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Treponemal infection in the Australian Northern Territory aborigines

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For many years, a moderate to high prevalence of positive reactions to standard tests for syphilis (STS) has been found in sera from the aboriginal inhabitants of the Northern Territory of Australia. In the survey reported here, people living in 18 areas of the Northern Territory were sampled to determine if the positive STS results were due to treponemal infection and, if so, to what extent this was endemic syphilis, yaws, or venereal syphilis. The results of the Treponema pallidum *immobilization test were taken to indicate the presence or absence of treponemal disease in the subject. Clinically, no cases of active treponemal infection were seen, though findings on old infections were difficult to interpret in the older age groups. The prevalence of treponemal infection varied from 3.4 % to 58.0 % in the areas tested. No serological evidence of treponemal infection in children under 15 years of age was found in 6 areas, while in 12 areas it varied from 2.2 % to 32.6 %. Sera from 60 people who had no clinical signs of treponemal infection gave high-titre CWR and VDRL test results. It was concluded that yaws, endemic syphilis, and probably venereal syphilis are to be found in the aboriginal population.*

Clinical yaws has been recorded for many years among the aboriginal population in the humid north of the Northern Territory of Australia (Fig. 1), particularly up to about 1945. A condition in the arid south of the Northern Territory, sometimes referred to as *irkintja* (Hackett, 1936), has also been recorded over a long period, and was generally thought to be either climatically modified yaws or a form of endemic syphilis. Those working in laboratories where sera from aborigines are tested have long realized that a moderate to high prevalence of positive standard serological tests for syphilis (STS) is found among these people. This has caused speculation as to whether these reactions indicate the spread of venereal syphilis in the aboriginal population, perhaps as a result of the gradual disappearance of yaws and endemic syphilis.

The survey reported here was undertaken to determine if the positive results were all due to treponemal infection, and if so, the proportions that were caused by yaws, endemic syphilis, and venereal syphilis. The field work was carried out under the direction of the School of Public Health and Tropical Medicine, University of Sydney, and the sera were sent to the Institute of Clinical Pathology and Medical Research for testing.

The Northern Territory was divided into two strata, corresponding to the administrative divisions, the dividing line corresponding closely to the 19th parallel of latitude. The northern stratum, which has an annual rainfall greater than 38 cm, includes areas of monsoonal coast, savanna woodland, savanna, and grassy steppe; the southern stratum has an annual rainfall less than 38 cm and includes dry grassland, semidesert, and desert. The temperature in the whole Northern Territory varies from 36.7°C on summer days to 3.3°C on cold winter nights.

Traditional aboriginal culture was based on a nomadic existence and a hunting–collecting economy. It was very poor in the material sense, but rich in magic and symbolism, mythology, and art, and there was a very close personal identification with the natural environment. The traditional nomadic existence was carried on by small local groups of one,

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two, or three families, who travelled independently through their territory in an endless cycle determined by season, availability of food, and ceremonial occasions. Personal contact outside the local group was infrequent and brief, and such contact as did occur, either personal or sexual, was governed by kinship and totemic rules. This traditional culture was shattered by contact with European settlement and attitudes. Rules and taboos that were accepted, and also easily enforced, in the nomadic situation were out of context in multitribal settlements, such as now exist. The aboriginal community, still mainly a rural population, became settled in relatively small groups and was generally dependent upon government or mission staff and cattle-station managements for food, shelter, employment, health and medical services, and education. The standard of living varied greatly but generally was very low materially and economically with little appreciation of hygiene. Many families tended to move between adjacent localities but were not true nomads.

The estimated aboriginal population of the Northern Territory in late 1968 was 21 119, of which 90% were accessible. A sampling frame of all aboriginal communities of 50 or more persons was constructed from available data and the total sampling frame population was estimated to be 15 548; a 10% sample of this population was surveyed. Each stratum was divided into substrata, substratification being based partly on geography and partly on the type of aboriginal community. One or two sampling stations were selected from each substratum by probability sampling. Altogether, 11 communities were sampled in the northern stratum, of which 9 had a population greater than 100 and 2 had a population of 50–99; the corresponding data for the southern stratum are 7 areas, 5 having a population greater than 100 and 2 having a population of 50–90 (Fig. 1).

