

Leptospirosis in rural West Malaysia

by Dora S.K. Tan
Virus Research Officer,
Institute for Medical Research,
Kuala Lumpur.

(Lecture given at the Seminar of the Malaysian Society of Parasitology & Tropical Medicine on 24th January, 1970.)

LEPTOSPIROSIS is one of the most important zoonotic diseases known to man. The main reservoir host is the rodent species although some serotypes are most commonly found in dogs, pigs or cattle. A high incidence of this disease may therefore be expected among the rural population and people who frequent areas likely to be contaminated with infected animal urine.

In West Malaysia, a serological survey of 4,819 afebrile individuals throughout the country, during the period of September 1960 to December 1961, revealed an overall antibody prevalence ratio of 11.8%. The test employed was the Sensitized-Erythrocyte-Lysis (SEL) test described by Chang et al. (1957) and recently evaluated as an epidemiology tool for human leptospirosis serological surveys (Tan, 1969). Among the localities surveyed were seven types of rural areas comprising one oil palm estate in Bukit Jelutong, Selangor; five rubber estates in various parts of W. Malaysia, five rice fields in Kelantan, one forest village in Ulu Langat, Selangor; one tin-mining village in Sungai Lembing, Pahang; and

scattered farms and aborigine settlements.

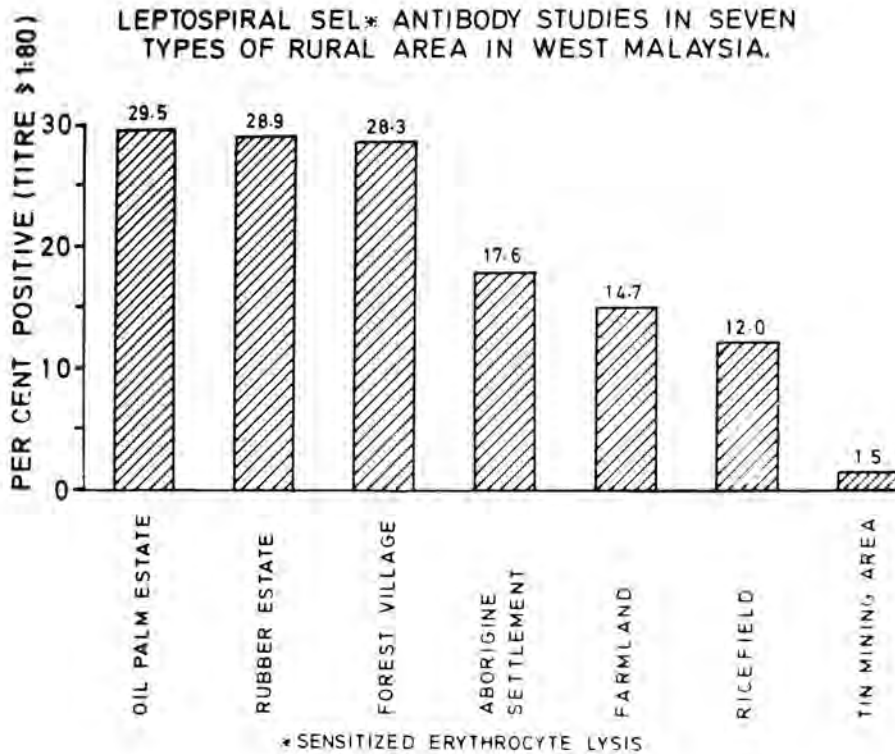
A ten-year clinical appraisal of leptospirosis in W. Malaysia was also carried out, the full results of which will be published elsewhere (Tan, in press)

RESULTS

Serological Survey

The following figure summarises the results of the serological survey in rural areas of W. Malaysia:

The highest incidence of leptospirosis was found in oil palm workers (29.5% or 18/61), rubber estate workers (28.9% or 4/221) and the Ulu Langat forest residents (28.3% or 17/60). The aborigines (most of whom have been re-settled in villages along forest fringes) with 17.6% or 27/153, farmers with 14.7% or 30/204 and padi planters in Kelantan with 12.0% or 31/259 form the second most highly infected group. Villagers living and working in the tin-mining area of Sg. Lembing, Pahang showed a very low incidence of 1.5% or 2/136. The total number of rural residents examined was 1,154 out of which 189 (16.4%) were found positive.



Tables 1 and 2 give the detailed results of the survey on the five rubber estates and the five Kelantan ricefields, respectively.

A very distinct and significant difference in the antibody prevalence ratios between the first three estates (42.6% – 45.9%) and the last two estates (0% – 3.3%) listed in Table 1 may be observed. On the other hand, the five Kelantan ricefields yielded less contrasting individual results (Table 2).

