.38	1.06
Mawphanrang	0	12	16	48	24	0
Umjarain	0	3.33	23.33	60	10	3.33
Nongtynniaw	2.13	4.26	21.28	53.19	14.89	4.26
Mawjai	1.82	7.27	23.64	56.36	9.09	1.82
Mawpat	13.79	24.14	41.38	13.79	3.45	3.45
Umsaw	37.5	25	25	4.17	8.33	0
Lawsiej	45.45	18.18	18.18	9.09	9.09	0
Mawhianrnga	9.09	27.27	9.09	18.18	36.36	0
Umdohlun	28	16	36	16	4	0
Dirang	14.29	42.86	42.86	0	0	0
Ranikor	21.95	39.02	31.71	7.32	0	0
Rilang	14.29	0	42.86	42.86	0	0
Lamjew	11.54	50	3.85	30.77	3.85	0
Maweit	10.87	50	15.22	21.74	2.17	0
Mawmarin	25.42	52.54	18.64	3.39	0	0
Mawnar Umsohiong	16.67	0	50	33.33	0	0
Nongdhar	11.11	16.67	33.33	38.89	0	0
Nongumbi	14.29	14.29	14.29	42.86	14.29	0
Total	14.88	30.32	24.34	23.5	5.98	0.97

Source: Field survey, 2011

Table 3. Sample villages: Dominance of communicable diseases

Village	Dominant number of diseases
Mawthabah	One
Nongbahjynrin	One
Nongtnger	One
Langpa	One
Rngimawpat	Three
Rangkhiat	One
Domiasiat	Two
Mawiawlang	One
Phudumiep	One
Phlangdiloin	One
Mawphanrang	Three
Umjarain	Three
Nongtynniaw	Three
Mawjai	Three
Mawpat	Two
Umsaw	Two
Lawsiej	Two
Mawhianrnga	Four
Umdohlun	Two
Dirang	Two
Ranikor	One
Rilang	Three
Lamjew	One
Maweit	One
Mawmarin	One
Mawnar Umsohiong	Two
Nongdhar	Three
Nongumbi	Three

Source: Field survey, 2011

There are twelve villages where a single communicable disease has affected majority of the households (Table 3 above). In another seven villages two types of communicable diseases dominate while three types of communicable diseases dominated in eight villages. In one-village four types of communicable diseases is dominant.

Fig. 2 shows the dominance of 4 types of diseases in the eastern part of the study area while dominance of 3 types of diseases are found in northwestern, northeastern and southern part of the study area. Dominance of 2 types of diseases are more in eastern, northwestern and southern part of the study area. Single communicable disease is found in the central and western part of the study area.

3.4.1 Malaria

Malaria, prevalent in 108 countries of tropical and sub-tropical world, is a perennial problem. Every year, malaria is reported to cause more than 250-660 million infections and more than a million deaths. The World Malaria Report estimates a total of 225 million cases and 781,000 deaths due to malaria in 2009. Malaria in India accounts for about 1.5 million cases with 50 percent due to *P. falciparum* annually under public health system reporting where nearly 100 million fever cases are examined annually. Due to underreporting and treatment seeking behavior from private sector, this appears to be an underestimation of the true burden of Malaria in the country [5].

About 80% of the malaria burden is in Northeastern states, Chhattisgarh, Jharkhand, Madhya Pradesh, Orissa, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan, West Bengal and Karnataka. However, other states are also vulnerable and have local and focal outbreaks [5]. The following tables and figures show the incidence of malaria among men, women and children of the study area.

Table 4 shows that more than 60 percent of the adult males suffered from malaria in a quarter of the villages while 30-60 per cent adult males had malaria in close to 40 per cent villages. Only in a single village no male suffered from Malaria. On the other hand 30-60 per cent adult females suffered from malaria in nearly 40 per cent villages while over 60 percent reportedly got an attack of malaria in well over a fifth of all the villages. In the case of children, more than half of the villages reported less than 30 per cent of children suffering from this disease. Around 30-60 per cent children got malaria in close to 30 per cent villages. In 17.9 per cent villages, more than 60 per cent children suffered from malaria. Thus it is clear that the area is notorious for malarial attack and all the groups are affected by it.

Table 4. Sample villages: Incidence of Malaria

Percentage of population	Percentage of village		
	Adult male	Adult female	Children
0	3.57	7.14	0
<30	32.14	32.14	53.57
30-60	39.29	39.29	28.57
>60	25.00	21.43	17.86

Source: Field survey 2011

Fig. 3 shows that the disease afflicts adult males more in the villages located in the northwestern and northeastern and one village in southern part

of the study area. In the southeastern part of the study area, the proportion of men suffering is between 30 to 60 percent of population while less than 30 percent of population suffering from malaria are mostly found in central part of the study area.

