

Mosquito-borne infections in Fiji

I. Filariasis in northern Fiji: epidemiological evidence regarding factors influencing the prevalence of microfilaraemia of *Wuchereria bancrofti* infections*

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SUMMARY

A survey of microfilaraemia among the population of Vanua Levu, Taveuni and Koro islands in northern Fiji was conducted in 1968 and 1969 as a prelude to a campaign of mass treatment with diethylcarbamazine.

The prevalences of microfilaraemia were found in the more moist conditions of Taveuni and Koro and on the windward southern side of Vanua Levu to be higher than on the drier northern side of Vanua Levu. On both sides of Vanua Levu prevalences were lower inland than near the coast.

Under apparently similar environmental conditions those of Fijian ethnic origin exhibited a higher prevalence of microfilaraemia than that shown by Indians. This ethnic difference and a difference between the prevalences in male and female Fijians are considered to be due more to higher rates of recovery from microfilaraemia in Indians and Fijian women than to diminished exposure to mosquitoes. Mathematical models have been used as an aid to the interpretation of the data, and, where appropriate, comparison has been made with the prevalence of antibodies to dengue, an arbovirus having the same vectors.

Household infections were analysed by computer techniques. Infections in large households were not proportionately higher than in small households, indicating that transmission was not intrafamilial. The clustering of infections within households, though present, was not marked. Among the occupants of outlying settlements the prevalence of microfilaraemia was relatively low indicating a lower risk of infection due to isolation.

INTRODUCTION

Signs of filariasis have been recognized in Oceania since the times of Captain Cook over two centuries ago and a number of careful surveys have been made both of the disease in man and of infections in the vector mosquitoes. The distribution of

* Much of the information in this paper has been abstracted from an unpublished report to the Director of Medical Services Fiji, 'Filariasis and arbovirus survey, Northern Fiji, 1968-9', by Mataika, Dando & Macnamara (1970).

the disease due to aperiodic *Wuchereria bancrofti* before effective control measures were instituted is known for various island groups, and Iyengar (1965) has given a good review of the epidemiology of filariasis in the South Pacific. Most of the islands in this region are too small to show appreciable internal climatic variations, and their populations are frequently too small to permit subdivisions according to attributes which might influence the epidemiology of filariasis.

The territory of Fiji has the greatest range of climatic differences and the largest population of any island group in the zone of aperiodic filariasis. Only New Caledonia has similar climatic variations, but New Caledonia differs from the others in that the main insect vector is *Aedes (Ochlerotatus) vigilax* rather than mosquitoes of the *Aë. (Stegomyia) scutellaris* group.

The population of Fiji is nearly equally divided between those of Fijian origin and those of Indian origin. The Indian group originally came mainly from the United Provinces and Madras. The Fijians are primarily Melanesian with a Polynesian admixture. In both groups the great majority have been born in Fiji and have grown up there. There is also a relatively small group of Chinese, Europeans, and those of mixed ethnic origin.

The principal mosquito vectors of *Wuchereria bancrofti* in Fiji are *Aë. (Stegomyia) polynesiensis*, Marks 1951, and *Aë. S. pseudoscutellaris*, Theobald 1910. Other vectors have been incriminated, but are of local or minor importance (Symes, 1960; Burnett, 1960*a*). These two *Aedes* mosquitoes were probably also the main vectors of dengue virus which ravaged the area during epidemics in 1930 and 1943 (Maguire *et al.* 1971).

Control of the insect vectors presents considerable obstacles (Burnett, 1960*b*), but control of the parasite by diethylcarbamazine administered to the human population has offered hope in Fiji (Burnett & Mataika, 1964) as it has elsewhere in the Pacific region (Laigret, Kessel, Bambridge & Adams, 1966; Ciferri, Siliga, Long & Kessel, 1969). Hence it was decided in 1966 by the Medical Department of the Government of Fiji that a campaign should be instigated for the control of filariasis by the mass administration of diethylcarbamazine. Initially the campaign was to cover the island of Vanua Levu, south of the main divide, the island of Teveuni and adjacent islets. Later Koro island was added to the area as well as Rotuma island. Nevertheless, before administering the drug, a survey of filariasis was called for, to provide a starting point from which the progress of the campaign could later be evaluated, and to provide, amongst other details necessary for the administration of the campaign, information on the current epidemiology of filariasis.

The survey began in December 1967, but was later extended to areas beyond those mentioned above, owing to the very satisfactory manner in which the control campaign was found to progress.

This paper outlines the procedures employed in the survey, and presents data associating the prevalence of microfilaraemia with climate, ethnic groups, sex and age groups, households and housing density.