By comparison, Table 3 shows leptospiral antibody ratios in the main state capitals of West Malaysia, which, of course, represent the urban setting of the country. A total of 2,388 town residents was examined of which 134 (5.6%) were positive. The ratios ranged between 0% in Johore Bahru to 12% in Georgetown, Penang.

Clinical appraisal

Out of 1,993 suspected cases of leptospirosis, 559 (28%) were confirmed positive. The highest number of cases occurred among males, 20 – 40 years old, and of the three main racial groups, Malay,

Chinese and Indian, the Indian community was most frequently affected, based on estimated population. This finding bore a direct relationship to the distribution of cases by occupation, where the general labourers (they deal with sewage, drainage, forestry, town-cleaning or anti-malarial work.) and rubber estate workers, who are mainly of Indian origin, headed the list in the order of case frequency (Table 4).

Padi planters, tin miners, farmers and veterinary workers were comparatively free of clinical leptospirosis. Similarly, the number of clinical cases in aborigines was so small that it had to be included with the "other races" in the distribution by racial group (Tan, in press). The oil palm estate worker has, apparently, also escaped the severe effects of leptospirosis.

DISCUSSION

The very high incidence of leptospirosis in the oil palm estate workers and forest residents may be attributed to the fact that rats, the main reservoir

LEPTOSPIROSIS IN RURAL WEST MALAYSIA

TABLE 1

LEPTOSPIRAL SEL + ANTIBODY STUDIES IN
FIVE RUBBER STATES IN W. MALAYSIA

LOCALITY	STATE	No. EXAMINED	POSITIVE	PER CENT
GUA MUSANG	KELANTAN	37	17	45.9
PUCHONG	SELANGOR	50	22	44.0
TANGKAK	JOHORE	54	23	42.6
SUNGEI CHOH	SELANGOR	60	2	3.3
BATU TIGA	SELANGOR	80	0	0
TOTAL		281	64	22.8

+ SENSITIZED ERYTHROCYTE LYSIS

TABLE 2

LEPTOSPIRAL SEL + ANTIBODY STUDIES IN
FIVE RICEFIELDS IN KELANTAN,
W. MALAYSIA.

Locality	No. Examined	Positive	Per cent
Pasir Puteh	51	10	19.6
Pasir Mas	53	7	13.2
Tanah Merah	49	6	12.2
Bachok	53	4	7.5
Tumpat	53	4	7.5
TOTAL	259	31	12.0

+ SENSITIZED ERYTHROCYTE LYSIS

TABLE 3

LEPTOSPIROSIS – SEROLOGICAL SURVEY OF STATE
CAPITALS (URBAN) IN W. MALAYSIA.

Capital	State	No. Examined	Positive	Per cent
Georgetown	Penang	224	27	12.0
Seremban	Negri Sembilan	277	20	7.2
Kuantan	Pahang	45	3	6.6
Kuala Lumpur	Selangor	527	33	6.3
Malacca Town	Malacca	398	19	4.8
Butterworth	Province Wellesley	320	14	4.4
Alor Star	Kedah	94	4	4.3
Kota Bharu	Kelantan	199	8	4.0
Ipoh	Perak	35	1	2.8
Kuala Trengganu	Trengganu	203	5	2.5
Johore Bharu	Johore	66	0	0
TOTAL		2,388	134	5.6

TABLE 4

**DISTRIBUTION OF 559 CASES OF LEPTOSPIROSIS
ACCORDING TO OCCUPATION
(1958 - 1968)**

Occupation	No. of cases	Per cent of total positive
General labourers	94	16.8
Rubber estate workers	53	9.5
School children	37	6.6
Army personnel (mainly Caucasian)	28	5.0
Housewives	23	4.1
Police	16	2.9
Business	12	2.2
Padi Planters	8	1.4
Tin miners	7	1.2
Office workers	7	1.2
Farmers	7	1.2
Field research workers	6	1.1
Medical	6	1.1
Veterinary workers	1	0.2
Miscellaneous	2	0.4
Total	307	54.9
Unknown/Unemployed	252	45.1
Grand total	559	100.0

host, abound in the areas in which these people live and work. The main rat species in oil palm estates is the *R. jalorensis* rat which is normally arboreal in habitat. However, being strongly attracted to the oil palm fruit, they are very numerous not only on tree tops but also at ground level when the fruit is cut down and stored. Although the incidence of leptospirosis in this rat species was found to be only 3% (Smith et al., 1961), their sheer abundance in numbers in these estates more than facilitates transmission of leptospirosis to the workers, the majority of whom live, as well as work there.