As far as women are concerned (Fig. 4) higher incidence is confined to the northeastern part and one village in southern part of the study area. In central part of the study area, women suffering from this disease constitute between 30 to 60 percent of population.

Fig. 5 shows that the children suffered the most in the northeastern, northwestern and one village in southern part of the study area.

From the Table 4 and Figs. 3 to 5 it is found that there are eight villages, which are highly affected by malaria. Here we will discuss the socio economic background of these villages and the population affected by malaria.

In Rangkhiat, malaria affects more in adult female with 60 percent of adult female population. In this village most of the people are farmers and daily labourers. The per capita income of this village is very less with only `494. The source of drinking water in this village is mainly from rivers and taps. From the field survey it is found that this village lack sanitation and health facilities.

In Mawphanrang malaria affects mostly children (92 percent of children population) followed by adult female (90 percent of adult female population) and then adult male (85 percent of adult male population). In this village most of the people are farmers and daily labourers. The per capita income of this village is very less with only 771. The source of drinking water in this village is mainly from wells and taps. From the field survey it is found that this village lack sanitation and health facilities.

In Umjarain malaria affects adult female the most (87 percent of adult female population) followed by children (86 percent of children population) and then adult male (86 percent of adult male population). In this village most of the people are farmers and daily labourers. The per capita income of this village is very less with only `696. The source of drinking water in this village is mainly from wells and taps. From the field survey

it is found that this village lack sanitation and health facilities.

In Nongtynniaw malaria affects adult male themost (76 percent of adult male population) followed by adult female (67 percent of female population) and then children (51 percent of children population). In this village most of the people are farmers and daily labourers. The per capita income of this village is very less with only `733. The source of drinking water in this village is mainly from wells and taps. From the field survey it is found that this village lacks sanitation and health facilities, although some household use toilets.

In Mawjai malaria affects adult female themost (77 percent of adult female population) followed by children (75 percent of children population) and then adult male (73 percent of adult male population). In this village most of the people are farmers and daily labourers. The per capita income of this village is very less with only `720. The source of drinking water in this village is mainly from wells and rivers. From the field survey it is found that this village lack sanitation and health facilities.

In Rilang malaria affects adult male the most(75 percent of adult male population) followed by adult female (66 percent of female population) and then children (63 percent of children population). In this village most of the people are farmers and daily labourers. The per capita income of this village is very less with only `503. The source of drinking water in this village is mainly from rivers. From the field survey it is found that this village lack sanitation and health facilities.

