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# Leptospiral infection among primitive tribes of Andaman and Nicobar Islands

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## SUMMARY

The Andaman islands were known to be endemic for leptospirosis during the early part of the century. Later, for about six decades no information about the status of the disease in these islands was available. In the late 1980s leptospirosis reappeared among the settler population and several outbreaks have been reported with high case fatality rates. Besides settlers, these islands are the home of six primitive tribes of which two are still hostile. These tribes have ample exposure to environment conducive for transmission of leptospirosis. Since no information about the level of endemicity of the disease among the tribes is available, a seroprevalence study was carried out among all the accessible tribes of the islands. A total of 1557 serum samples from four of the tribes were collected and examined for presence of antileptospiral antibodies using Microscopic Agglutination Test (MAT) employing 10 serogroups as antigens. An overall seropositivity rate of 19·1% was observed with the highest rate of 53·5% among the Shompens. The seropositivity rates in the other tribes were 16·4% among Nicobarese, 22·2% among the Onges and 14·8% among the Great Andamanese. All of the tribes except the Onges showed a similar pattern of change in the seroprevalence rates with age. The prevalence rates were rising from low values among children to reach a peak in those aged 21–40 years and then declined. Among Onges the seroprevalence rates continued to rise beyond 40 years. In all the tribes, seroprevalence rates were found to be significantly higher among the males. The commonest serogroups encountered were Australis followed by Grippotyphosa, Icterohaemorrhagiae, Pomona and Canicola.

## INTRODUCTION

Leptospirosis, one of the commonest zoonoses, has worldwide distribution. Until recently it was considered as an uncommon disease in most of the countries. During the past two decades, the disease is being recognized with increasing frequency and it is receiving more attention as an important public health problem. Leptospirosis is primarily an occupational disease affecting occupational groups such as agri-

cultural workers, livestock farmers, sewer workers, veterinarians etc. It can also be contracted by those who live in contaminated environments, whether or not their work is considered to put them at risk of infection [1]. The transmission cycle of infection involves interaction between one or more species of animal hosts harbouring the organism and an environment favourable for its survival and human beings.

The history of leptospirosis in Andamans dates back to the end of nineteenth century. During the

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period 1890–1930 there had been several reports of cases of disease presenting with acute fever, jaundice and haemorrhagic tendencies [2–4]. Many of these cases were suspected to be due to leptospirosis on clinical grounds [4]. In 1929, the presence of leptospirosis in the Andamans was confirmed bacteriologically by isolating the organism from several patients with Weil's disease [5]. It was the first report of bacteriologically confirmed leptospirosis from India. During those days the disease had a very high incidence rates in the Andamans. But no information exists about the status of the disease in the Andamans after the 1930s. In the late 1980s annual post-monsoon outbreaks of febrile illness with haemorrhagic tendencies and case fatality rates in the range of 10–50% started occurring in North and South Andaman. In 1993, the cause of these outbreaks was identified as leptospirosis through serological studies [6]. Afterwards a systematic search for the disease was started in the Andamans and it was found that leptospiral infection is highly endemic among several population groups with seroprevalence rates exceeding 55% in some areas [7, 8].

The Andaman and Nicobar islands, an Indian Union Territory, is an archipelago of more than 500 tropical islands situated in the Bay of Bengal about 1200 km east of the Indian sub-continent. The islands receive a high annual rainfall of more than 3000 mm and the relative humidity ranges between 70 and 90% throughout the year. About 86% of the land area is covered with tropical rain forest. Rice is the main food crop grown in this territory and the cultivating techniques remain conventional with very little mechanisation. All these factors make the environment of these islands ideal for the successful transmission of leptospirosis.