In the forest areas, the predominant rodent species are the three forest giant rats, *R. bowersi*, *R. mulleri* and *R. sabanus*, in which the overall incidence of leptospirosis was found to be 17%. These are ground rats and are numerous especially where man has made his settlement. Transmission of leptospirosis to the forest residents is therefore very feasible.

The five rubber estates examined showed very high antibody ratios in three of them and very low in the remaining two (Table 1). Here, the main rat species is also *R. jalorensis* but unlike the conditions in the oil palm estates, these tree rats are not

attracted to ground level by the products of the rubber tree in the same way as they are by the oil palm fruit and are therefore not expected to be an important source of leptospirosis to the rubber estate workers. The extremely high infection rates found in the above-mentioned three estates must therefore be attributed to factors other than those directly related to the rubber industry.

Many rubber estates, especially the small ones, are closely adjacent to forest areas and are likely to be invaded by the highly-infected rats from them. Most of the workers, in the course of their daily duties, trudge through the estate bare-footed. After a period of rainfall, the water on the ground, if previously contaminated with infected rat urine, may well serve as an effective vehicle for the transmission of leptospirosis through the worker's feet, the skin of which is often far from intact. This situation is, in fact, true of the three estates which showed high antibody prevalence ratios. Secondary forests are, indeed, situated near or around these estates, whereas the last two estates, with extremely low antibody ratios, stretch for miles across the country with hardly a secondary forest in sight.

LEPTOSPIROSIS IN RURAL WEST MALAYSIA

Another possible means of infection is through infected house rats, *R. r. diardi* (incidence: 3%) or *R. norvegicus* (incidence: 34%). In addition, the scrub or grassland rat, *R. exulans* (incidence: 7%) commonly enters homes from its normal habitat. The homes of the estate workers, situated in the estates themselves, are usually in the form of "labour lines" which consists of about 10 – 12 small brick housing units attached to one another to form a "line". These units are often overcrowded and it would be surprising if one does not find most of them infested with commensal rats. Infection in this case is by contact with food and utensils contaminated with rat urine.

The aborigines, originally from the jungles of West Malaysia, are gradually being re-settled in farms and villagers. Their leptospiral antibody ratio (17.6%) did not vary much from those of farmers (14.7%) and padi planters (12%). The tin-mining village sampled was conspicuously low in incidence (1.5%) which supports Baker's unpublished findings that most mining pools in West Malaysia were very infrequently contaminated with leptospires, especially during the dry seasons.

The presence of specific antibody against a disease in an individual merely indicates that he has been previously infected by that particular disease. Whether the outcome of the infection is a latent, mild or severe disease depends mainly on the level of acquired immunity, the virulence and dose of the infecting organism.

In West Malaysia, the number of clinical cases severe enough to be hospitalised, (and eventually laboratory-confirmed as leptospirosis) has been small

compared to the number of infected persons, detected by antibody surveys. SEL antibodies are acquired as early as four to six years of age, especially by children in rural areas. As these antibodies have been found to last for about two years only (Tan, 1969) the persistence of antibody prevalence ratios throughout the older age-groups at much the same levels indicates constant re-infection throughout life even up to 60 years and above (Table 5). This pattern confirms the endemicity of leptospirosis in this country and supports the observation that no severe epidemics of leptospirosis have been experienced in West Malaysia so far.

Frank clinical leptospirosis was uncommonly encountered among the oil palm estate workers, aborigines, forest residents, padi planters and tin miners (Table 4). It is possible, of course, that most of the clinical cases were mild and often did not require medical treatment, much less hospitalisation. In those groups with antibodies, acquired immunity due to constant exposure to infection might account for the relatively small number of clinical cases, whereas in the case of the tin miners this was presumably due to comparatively infrequent or low degree of exposure to the disease.

Although the rodent host species most frequently found in ricefields, viz. *R. argentiventer*, had a high leptospiral (*L. javanica*) excretion rate (Smith et al., 1961) and contamination of the ricefields was expected to be serious; when the inlet and outlet water of a ricefield was checked for leptospires during a 5½-month period of observation, the outlet water yielded only half the number of isolates as the inlet water

TABLE 5

LEPTOSPINAL SEL + ANTIBODY RATIOS IN DIFFERENT AGE GROUPS

Age groups	No. Examined	Positive	Per cent
0 – 10	193	19	9.8
11 – 20	781	99	12.7
21 – 30	1,571	191	12.2
31 – 40	1,080	111	10.3
41 – 50	673	90	13.4
51 – 60	331	42	12.7
60 or more	190	16	8.4
Total	4,819	568	11.8