In Mawnar Umsohiong malaria affects children the most (77 percent of childrenpopulation) followed by adult male (66 percent of male population) and followed by adult female (50 percent of adult female population). In this village most of the people are farmers, daily labourers, businesspersons and some government servants. There is 57 percent of male population who smoke local tobacco. The per capita income of this village is `1079. The source of drinking water in this village is mainly from taps and wells. From the field survey it is found that this village lacks sanitation and health facilities, although some households use toilets.
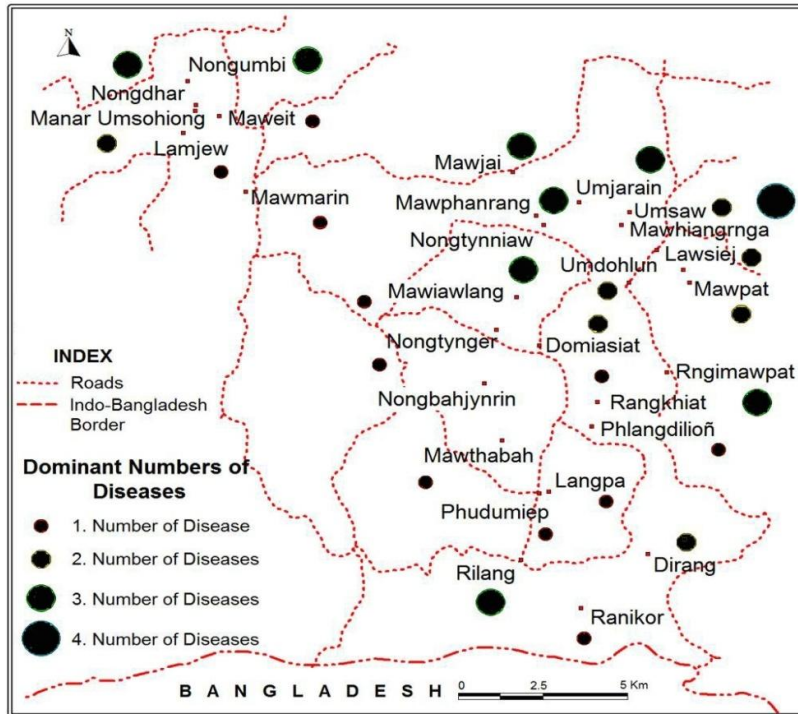
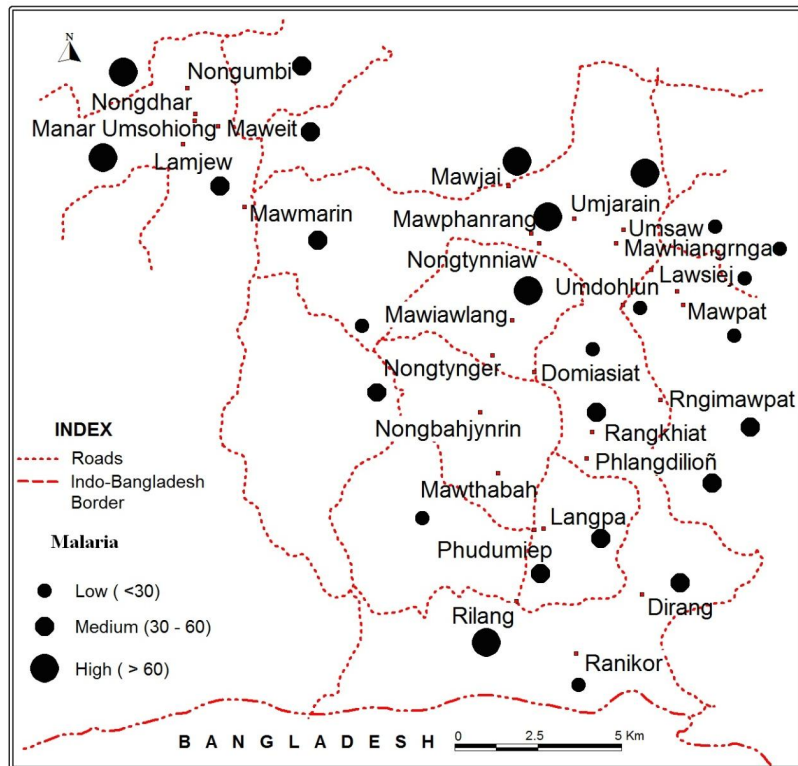**Fig. 2. Dominant communicable diseases**
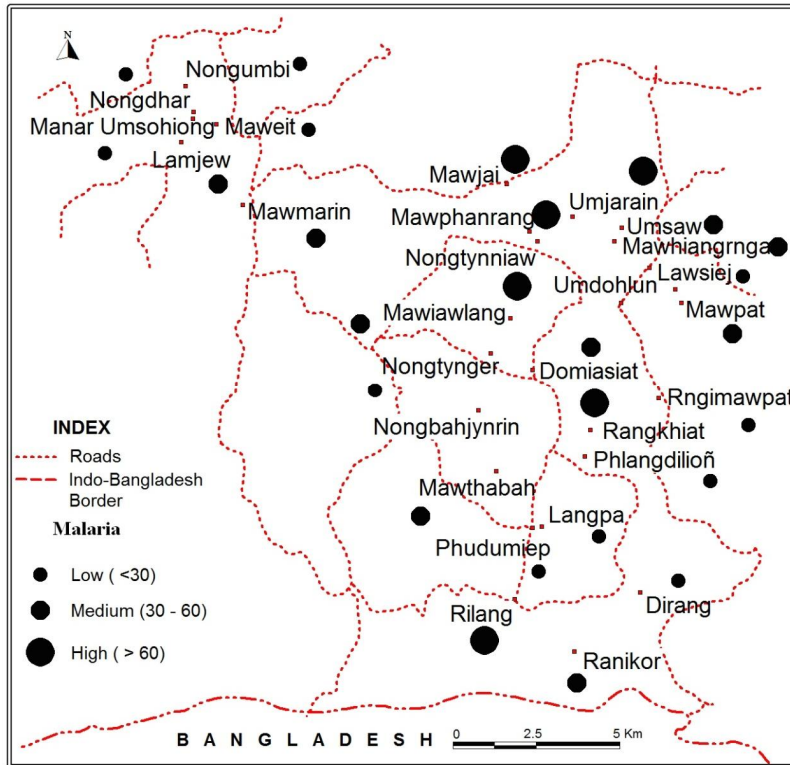