The islands are the home of six aboriginal tribes. These tribes can be broadly divided in two racial groups, i.e. Negroto living in Andaman district and Mongoloid group living in Nicobar district. The four Negroto tribes are Great Andamanese, Onges, Jarawas and Sentinelese and the two Mongoloid tribes are Nicobarese and Shompens. Jarawas and Sentinelese are still hostile to the outside world. All the tribes except Nicobarese live in primitive conditions and their populations have shown continuous reduction in number. They have ample exposure to an environment which is favourable for transmission of leptospirosis. As leptospirosis is found to be highly endemic in the Andaman islands, it is quite probable that these tribal groups are also acquiring leptospiral infection due to

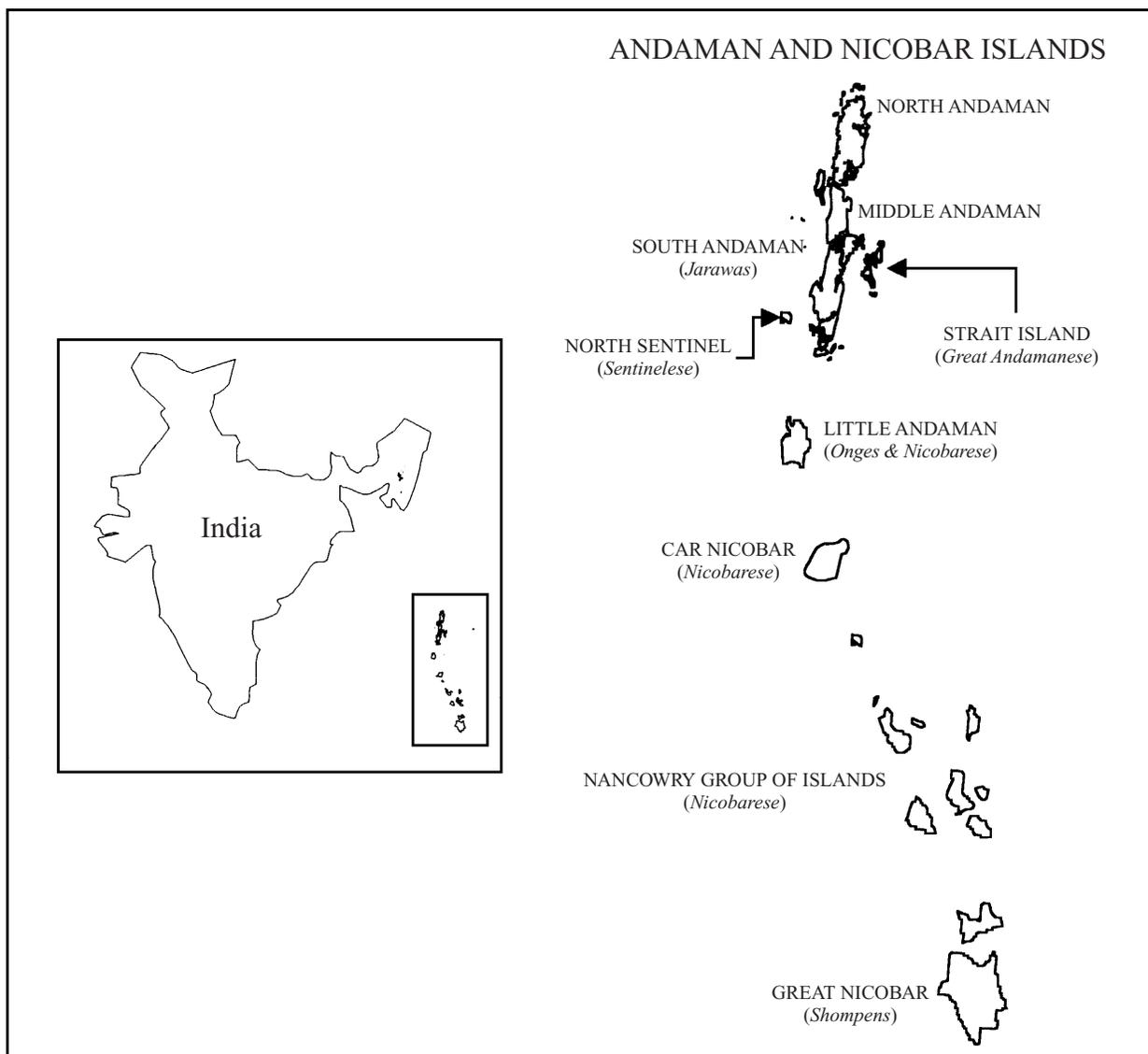
their unprotected exposure to the environment. At present, no information is available about the prevalence of leptospiral infection among these tribes. Hence the present study was undertaken with the objectives of assessing the prevalence of leptospiral infection among the accessible tribes of Andaman and Nicobar Islands and to study any correlation between the seroprevalence rates and the life style and the pattern of exposure to the environment.