A concomitant survey of antibodies against dengue arbovirus was undertaken. The full results of this survey are presented elsewhere (Maguire *et al.* 1971)

but reference will be made to the results where they facilitate the understanding of the epidemiology of filariasis. In Fiji the two diseases are comparable in that (1) man is the sole vertebrate host, (2) the same species of mosquito transmit both diseases (Rosen, Rosebook, Sweet & Sabin, 1954) and (3) the extrinsic incubation periods of the two diseases are similar.

Climatological and social factors

Vanua Levu is the second largest island of the Fiji group. It is approximately 110 miles long and has an average width of 20 miles. A chain of hills attaining a height of 2000 feet forms a backbone of the island. The hills lie across the flow of the prevailing SE trade winds so that on the windward side there is a high annual rainfall with an average of just under 100 in. (2.54 m.) on the coast increasing to about 200 in. inland. Seasonal variations are slight. On the leeward side of the island rainfall is less with an average of about 80 in. (2.03 m.) per annum along the coast, and seasonal variations are more conspicuous with a relatively dry period during the cooler months of the year.

The climatic differences between the two areas are reflected in the vegetation. On the windward side the area is heavily wooded and coconut plantations are common. On the leeward side hill forest rapidly gives way to extensive grassland and the cultivation of sugar cane. Mangrove swamps are more extensive along the northern shores than on the southern more steeply sloping coastline.

The island of Taveuni is smaller than Vanua Levu being 26 miles long and 6-7 miles wide. Although a high chain of hills runs down the middle of the island both sides are humid with high rainfall. Coconut plantations are extensive and the proportion of Fijians living outside villages is higher here than on Vanua Levu.

Koro island is situated to the south of Vanua Levu. It is smaller than Taveuni, but otherwise similar in its climate.

The Fijian* population for the most part lives in village communities. Villages have populations of about 100, and are relatively well kept. In recent years there has been an increasing tendency to break away from village life and for individuals to build their homes near their farms and in relative isolation. Such dwellings are referred to as settlements.

Infants are usually well clothed and kept indoors. From 2 years to 6 years of age, the children roam the village and surrounding areas, often very lightly clad. From 6 to 14 years of age most children attend school.

Adult men are engaged mainly in agricultural work and copra production. The women, when not engaged in their domestic duties, spend most of their time fishing on the reef. Most villages are close to the sea, but women even from inland villages will make frequent visits to the coast.

The dwellings of Indians are usually relatively scattered, although on some copra plantations there are quarters provided for the workers and their families. Most of the cultivation of sugar cane is undertaken by Indians and is concentrated

* The description Fijian or Indian applied to persons refers to their ethnic origin and has no significance in regard to citizenship or nationality. The majority of the population whether ethnically Fijian or Indian were born in Fiji.

on the north side of Vanua Levu. The dwellings are scattered around the cane fields.

In the copra-producing areas the Indian men are largely occupied on the plantations, and the women are mainly engaged in domestic duties. The women are well covered with clothing. In the sugar producing areas women frequently assist on the plantations. Boys and girls when not at school assist their fathers or mothers.

SURVEY METHODS

Two surveys are reported below. The first survey was made on Taveuni island, in southern Vanua Levu and on Koro island. It started early in 1968 and was completed in about 1 year. The second survey was in northern Vanua Levu and was undertaken in June 1969.

Selection of villages for survey for microfilaraemia

First survey. From the report on the census of the population 1966 (Zwart, 1968) was made a list of villages and census areas designated 'Remainder of area'. These were given serial numbers and then selected partly at random and partly by deliberate choice. Forty villages including census areas termed 'Remainder of area' were finally designated for survey. Thirty-seven had been selected at random and three by deliberate choice to cover areas otherwise very poorly represented. The population to be covered by blood examination represented about 15% of the total in the survey area.

Second survey. In northern Vanua Levu four inland and four coastal villages as well as four small offshore islands were selected for survey by deliberate choice. The inhabitants of these villages were nearly all Fijians. In addition some Indian children from sugar-cane growing areas were examined.

Operational procedures

A survey team of nine persons was formed. This team was responsible for the survey here reported, for an entomological survey, and for a census of the population preparatory to mass treatment. The procedure was to send one member ahead of the main team by 1 or 2 days to explain to the inhabitants of the village the aims of the work. He would then number all the houses in the village and prepare lists of all homeowners and occupants of the houses. The main team would arrive the following day and would see and examine by households all persons present.

Blood examination for microfilariae

The survey was conducted during daylight. As far as possible venous blood was collected from everyone but when this was not possible capillary blood was usually obtained, although on the offshore islands of northern Vanua Levu and for Indian school children in northern Vanua Levu only capillary blood was examined. Three thick smears each of 20 mm.³ blood were made, dried and later stained with

Giemsa stain. The smears were examined for microfilariae under a microscope, often a 'Visopan' projection microscope, and the number of microfilariae in each drop was recorded. If a smear was unsatisfactory, it was ignored and recorded as not examined. The arithmetic mean number of microfilariae per 20 mm.³ drop was the number taken for all analyses.