Fig. 3. Distribution of malaria incidence among men

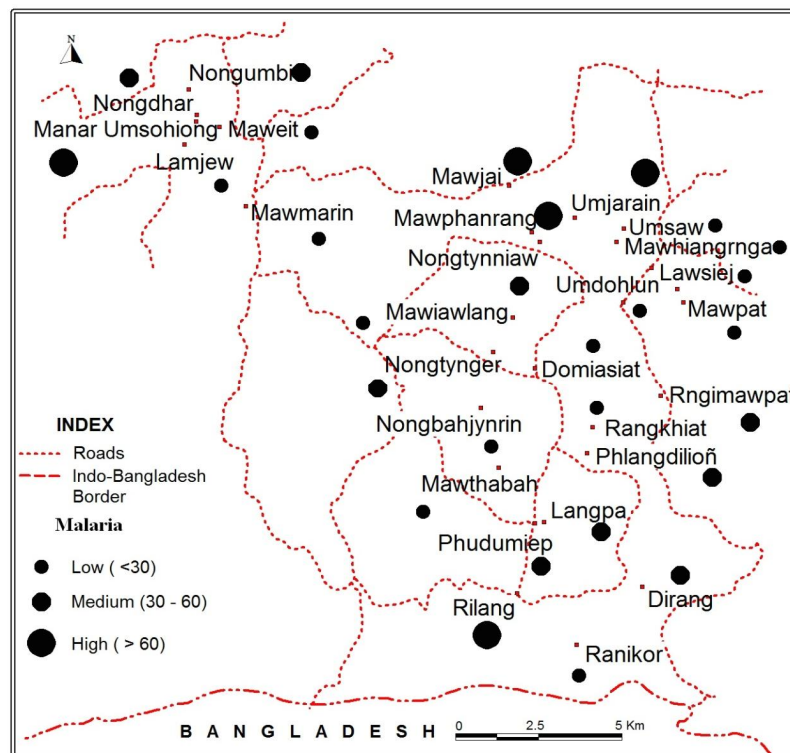**Fig. 4. Distribution of malaria incidence among women**

Fig. 5. Distribution of malaria incidence among children

In Nongdhar malaria affects adult male the most (62 percent of adult population) followed by adult female (54 percent of female population) and followed by children (52 percent of children population). In this village most of the people are farmers, daily labourers, businesspersons and some government servants. The per capita income of this village is `1104. The source of drinking water in this village is mainly from taps. From the field survey it is found that this village lacks sanitation, although some household use toilets. Health worker is available in this village with the presence of a nurse.

There are four villages where the percentage of men, women and children population affected is more than 60 percent. These villages are Mawphanrang, Umjarain, Mawjai and Rilang. Nongtynniaw is the village where both men and women population affected is more than 60 percent. Mawnar Umsohiong is the village that both men and children population is highly affected with more than 60 percent of population. Nongdhar is the village that men population is highly affected with more than 60 percent of population. Rangkhiat is the village that women population is highly affected with more than 60 percent of population.

There are eleven villages where the cases of malaria are more among men. These villages are Nongtnger, Mawphanrang, Umjarain, Nongtynniaw, Mawjai, Rilang, Lamjew, Maweit, Mawnar Umsohiong, Nongdhar and Nongumbi. This shows that the disease burden in this village is high because the financial condition is deteriorating, and hence the working population is affected. When we look to the study areas as a whole, it shows that the incidence of malaria is more among men than women or children population.

3.4.2 Diarrhoea

Diarrhoeal disease is the second leading cause of death in children under five years old. It is both preventable and treatable. Diarrhoeal disease kills 1.5 million children every year. Globally, there are about two billion cases of diarrhoeal disease every year. Diarrhoea is one of the most important causes of morbidity in the developing countries, next only to respiratory diseases. It is estimated that about 3 million children die of diarrhoea, four-fifth of them less than 2 years of age; and the total number of diarrhoea episodes run to over 1.8 billion.In 1998, the estimated number of deaths due to diarrhoea was 22 lakhs.

The develop countries of Europe and Americas accounted for less than 1.5 lakhs. India alone accounted for 7 lakhs deaths. Within the country, the distribution of diarrhoeal cases is quite erratic.The main immediate cause of death from acute diarrhoea is dehydration. According to treatment guide- lines issued by WHO (1995), most cases of childhood diarrhoea can be treated at home by continuous feeding and increasing fluid intake [6].

The following tables and figures show the incidence of diarrhoea among men, women and children of the study area.

Table 5 shows almost a uniform pattern for men women and children affected by diarrhoea. There are five villages where the percentage of adult male population is more than 60 percent affected. These villages are Umjarain, Nongtynniaw, Mawjai, Nongdhar, and Nongumbi. There are eight villages in the category of 30 to 60 percent and the villages are Domiasiat, Mawphanrang, Mawpat, Umsaw, Lawsiej, Mawhianrnga, Umdohlun and Mawnar Umsohiong. In thirteenvillages affected in the category of less than 30 percent. Nongbah Jynrin and Mawiawlang are the two villages where there is no case of diarrhoea.

Table 5. Sample villages: Incidence of diarrhoea

Percentage of population	Percentage of village		
	Adult male	Adult female	Children
0	7.14	17.86	7.14
<30	46.43	50	57.14
30-60	28.57	14.29	21.43
>60	17.86	17.86	14.29

Source: Field survey, 2011

There are five villages where the percentage of adult affected female population is more than 60 percent. These villages are Mawphanrang, Umjarain, Nongtynniaw, Mawjai, and Nongumbi. There are four villages in the category of 30 to 60 percent and the villages are Rngimawpat, Mawpat, Umdohlun and Nongdhar. And there are fourteen villages in the category of less than 30 percent. Mawthabah, Nongbahjynrin, Mawiawlang, Phudumiep, Dirang are the five villages where there is no case of diarrhoea.