## MATERIALS AND METHODS

The six tribes of these islands together constitute about 8% of the total population of over 280000 of the islands (9). More than 90% of the tribal population belong to the Nicobarese group settled in Car Nicobar, Nancowry group of islands and in Harminder Bay of Little Andaman. The Great Andamanese are rehabilitated in a settlement in Strait island and Onges in Dugong Creek and the South Bay area of Little Andaman island. Shompens are nomadic in nature and live in deep jungles of Great Nicobar island. The habitats of these tribes are shown in Figure 1.

### Sampling

The break-up of the tribal population in each island and details of sampling are summarized in Table 1. Nicobarese are the largest tribal group and their population constitutes about 98.9% of the total population of four tribes studied. The populations of Shompens, Onges and Great Andamanese are restricted to relatively small groups of individuals and in these tribes total coverage was attempted. About 80% of the population of Onges and Great Andamanese could be covered under the study. The Shompens lead a much more primitive life than the other three tribes studied and they do not stay permanently in any settlement. Besides, they are reluctant to meet outsiders and do not entertain visits of outsiders in their huts situated in deep jungles. Because of these difficulties only 101 persons of the estimated population of 157 Shompens could be contacted and included in the study. There are three distinct groups of Nicobarese, namely those living in Car Nicobar, those of Nancowry group of islands and those settled in Harminder Bay of Little Andaman. Representative random samples from each of these groups were drawn and included in the study. More than 5% of Nicobarese belonging to these three groups were



**Fig. 1.** Habitats of the primitive tribes of Andaman and Nicobar Islands.

included in the study. The overall coverage for all the studied tribes was 5.8%.

### Serological techniques

Serum samples were collected from the individuals included in the study and these samples were stored at  $-70^{\circ}\text{C}$  until processed. The serum samples were tested for anti-leptospiral antibodies using the Microscopic Agglutination Test (MAT) following the standard procedure [10]. Reference strains belonging to 10 serogroups, which are common in India, were used as antigens in MAT. These strains belonged to the serogroups Australis, Autumnalis, Bataviae, Canicola, Grippityphosa, Icterohaemorrhagiae, Javanica, Pomona, Sejroe and Tarassovi. In addition to these 10

reference strains, two local isolates belonging to serogroup Grippityphosa and Icterohaemorrhagiae were also included in the panel of antigens. All of the samples were tested at doubling dilutions from 1:50 to 1:200. Positive samples were screened up to end titres. Though 1:100 is the internationally accepted cut-off value denoting positivity, it has been shown that dilutions of 1:50 have been shown to persist for lengthy periods [11]. Hence 1:50 has become the commonly used cut-off point denoting seropositivity in seroepidemiological studies [12]. Considering this, a titre of 50 was taken as the cut-off value for seropositivity in the present study. When positive MAT titres were obtained against multiple serogroups, the one against which the highest titre was obtained was taken as the infecting serogroup.

Table 1. Details of sampling and seroprevalence rates among the four tribes

Tribe	Population	Samples tested (% of total population)	Positive	Prevalence (95% CI)
Nicobarese				
Car Nicobar	15781	770 (4.9)	114	14.8 (12.29–17.38)
Nicobarese				
Nancowry group	9702	308 (3.2)	63	20.5 (15.99–25.00)
Nicobarese				
Little Andaman	1078	271 (25.1)	44	16.2 (11.81–20.59)
Nicobarese				
Overall	26561	1349 (5.1)	221	16.4 (14.42–18.38)
Shompens				
Great Nicobar	157	101 (64.3)	54	53.5 (43.77–63.22)
Onges				
Little Andaman	102	80 (78.4)	18	22.5 (12.78–32.22)
Andamanese				
Strait island	32	27 (84.4)	4	14.8 (1.41–28.19)
Total	26852	1557 (5.8)	297	19.1 (17.15–21.05)