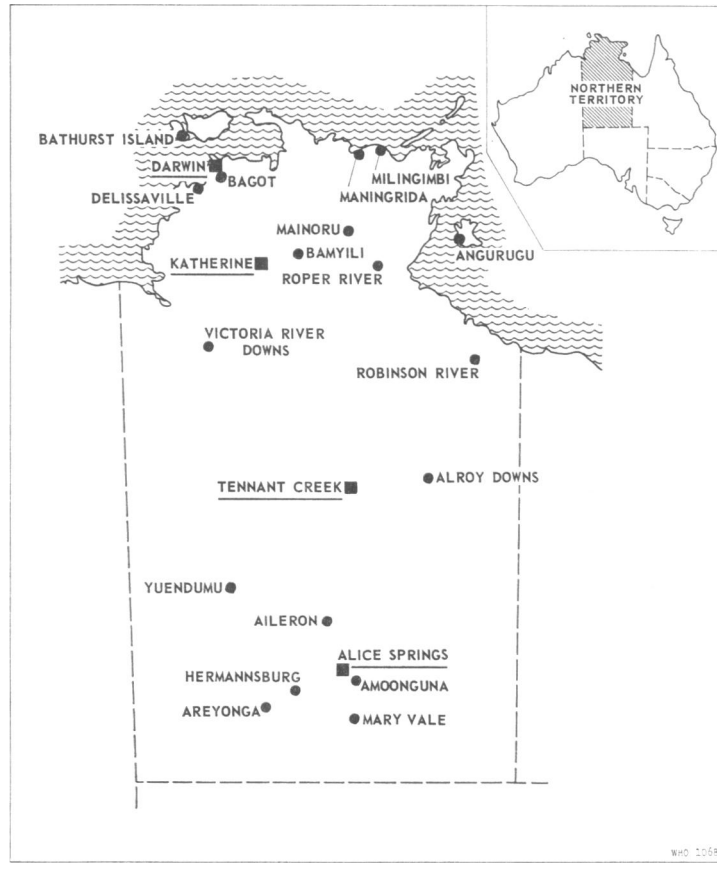

Fig. 1. Location of main towns (■) and the 1968 sampling stations (•) in the Northern Territory of Australia.

The households examined at each sampling station were drawn from a table of random numbers. A household consisted of all the people living in a dwelling with or without attached shelters, or in a group of small shelters. These people generally ate together and shared the basic necessities of daily living. Usually, this meant an extended family, with or without some attached persons. The communities were divided into three groups—namely, missions, settlements, and pastoral properties.

Each person included in this survey received as complete a clinical examination as possible. The female pudenda and the male genitalia were not always examined since it was felt that the subjects' cooperation would have been lost if this had been insisted upon. Comments in this report, such as " no clinical evidence of venereal syphilis ", must be considered with this limitation in mind since most chancres or condylomata, if present, would not have been seen. No clinical cases of florid yaws, endemic syphilis, or venereal syphilis were seen, though some subjects showed signs of previous yaws infection. However, active yaws was seen during the course of this survey in people who were outside the survey sample. One case of " burned out " gangosa was found, and a few cases of marked anterior bowing of the tibia were seen even in young people. There were many cases of slight bowing of the tibia, skin eruptions, plantar hyperkeratoses, leg scars, perforated nasal septa and perforated and deformed palates. These clinical findings were difficult to interpret, especially in the older age groups, as in many instances they could not be distinguished from conditions resulting from poor nutrition, old injuries, and camp-fire burns. Perforated nasal septa referred to are the high septal perforations, which appeared to be pathological, rather than the low, soft-tissue septal perforations that had been made as a tribal custom for purposes of ornamentation. No cases of congenital, cardiovascular, or central nervous system syphilis were seen. Over the past 10 years, penicillin has been widely used, especially among the children. A clinical diagnosis of past or present treponemal disease was made in 4.1% of the total sample, and was made more often in the southern stratum (5.0%) than in the northern stratum (3.5%). Otherwise, differences in clinical signs between people in the various substrata or other groupings were minimal.

Sera were received from 1 570 aboriginal people aged more than 1 year. Full serological tests were carried out on only 1 542 sera and these results form the basis of this report. The following tests were performed on each serum: cardiolipin Wassermann reaction (CWR), Venereal Disease Research Laboratory (VDRL) test, Reiter protein complement-fixation (RPCF) test, and a *Treponema pallidum* immobilization (TPI) test. Sera found to be positive to the CWR or VDRL tests were titrated. A positive TPI test result was regarded as evidence of treponemal infection and all other test results were compared with it. A previous suggestion that there was a high reactor rate to the gonococcal complement-fixation (GCF) test among the aborigines, and hence that the positive STS were caused by venereal syphilis, prompted us to perform the GCF test on each of the 1 542 sera.