RESULTS

Survey coverage

First survey. The blood examination of two villages had to be ignored as the smears were spoiled by rain.

Of the total numbers of Fijians and Indians in the villages and areas selected for survey the percentages who were examined for microfilaraemia were 68 and 55 respectively. Losses from the desired 100% coverage were largely in the regions designated 'Remainder of area' and in the 0 to 4 year old age group. Coverage in the typical 'Fijian village' was over 80%. In these villages the losses were primarily due to temporary absence and rarely due to wilful refusal to be examined, since the co-operation of the people was excellent. Although temporary visitors to a village were examined, they were not recorded as inhabitants of the village; and, unless they happened to be permanent inhabitants of one of the other villages which were to be surveyed, their records would not have been analysed.

Second survey. The coverage of the Fijian villages was comparable to that of the first survey. The 256 Indian school children came from homes in and around Labasa.

Prevalence of microfilaraemia

An initial examination of the results indicated that there were differences in prevalence in the geographical areas of Taveuni and Koro, southern Vanua Levu, and northern Vanua Levu. The entomological work had shown that there were vector differences between villages situated one half mile or less from the sea and those situated further inland. Therefore data from villages situated in these two different areas were analysed separately. Data on persons living on estates or in settlements were first analysed separately, but here the results were similar to those of inland villages, although a high proportion of this population were living close to the sea. For Fijians the results derived from inhabitants of inland villages, settlements and estates have been combined. Since Indians do not live in villages, the results concerning them apply to settlements and estates only. In northern Vanua Levu there was little difference between the results from offshore islets and coastal villages. The results have been combined.

In Tables 1-3 are presented prevalences of microfilaraemia divided according to geographical region, race and sex, with subdivisions according to age, where justified. Also presented are the geometric mean counts of microfilariae per 20 mm.³ blood of positive cases. This figure is almost identical with the median count and will be referred to as the *Mf. D*₅₀. The standard deviation of the logarithm of the counts is expressed as the logarithm to the base 10. The reciprocal of this figure is equivalent to the factor 'b' described in the analytical procedures of the Expert Committee on Filariasis (W.H.O. Expert Committee, 1967).

Table 1. Prevalence of microfilaraemia in Fijian males, 1968-9

	Vanua Levu				
	Taveuni Koro	Southern coastal	Southern inland and settlements	Northern coastal and islets	Northern inland
No. of villages/districts ...	8	16	14	10	4
Age (yr.)					
0- < 5	77* (0)†	96 (0)	72 (0)	89 (0)	21 (5)
5- < 10	87 (13)	112 (1)	69 (0)	109 (1)	35 (3)
10- < 15	63 (19)	84 (6)	45 (4)	83 (7)	24 (4)
15- < 20	35 (29)	58 (16)	34 (9)	48 (6)	16 (0)
20- < 30	64 (53)	78 (35)	39 (21)	48 (12)	30 (3)
30- < 40	56 (41)	90 (46)	40 (28)	54 (18)	25 (12)
40- < 50	38 (32)	56 (46)	36 (25)	39 (28)	16 (25)
50- < 60	39 (46)	35 (40)	16 (28)	50 (28) }	19 (5)
≥ 60	24 (27)	27 (41)	15 (67)	26 (27) }	
All ages	483 (27)	636 (21)	366 (13)	549 (10)	186 (6)
Positive cases: G.M.‡	14	10	9	4	2
Log ₁₀ S.D.	0.627	0.633	0.640	0.606	0.704

* Number of individuals examined.

† Percentage of individuals showing microfilaria, 0.3 per 20 mm.³ of blood.

‡ G.M. = geometric mean of number of microfilariae in 20 mm.³ of blood.

Log₁₀ S.D. = standard deviation of log₁₀ of individual microfilarial counts.

Table 2. Prevalence of microfilaraemia in Fijian females, 1968-9

	Vanua Levu				
	Taveuni Koro	Southern coastal	Southern inland and settlements	Northern coastal and islets	Northern inland
No. of villages/districts ...	8	16	14	10	4
Age (yr.)					
0- < 5	71 (0)	112 (2)	73 (0)	63 (2)	21 (0)
5- < 10	93 (5)	114 (7)	49 (0)	97 (4)	32 (0)
10- < 15	64 (14)	92 (7)	42 (5)	66 (1)	23 (4)
15- < 20	36 (28)	49 (18)	30 (13)	50 (14)	15 (0)
20- < 30	70 (26)	108 (30)	75 (11)	62 (8)	30 (3)
30- < 40	52 (27)	85 (21)	66 (18)	68 (7)	34 (6)
40- < 50	41 (39)	56 (29)	37 (22)	52 (8)	19 (0)
50- < 60	21 (38)	41 (37)	19 (42)	30 (10) }	21 (10)
≥ 60	16 (38)	31 (42)	15 (47)	22 (14) }	
All ages	464 (19)	688 (17)	406 (12)	510 (6)	195 (3)
Positive cases: G.M.	5.5	4.1	4.4	3.4	1.0
Log ₁₀ S.D.	0.859	0.662	0.596	0.584	—

For explanation, see Table 1.