Table 2. Common serogroups against which antibodies were detected by MAT

Serogroup	Nicobarese (n = 221)	Shompens (n = 54)	Onges (n = 18)	Andamanese (n = 4)	Total (n = 297)
Australis	96 (43.4)	12 (22.2)	4 (22.2)	2 (50)	114 (38.4)
Grippotyphosa	74 (33.5)	22 (40.7)	9 (50.0)	0 (0.0)	105 (35.4)
Icterohaemorrhagiae	14 (6.3)	11 (20.3)	1 (5.5)	0 (0.0)	26 (8.8)
Pomona	14 (6.3)	0 (0.0)	4 (22.2)	0 (0.0)	18 (6.1)
Canicola	9 (4.1)	3 (5.5)	0 (0.0)	0 (0.0)	12 (4.0)
Mixed	14 (6.3)	6 (11.1)	0 (0.0)	2 (50)	22 (7.4)

## RESULTS

Of the 1557 sera samples tested by MAT, anti-leptospiral antibodies against one or more serogroups of leptospires were found in 297 persons giving an overall seroprevalence rate of 19.1%. Of these 297 seropositives, 28 gave a titre of 200 and one of them gave a titre of 400 and another 800. Both these persons were from the Shompens tribe and the serogroup involved was Grippotyphosa. Since the proportion of different tribes in the total sample was not similar to the proportion of each tribe in the total tribal population, the overall prevalence was standardized for each tribal group. The standardized overall prevalence of leptospiral infection among the four tribes was 17.16% (95% CI = 15.29–19.03). The seroprevalence rate was highest among Shompens, followed by Onges and Nicobarese (Table 1). The

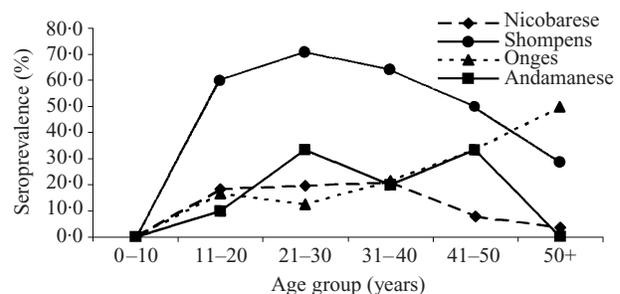


Fig. 2. Seroprevalence rates by age among the four tribes.

seroprevalence rates among different groups of Nicobarese were not significantly different from each other.

In all the tribes, the prevalence was significantly higher in males than in females (Nicobarese:  $\chi^2 = 7.81$ ,  $P = 0.0052002$ ; Shompens:  $\chi^2 = 5.3$ ,  $P = 0.021356$ ; Onges:  $\chi^2 = 8.42$ ,  $P = 0.0037$ ; And-

manese: Fischer's exact  $P = 0.0407$ ). The age-specific rates of leptospiral infection for individual tribes are shown in Figure 2. The pattern is similar for Shompens, Nicobarese and Great Andamanese with seroprevalence rates rising from low values among children to reach peaks in 21–40 year age group and then declining. In contrast, the Onges showed a different pattern with seroprevalence rates increasing even beyond 40 years of age.

Among the positive sera samples, Australis was the commonest serogroup followed by Grippotyphosa, Icterohaemorrhagiae, Pomona and Canicola. 'Mixed equals' were observed in 7.4% and its prevalence ranged between 0 and 50% in different tribes. In Shompens and Onges, Grippotyphosa was more common than Australis, whereas in Nicobarese Australis was more common. Among the Andamanese, antibodies against Grippotyphosa were not detected in any individuals. There were only four individuals with anti-leptospiral antibodies among the 27 Andamanese tested. Two of these four had antibodies against Australis and the other two had mixed reactions. The commonest serogroups involved in 'mixed equal' were Australis and Grippotyphosa.