There are four villages where the percentage of children population is more than 60 percent affected. These villages are Mawphanrang,

Umjarain, Mawjai, and Nongumbi. There are six villages in the category of 30 to 60 percent where the villages are Rngimawpat, Domiasiat, Nongtynniaw, Mawpat, Umdohlun and Nongdhar. And there are sixteen villages affected in the category of less than 30 percent. Mawthabah and Mawiawlang are the two villages that there is no case of diarrhoea.

The Fig. 6 shows the incidence of diarrhoea in the study area. It is found from the figure that most of the villages suffered from diarrhoes less than 30 percent of their population.

There are three villages where the percentage of men, women and children population affected is more than 60 percent. These villages are Umjarain, Mawjai and Nongumbi. Nongtynniaw is the village where both men and women population affected is more than 60 percent. Mawphanrang is the village that both women and children population is highly affected constituting more than 60 percent of population. Nongdhar is the village that men are highly affected and comprised more than 60 percent of population.

There are six villages where the incidence of diarrhoea is more among men. These villages are Mawphanrang, Umjarain, Nongtynniaw, Mawjai, Nongdhar and Nongumbi. This shows that the disease burden in this village is high as the financial condition deteriorates because the working population is affected. When we look to the study area as a whole, it shows that the incidence of diarrhoea is more among children than men or women population.

3.4.3 Respiratory problems

Acute respiratory infections (ARIs), a group of diseases that includes pneumonia, influenza, and respiratory syncytial virus (RSV), result in 4.25 million deaths worldwide every year. ARIs are also the leading cause of illness in children and their leading killer. These diseases are responsible for at least six percent of the world's disability and death [7].

While the immediate bacterial or viral triggers of ARIs are unique, the underlying drivers are often the same and can include some combination of malnutrition, pollution, overcrowding, and tobacco use. Poverty is also an underlying risk factor, as evidenced by the disproportionate impact of ARIs on developing countries and vulnerable populations. Acute respiratory infections (ARIs) contribute to major disease associated mortality and morbidity among children under 5 years in India [7,8].

The following tables and figures show the incidence of respiratory problems among men, women and children of the study area.

Table 6 shows that Rilang is the only village where the percentage of adult male population affected is more than 20 percent. There are three villages in the category of 10 to 20 percent and the villages are Rngimawpat, Lawsiej and Umdohlun. And there are fourteen villages in the category of less than 10 percent. There are ten villages where there is no case of respiratory problem.
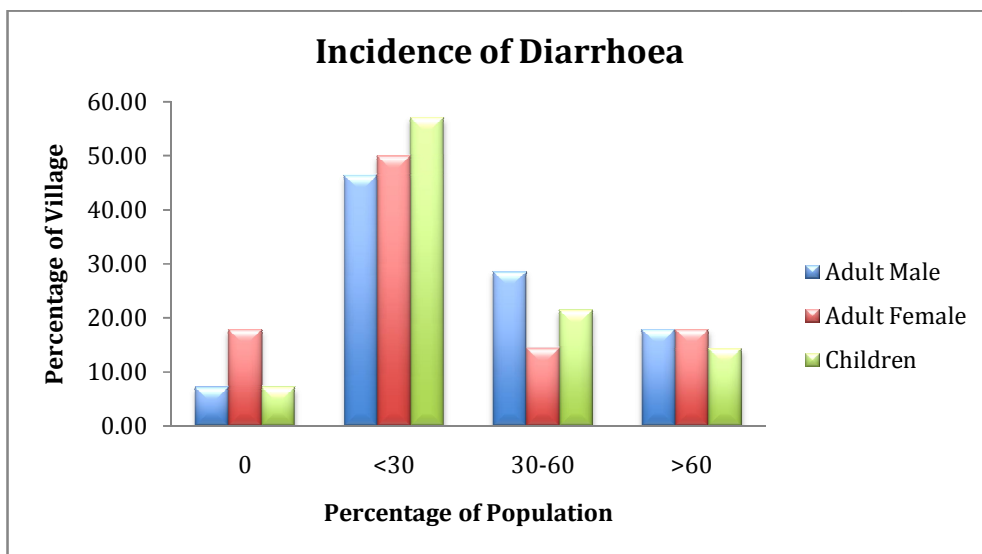

Fig. 6. Incidence of diarrhoea in the study area

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Table 6. Sample villages: Incidence of respiratory problems

Adult male	
Percentage of population	**Percentage of village**
0	35.71
<10	50
10-20	10.71
>20	3.57
Adult female	
Percentage of population	**Percentage of village**
0	35.71
<10	50
10-20	7.14
>20	7.14
Children	
Percentage of population	**Percentage of village**
0	3.57
<10	67.86
10-15	17.86
>15	10.71

Source: Field survey, 2011

From the table it is found that there are two villages where the percentage of adult female population affected is more than 20 percent. These villages are Rngimawpat and Rilang. There are two villages in the category of 10 to 20 percent and the villages are Umdohlun, Dirang.There are fourteen villages in the category of less than 10 percent. And there are ten villages where there is no case of respiratory problem.