RESULTS

Results in total population tested

Of the 1 542 sera tested, 765 were from males and 777 from females. The prevalence of treponemal infection in the whole group was 23.0%, 354 sera being positive to the TPI test. Males showed a prevalence of 24.7% and females 21.2%, with 189 and 165 sera, respectively, giving positive reactions to TPI tests (Table 1). The endemic treponematoses are diseases of childhood, usually contracted before the age of 15 years. For the purposes of this report, children are those aged 1–14 years and adults those aged 15 years and over. Positive TPI reactions were found with sera from 36 (5.6%) of 643 children compared with 318 (35.4%) of 899 adults (Table 1).

Results in each age group

Tables 1 and 2 show the prevalence of treponemal infection in the various age groups and in males and females in each group. The percentage prevalence of infection tended to increase with age, except for those aged 5–9 years and 60 years and over. As expected, it was lower in females than in males, except those aged 5–9 years, in whom the male prevalence was 0.8% compared with 6.6% in females. In the young children aged 1–4 years the prevalence of infection in males was much higher than in females (6.9% and 3.9%, respectively).

Results in each area tested

The number and proportion of TPI-reactive sera found in each area, and in males and females in each area, are shown in Table 3, while Table 4 compares these results in adults and children. The highest prevalence of treponemal infection (58.0%) was

Table 1. TPI test results in relation to age and sex of the population studied in the whole of the Northern Territory of Australia

Age (years)	No. of sera tested	TPI-reactive		Males			Females		
		No.	%	No. of sera tested	TPI-reactive		No. of sera tested	TPI-reactive	
					No.	%		No.	%
1–14	643	36	5.6	321	17	5.3	322	19	5.9
15–29	386	69	17.9	194	41	21.1	192	28	14.6
30–44	280	106	37.9	118	47	39.8	162	59	36.4
45–59	145	95	65.5	79	53	67.1	66	42	63.6
⩾ 60	88	48	54.5	53	31	58.5	35	17	48.6
total adults	899	318	35.4	444	172	38.7	455	146	32.1
total sera	1 542	354	23.0	765	189	24.7	777	165	21.2

found at Maningrida, a large multi-tribal settlement in the northern stratum. Here, the prevalence rate was also the highest for both males (62.1%) and females (52.4%). Two other areas in the northern stratum had high prevalence rates—namely, Robinson River (44.4%) and Mainoru (44.0%). Sera from 50.0% of the males and 38.9% of the females at Robinson River gave positive TPI reactions; the corresponding proportions for Mainoru were 38.5% and 50.0%. Of the 18 areas tested, 11 had over 20% of sera reactive to the TPI test; the same 11 areas had over 20% prevalence of infection in males; 9 of these areas had over 20% prevalence of infection in females. The lowest rate of infection was found at Hermannsburg Mission in the southern stratum, where of 59 sera tested only 2, from an adult male and an adult female, were positive to the TPI test.

In adults, the highest prevalence of treponemal infection was seen at Maningrida (77.2%), then Mainoru (67.9%), Robinson River (66.7%), and Bamyili (54.1%), all in the northern stratum, and Yuendumu (49.2%) in the southern stratum. Of the 18 areas tested, only 6 had prevalence rates less than 20% in adults, 4 of these being in the southern stratum.

In the children, 14 (32.6%) of 43 sera tested at Maningrida were reactive to the TPI test, 3 (13.6%)

Table 2. Results of TPI test in relation to age and sex in the children studied

Age (years)	No. of sera tested	TPI-reactive		Males			Females		
		No.	%	No. of sera tested	TPI-reactive		No. of sera tested	TPI-reactive	
					No.	%		No.	%
1–4	204	11	5.4	102	7	6.9	102	4	3.9
5–9	239	9	3.8	118	1	0.8	121	8	6.6
10–14	200	16	8.0	101	9	8.9	99	7	7.1
total	643	36	5.6	321	17	5.3	322	19	5.9