## DISCUSSION

The overall prevalence rate among all the tribes taken together was much less than the prevalence rates observed among other population groups of Andaman islands [7, 8]. But the Shompens showed a very high prevalence rate of 53.5% and among those Shompens aged 21–30 years a very high seroprevalence rate of 71% was observed (Fig. 2). Although any type of contact with animals pose the risk of acquiring leptospiral infection, in most instances it is acquired through contact with environment contaminated with infected animal urine [1]. The suitability of the environment for survival of leptospire is an important factor determining risk of infection and thus the endemicity. All the four tribes studied keep dogs, pigs and cattle. But the type of environment in the habitat differs from tribe to tribe. The Little Andaman, Strait island, Car Nicobar and Nancowry group of islands, where the Nicobarese, Great Andamanese and Onges live, are flat sandy lands, whereas the homeland of Shompens – Great Nicobar has an undulating geography with small hillocks, valleys and marshy plains. One of the two rivers of the Andaman and Nicobar Islands flows in Great Nicobar and there are several rivulets and streams with wet and marshy

banks. The Shompens are jungle dwellers and are the most primitive among the four tribes studied. They trek long distances through jungles in search of forest produce on which they subsist. The tropical forest of Great Nicobar is rich in rodent populations of various species and the tribesmen have every chance of getting into direct contact with rodent urine through contaminated soil, which is an established vehicle of transmission of leptospirosis. They do not have the habit of wearing footwear. The wet and marshy nature of the soil, their constant exposure to the environment and close contact with animals, especially dogs put them at high risk of acquiring leptospiral infection and this is reflected in the high seroprevalence rate observed among them. In contrast to the high prevalence rate observed among Shompens, the other three tribes had lower prevalence rates. However, the prevalence rates of 15–23% observed among them indicate that leptospiral infection is occurring frequently among them also. The Nicobarese live near the seashore where the soil is sandy with very low water retaining capacity. The nature of soils in Onge and Andamanese settlements is similar and are relatively dry. This might be an explanation for the lower prevalence among them in spite of their close contact with animals. Moreover, the Onges and Andamanese very rarely go out into the jungles these days. As the Andaman and Nicobar Administration is providing them with food and all other necessary facilities they do not have to visit the jungles to collect forest produce.

Higher prevalence in males is a universal phenomenon [13] and is generally attributed to their more frequent outdoor activities. In all the tribes, the seroprevalence was found to increase with age till 40 years of life, with maximum prevalence in the age group of 20–40 years. However, after 40 years of age the prevalence was found to be decreasing among all the tribes except Onges. The increase in seroprevalence with age might reflect the cumulative effect of exposure and re-exposure to the environment contaminated with leptospire [14]. The finding that the prevalence decreases after 40 years of age is not suggested by earlier serosurveys carried out in endemic areas of these islands [7, 8]. It has been shown that half of the seropositive individuals become seronegative within a year [11]. Probably the outdoor activities of the older individuals are significantly less than that of young adults and by passage of time more and more persons become seronegative. But the Onges showed a different pattern, which is more like the pattern

observed among other population groups of the islands [7, 8].

The serogroups involved in leptospiral infection among the tribes were Australis, Grippotyphosa, Pomona and Canicola. These are the common serogroups involved in outbreaks of leptospirosis in North and South Andaman [7, 8]. Other than the casual observation of high incidence of jaundice among the people of the area, there is no authentic information about the magnitude of clinical leptospirosis in the tribal population of these islands. As leptospiral infection is endemic in different degrees among the tribes, it is likely that clinical disease might be common among them and might be one of the reasons for the very high mortality observed among them [15]. At the time of collection of blood all the subjects were apparently healthy. Only two of the seropositives had MAT titres  $\geq 400$  and in the absence of symptoms and a second sample to test for rise in titres, it is not possible to infer with certainty whether they were having current infection or not. Further studies however are required to understand the actual morbidity and mortality burden due to clinical leptospirosis among these tribes.

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