There are three villages where the percentage of children population affected is more than 15 percent. These villages are Mawhianrnga, Umdohlun, and Mawnar Umsohiong. There are five villages affected in the category of 10 to 15 percent where in the villages are Langpa, Domiasiat, Nongtynniaw, Dirang and Rilang. In nineteen villages less than 10 percent children are affected by the disease. Nongumbi is the village where there is no case of respiratory problem.

From the Table 6 it is found that there are five villages, which are highly affected by respiratory problems. In Rngimawpat, respiratory problems affects adult female the most (21 percent of adult female population) followed by adult male population (18 percent of adult male population). In this village most of the people are farmers and

daily labourers. 18 percent of male population smoke cigarettes and 37 percent smoke local tobacco. The per capita income of this village is very less with only `722. The source of drinking water in this village is mainly from wells and rivers. This village lacks sanitation and health facilities.

3.4.4 Prolonged Cold/Cough

Pertussis, or whooping cough, is an acute infectious disease caused by the bacterium *Bordetella pertussis*. Pertussis remains a major health problem among children in developing countries with 195,000 deaths resulting from the disease in 2008 as per World Health Organization estimate [9]. Whooping cough is prevalent in almost all countries especially the tropics. Children below 5 years are most affected which account for almost 90 per cent of all cases. However, there is a recent increase in the incidence of this desease among the adolescent age group. Whooping cough usually spreads by respiratory droplets infection from symptomatic infected individuals or by direct contact [10].

Table 7. Sample villages: Incidence of prolonged cold/cough

Percentage of population	Percentage of villages		
	Adult male	**Adult female**	**Children**
0	17.86	14.29	14.29
<30	42.86	57.14	50
30-60	25	14.29	21.43
>60	14.29	14.29	14.29

Source: Field survey, 2011

Table 7 above shows that over 60 percent of the population- male, female and children suffered from prolonged cold and cough in about 14 per cent of the villages. These villages areMawphanrang, Umjarain, Nongtynniaw and Mawjai. There are seven villages in which 30-60 percent adult male population suffered from this disease. These villages are: Rngimawpat, Lawsiej, Umdohlun, Rilang, Mawnar Umsohiong, Nongdhar and Nongumbi. In four other villages 30 to 60 percent women suffered from cough and cold and the villages are Umdohlun, Rilang, Nongdhar and Nongumbi. In six villages 30 to 60 percent children were affected by this disease and the villages are Mawhianrnga, Umdohlun, Rilang, Mawnar Umsohiong, Nongdhar and Nongumbi.
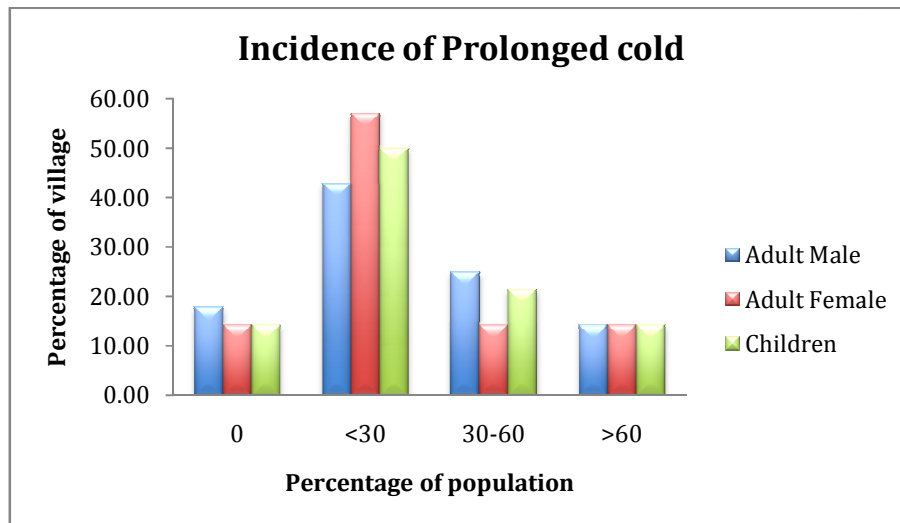
Fig. 7. Incidence of prolonged cold in the atudy area

The Fig. 7 shows the incidence of prolonged cold in the study area. It is found from the figure that most of the villages suffered from prolonged cold less than 30 percent of their population.