+ SENSITIZED ERYTHROCYTE LYSIS

(Baker, unpublished findings). Analysis of water and soil samples taken from the Kelantan ricefields by the author showed very low pH values in both (mean pH of water: 5.9; mean pH of soil: 5.2) and *L. javanica* survives for very short periods below pH 6.0. Moreover, the soil types were reported by the Malaysian Department of Agriculture to include sandy loam, montmorillonite clay loam and peat and Smith & Turner (1961) have disclosed that leptospire were readily absorbed by bentonite clay which is similar to the montmorillonite clay of the ricefields. The small number of clinical cases among the padi planters may therefore be attributed not only to acquired immunity from constant exposure to leptospirosis but also to reduced virulence and dose of the leptospire due to the unfavourable growth conditions for the leptospire in the ricefields.

Why rubber estate workers are so highly susceptible to clinical leptospirosis is not clearly understood. Since those with very high antibody ratios are expected to be immune from the ill effects of leptospirosis, the workers who fall ill and land in hospital are presumably from estates which are normally "leptospirosis-free" and therefore have had no opportunity to develop immunity from constant exposure. An incidental infection through contact with infected rats from nearby forest or through swimming in contaminated forest streams which happen to flow past the estates can, therefore, cause illness in the non-immune victim. In order to substantiate this theory, it is necessary (1) to carry out more surveys to verify the existence of "leptospirosis-free" rubber estates, and (2) to show that the majority of susceptible rubber estate workers do actually come from such estates, if any.

SUMMARY

A serological survey for leptospiral antibodies employing the Sensitized-Erythrocyte-Lysis (SEL) test was performed in West Malaysia during the

period of September 1960 to December 1961. Of 4,819 afebrile individuals studied, 11.8% were positive. Among the localities surveyed were seven types of rural areas, comprising one oil palm estate in Selangor, five rubber estates in various parts of West Malaysia, five ricefields in Kelantan, one forest village in Selangor, one tin-mining village in Pahang and scattered farms and aborigine settlements.

The highest incidence of leptospirosis was found in oil palm estate workers, rubber estate workers and in forest residents (28.3% to 29.5%). The aborigines, farmers and padi planters had moderately high antibody ratios (12% to 17.6%) while the villagers in the tin-mining area showed a very low incidence of 1.5%. Of the five rubber estates surveyed, three revealed extremely high antibody ratios (42.6% to 45.9%) while the remaining two gave ratios of 0% and 3.3%, respectively. The possible connection between these results and environmental factors was discussed.

Of the 1,154 residents examined, 16.4% were positive. On the other hand, only 5.6% of 2,388 town residents surveyed had significant antibodies.

The number of clinical cases severe enough to be hospitalised was small compared to the number of infected persons, detected by antibody surveys. Immunity was acquired as early as four to six years of age, especially among rural children. In the above groups of persons studied, except for rubber estate workers, a very low proportion suffered from the ill-effects of leptospirosis. Possible reasons for these were given and further studies were recommended.

ACKNOWLEDGEMENT

The author wishes to thank Dr. B. Freeman, of the Sg. Lembing tin-mining estate, all the Health Officers, Health Inspectors and Estate Managers for collecting or assisting in the collection of sera specimens for the survey. She is also indebted to Mr. Mohamed Omar and Mr. Johan Haji Adam for their technical assistance.

REFERENCES

- CHANG, R. S., SMITH, D. J. W., McCOMB, D. E., SHARP, C. F. & Tonge, J. I. (1957) — The use of erythrocyte sensitizing substance in the diagnosis of leptospirosis. *Amer. J. trop. Med. Hyg.*, 6, 101–107.
- SMITH, C. E. G. and TURNER, L. H. (1961) — The effect of pH on the survival of leptospire in water. *Bull. Wild. Hlth. Org.*, 24, 35–43.
- SMITH, C. E. G., TURNER, L. H., HARRISON, J. L. & BROOM, J. C. (1961) — Animal leptospirosis in Malaya.
1. Methods, zoogeographical background and broad analysis of results. *Bull. Wild. Hlth. Org.*, 24, 5–21.
- TAN, DORA S. K. (1969) — Sensitized-Erythrocyte-Lysis (SEL) test as an epidemiological tool for human leptospirosis serological surveys. *Bull. Wild. Hlth. Org.*, 40, 899–902.
- TAN, DORA S. K. (in press) — Clinical leptospirosis in West Malaysia (1958–1968). *SEA J. trop. Med. pub. Hlth.*