Table 3. Number and percentage of TPI-reactive sera in each area, by sex

Area	No. of sera tested	TPI-reactive		Males			Females		
		No.	%	No. of sera tested	TPI-reactive		No. of sera tested	TPI-reactive	
					No.	%		No.	%
Maningrida	100	58	58.0	58	36	62.1	42	22	52.4
Angurugu	87	9	10.3	39	5	12.8	48	4	8.3
Milingimbi	101	28	27.7	38	11	29.0	63	17	27.0
Bathurst Island	100	26	26.0	43	12	27.9	57	14	24.6
Delissaville	90	11	12.2	48	8	16.7	42	3	7.1
Roper River	98	22	22.5	47	10	21.3	51	12	23.5
Bamyili	102	33	32.4	54	17	31.5	48	16	33.3
Bagot	100	22	22.00	57	14	24.6	43	8	18.6
Victoria River Downs	110	31	28.2	54	17	31.5	56	14	25.0
Robinson River	36	16	44.4	18	9	50.0	18	7	38.9
Mainoru	50	22	44.0	26	10	38.5	24	12	50.0
Hermannsburg	59	2	3.4	30	1	3.3	29	1	3.5
Yuendumu	95	29	30.5	42	15	35.7	53	14	26.4
Areyonga	99	5	5.1	44	4	9.1	55	1	1.8
Amoonguna	105	9	8.6	58	5	8.6	47	4	8.5
Mary Vale	99	12	12.1	52	4	7.7	47	8	17.0
Aileron	70	14	20.0	33	7	21.2	37	7	18.9
Alroy Downs	41	5	12.2	24	4	16.7	17	1	5.9

of 22 at Mainoru and 2 (13.3%) of 15 at Robinson River. No children had sera giving positive TPI reactions at Bamyili and Yuendumu, where high prevalence rates were found in the adults. In 6 of the 18 areas studied, no child had a serum that gave positive reactions to the TPI test; 5 of these areas were in the southern stratum. In each of the two remaining areas in the southern stratum, serum from only one child gave a positive TPI test result.

Results in the northern and southern strata

Table 5 shows the number of sera reactive in the TPI test for the total population studied and for adults and children in each stratum.

In the northern stratum, of 974 sera tested, 278 (28.5%) were found to be positive to the TPI test, the adults having a prevalence rate of 42.4%. The rates for the southern stratum were approximately half those for the northern stratum for these two groups. The most marked contrast in prevalence of infection occurred in the children. In the northern stratum, 34 (8.5%) of 398 sera reacted positively to TPI tests compared with 2 (0.8%) of 245 sera in the southern stratum.

Comparison of test results with the TPI test

Table 6 compares the results of the CWR, RPCF, and VDRL tests with the TPI test. Altogether, 354 sera gave positive reactions to the TPI test. The number of sera reactive to both TPI and VDRL tests was 265; to TPI and RPCF tests, 227; and to TPI and CWR tests, 207. The VDRL test was the only one to show complete agreement with the TPI test in any individual area tested, and then in only 4 of the 18 areas.

Biological false positive (BFP) reactions occurred in 61 sera as follows: CWR in 1, VDRL in 16, CWR and VDRL in 4, and RPCF in 40 sera.

A total of 60 sera, reactive in all tests, had high CWR and/or VDRL test titres. Test titres were regarded as high when the CWR titre was 40, 80, 160, or 320 and the VDRL test was positive for serum

Table 4. Number and percentage of TPI-reactive sera in adults and children in each area

Area	Total no. of sera tested	Adults			Children		
		No. of sera tested	TPI-reactive		No. of sera tested	TPI-reactive	
			No.	%		No.	%
Maningrida	100	57	44	77.2	43	14	32.6
Angurugu	87	45	8	17.8	42	1	2.4
Milingimbi	101	57	27	47.4	44	1	2.3
Bathurst Island	100	62	22	35.5	38	4	10.5
Delissaville	90	54	8	14.8	36	3	8.3
Roper River	98	53	19	35.9	45	3	6.7
Bamyili	102	61	33	54.1	41	0	0
Bagot	100	62	21	33.9	38	1	2.6
Victoria River Downs	110	76	29	38.2	34	2	5.9
Robinson River	36	21	14	66.7	15	2	13.3
Mainoru	50	28	19	67.9	22	3	13.6
Hermannsburg	59	21	2	9.5	38	0	0
Yuendumu	95	59	29	49.2	36	0	0
Areyonga	99	57	5	8.8	42	0	0
Amoonguna	105	59	8	13.6	46	1	2.2
Mary Vale	99	63	11	17.5	36	1	2.8
Aileron	70	42	14	33.3	28	0	0
Alroy Downs	41	22	5	22.7	19	0	0

Table 5. Number and percentage of TPI-reactive sera in northern and southern strata; totals for adults and children

Northern Territory division	Total no. of sera tested	TPI-reactive		Adults			Children		
		No.	%	No. of sera tested	TPI-reactive		No. of sera tested	TPI-reactive	
					No.	%		No.	%
northern stratum	974	278	28.5	576	244	42.4	398	34	8.5