There are six villages where the incidence of prolonged cold is more among men. These villages are Mawphanrang, Umjarain, Nongtynniaw, Mawjai, Rilang and Nongumbi. This shows that the disease burden in these villages is high as financial condition deteriorates, and so the working population is affected. When we look to the study area as a whole it shows that the incidence of prolonged cold is more among children than men or women population.

3.4.5 Skin related diseases

Skin diseases in developing countries have a serious impact on people's quality of life and bring out significant burden to the nations. It affects more than 60 percent of the general population. Prevalence of skin disease depends on factors such as genetics, racial constitution, social and hygienic standards, customs and occupations. Transmissible skin diseases are observed in people living under poor socioeconomic and unhygienic condition. In India there is a significant incidence of infectious disorders in rural communities because of underdeveloped economy and social backwardness. Ignorance on seriousness of the disease and improper medication worsens the condition. Up to 80 percent of the populace suffering from skin problems may not seek medical help [11].

Table 8 shows over 10 percent of adult male population suffered from skin diseases in two villages namely Rngimawpat and Rilang.In three other villages-Rangkhiat, Mawjai and Nongumbi-such males constituted 5 to 10 percent of their population. Less than 5 percent males complained of skin diseass in 10 other villages. Nearly half of the villages were free of such cases.

Table 8. Sample villages: Incidence of skin related diseases

Adult male	
Percentage of population	**Percentage of village**
0	46.43
<5	35.71
5-10	10.71
>10	7.14
Adult female	
Percentage of population	**Percentage of village**
0	46.43
<4	32.14
4-8	17.86
>8	3.57
Children	
Percentage of population	**Percentage of village**
0	42.86
<5	39.29
5-10	14.29
>10	3.57

Source: Field survey, 2011

3.4.6 Tuberculosis

According to WHO, Tuberculosis (TB) is a worldwide pandemic. Among the 15 countries with the highest estimated TB incidence rates, 13 are in Africa, while half of all new cases are in six Asian countries, viz., Bangladesh, China, India, Indonesia, Pakistan and Philippines. A WHO fact sheet dated March 2010 stated that overall one third of the world's population (over 2 billion) is currently infected with the TB bacillus. According to it, every second, someone in the world is newly infected with TB bacilli and 1 in every 10 of these newly infected people will become sick or infectious later in life [12].

TB is one of the major public health problems in India with a significant impact on the health and economy of the country. India is the highest tuberculosis (TB) burden country in the world, accounting for nearly one-fifth of the global incidence. Annually more than 250,000 people die of TB. This is most unfortunate as TB is a curable disease if treated appropriately and adequately [13].

Table 9 shows that there are two villageswhere the percentage of adult male population affected by TB is more than 6 percent. These villages are Ranikor and Nongumbi. In Mawphanrang and Dirang 3 to 6 percent adult males are infected by TB. There are three villages in the category of less than 3 percent adult males living with the disease. No case of tuberculosis was detected among the males in the remaining 22 villages. In Nongdhar village more than 8 percent adult females reportedly suffer from TB. Around 4 to 8 percent females suffer from this deadly disease in Mawpat while less than 4 percent females are infected by TB in five more villages. Less children are affected by TB though there are 6 villages which have children living with TB. Their proportion is less than three percent in 5 such villages.

From the Table 9 it is found that in Nongdhar village tuberculosis affects 18 percent adult female population. In this village most of the people are farmers, daily labourers, businesspersons and some government servants. The per capita income of this village is `1104. The source of drinking water in this village is mainly from taps. This village lacks sanitation, although some households use toilets. Health facilities are available in this village with the presence of a nurse. TB incidence is high among the males in Ranikor and Nongumbi villages where more than 6 percent of men have TB. Nongdhar is the village where8 percent women have TB infection. Higher incidence of TB among children is found in Mawhianrnga. There are two villages where the incidence of tuberculosis is more among men. These villages are Ranikor and Nongumbi.

Table 9. Sample villages: Incidence of tuberculosis

Adult male	
Percentage of population	**Percentage of village**
0	75
<3	10.71
3-6	7.14
>6	7.14
Adult female	
Percentage of population	**Percentage of village**
0	75
<4	17.86
4-8	3.57
>8	3.57
Children	
Percentage of population	**Percentage of village**
0	78.57
<1	10.71
1-3	7.14
>3	3.57

Source: Field survey, 2011

3.4.7 Relationship between PCI and percentage of population affected

The relationship of disease burden and PCI (per capita income) is calculated by cross tabulation and correlation.

Table 10. Relationship of PCI and population affected of households

Population	Average PCI	Pearson's		Spearman's	
		Value	**Sig.** [*]	**Value**	**Sig.** [*]
Highly affected	810.38	-0.004	0.917	-0.007	0.859
Affected	745.46				
Not affected	965.35				

Source: Field survey

The Table 10 shows the average PCI of households, which fall under different category of population affected and the correlation of PCI and disease. It is found from the table that the highest PCI fall in the category of not affected population, the second highest PCI in the category of highly affected population and the lowest PCI in the category of affected population. It shows that there is some relationship between PCI and affected population because it is found that the highest per capita income falls in the not affected category. But when we looked into the highly affected and affected population the relationship is not as expected, because the highly affected population has higher per capita income than the affected population. This is the reason why the correlation is very low and not statistically significant.

The Table 11 shows the frequency of population affected and PCI of households. From the table it is found that PCI increases diseases burden also increases. This shows that the PCI (per capita income) doesn't have any effect on the disease burden.

Plate 1. Road to Phlangdiloin

Plate 2. A thatch house where the residents of Phlangdiloin live

Plate 3. A source of water supply (water pipe) in Nongtynniaw

Plate 4. A common water supply that was constructed in Nongtynniaw

Plate 5.Thatch house in Mawphanrang

The Table 12 shows the average PCI of villages, which fall under different category of population affected and the correlation of PCI and disease. It is found from the table that the highest PCI fall in the category of affected population, the second highest PCI in the category of highly affected population and the lowest PCI in the category of less affected population. This shows that there is no relationship between PCI and disease. From

Table 11. Frequency of PCI and population affected of households

		Population		
		Highly affected	**Affected**	**Not affected**
PCI	High	50.00%	29.30%	20.70%
	Medium	47.90%	36.80%	15.30%
	Low	53.80%	38.50%	7.70%

Source: Field survey

Table 12. Relationship of PCI and population affected of villages

Population	Average PCI	Pearson's		Spearman's	
		Value	**Sig.**[*]	**Value**	**Sig.**[*]
Highly affected	751.78	0.058	0.768	0.052	0.793
Affected	777.6				
Less affected	674				

Source: Field survey

Table 13. Frequency of PCI and population affected of villages

		Population		
		Highly affected	**Affected**	**Less affected**
PCI	High	33.30%	50.00%	16.70%
	Medium	31.30%	56.30%	12.50%
	Low	33.30%	50.00%	16.70%

the correlation it is found that the relationship is statistically insignificant.

The Table 13 above shows the frequency of population affected and PCI of villages. From the table it is found that PCI (per capita income) doesn't have any effect on the disease burden.

PCI does not have any relation with the disease burden in the study area. This is mainly income is very low in the study area as a whole. It shows that there are other factors contributing to the growth of diseases in the study area. It may be due to the geographical location, socio economic factors and lack of health facilities in the study area.

4. CONCLUSION

A study of the morbidity pattern reveals the dominance of communicable diseases as reported by the respondents. The types of sicknesses recorded during the survey shows that the most prevalent type of sickness is malaria that afflicted more than 45.27 percent adult males, 41.20 percent adult females, and 33.18 percent children of the population interviewed. Diarrhea/dysentery affected 32.03 percent of the children, 29.62 percent of the adult

males and 28.93 percent of the adult females. Prolonged cold/cough afflicted 27.57 percent of children and 26.52 percent of adult male and 26.12 percent of the adult female population. Respiratory problem accounts for 6.29 percent of children, 4.31 percent of adult females and 3.84 percent of the adult male population.Thirty persons contracted tuberculosis, of which 1.12 percent of adult female, 1.03 percent of adult males and 0.30 percent of the children population. Skin diseases are found among an insignificant 2.63 percent of children, 2.44 percent of the adult male and 2.34 percent of the adult female population.

Statistically there is no relationship between per capita income (PCI) and the diseases burden and the same with calorie intake in relation to disease burden. Lack of proper sanitation, lack of pure drinking water, lack of health facilities low literacy rate and lack of awareness are the main factors for the diseases burden in the study area.

Morbidity pattern as reported by the people reveals a clear incidence of communicable diseases, which afflicts the children much more than the adults. This shows the need for an efficient control of these diseases by way of adequate healthcare facility, which can easily

control such diseases. Fortunately, the people are not affected by much of the degenerative type of diseases requiring hospitalization. Only a little over a quarter of the population reported that they have not suffered from any of these diseases during the reference period.

The study provides valuable insights into the health, healthcare and disease burden in part of Khasi Hills, which is now at the centre of controversy largely due to the proposed uranium mining in the area. The present study in no way is related to the health consequences of uranium mining but provides a general health and nutritional profile of the area and its population. While uranium mining may bring revenue for the state and may usher in all round development of the state due to its high economic value, the study raises some very pertinent issues pertaining to the health of the people who live around the site of uranium mining and brings forth the problem of communicable diseases, which requires urgent attention.

CONSENT

As per international standard or university standard written patient consent has been collected and preserved by the authors.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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