Infections in households

For the areas Taveuni and Koro islands, coastal southern Vanua Levu, and inland southern Vanua Levu, Fijian households were analysed according to the number of occupants and the number of these who showed microfilaraemia. Households of more than 10 were excluded. From the data obtained, a figure,

the mean infected proportion of the household, was derived by dividing the mean number of microfilaraemic individuals in a household of given occupancy by the number of these occupants. These figures are comparable between households of different sizes. The results are shown in Table 5.

Table 3. Prevalence of microfilaraemia and microfilarial density among Indians and 'other races' of all ages

Area	Race	Males			Females		
		No. ex.	% +	Mf. D. geom. mean	No. ex.	% +	Mf. D. geom. mean
Taveuni	Indian	130	11	26	141	14	9
S. Vanua	Indian	160	10	4	156	3	3
Levu	Other	104	18	4	100	10	4
N. Vanua	Indian	189	0	/	67	1	/
Levu	(Age 15-22)						

Table 4. Infection (a) and recovery (b) rates indicated by microfilaraemia among Fijians in three different epidemiological areas in northern Fiji and used to construct mathematical models

Sex		Area		
		Taveuni and Koro	Southern Coastal	Vanua Levu Inland
Both M. and F.	Infection rate	0.085	0.080	0.044
M.	Age	15+	15+	15+
	Recovery rate	0.100	0.110	0.119
	Asymptote of Mf. prevalence	0.46	0.42	0.27
F.	Age	7.5-40	7.5-40	10-40
	Recovery rate	0.230	0.240	0.231
	Asymptote of Mf. prevalence	0.27	0.25	0.16

Prevalence = $(1 - e^{-(a+b)t}) a / (a + b)$ where a = infection rate, b = recovery rate, t = years of exposure.

These proportions have been compared with those which might be expected if the infected individuals allowing for risk appropriate to age and sex were distributed at random among households.

The stochastic frequency of infected individuals in households was obtained by computer analysis employing Monte Carlo simulation and the observed probabilities of microfilaraemia pertaining to specific age/sex groups within the area under review. The 'expected' infected proportions of households are shown in Table 5.

In Table 6 are shown the observed and expected distributions of households containing a stated number of infected individuals.

The interpretation of these results will be presented in the discussion.

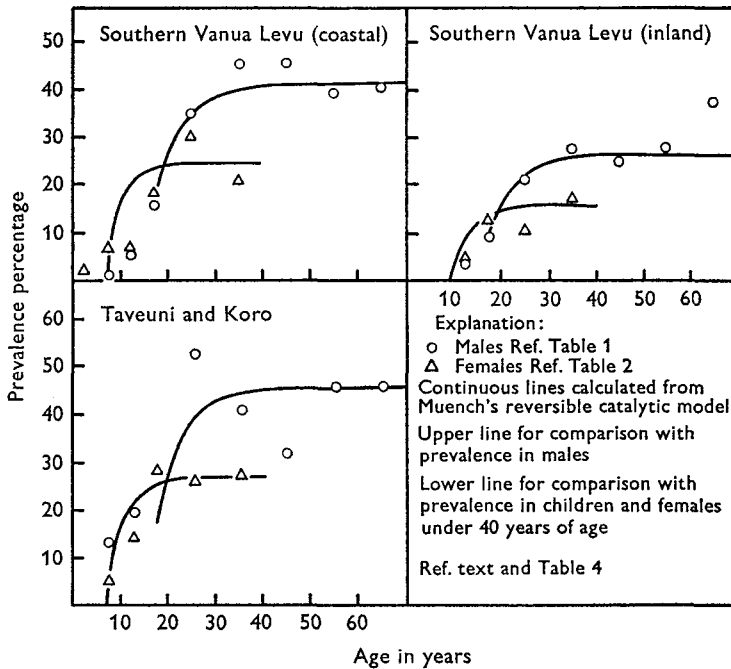


Fig. 1. Prevalence of microfilaraemia.

DISCUSSION

Stability of epidemiological pattern

The population examined, with the exception of those under 5, showed figures for race, sex and age distributions which were close enough to those of the 1966 census to show that no particular selection of individuals had been introduced into the survey.

Although the population of the area had shown considerable natural increase since the previous national census in 1956 (Zwart, 1968), neither immigration nor emigration had been marked.

Surveys for microfilaraemia were conducted in the past in the same areas as our surveys (Nelson & Cruickshank, 1955; Symes, 1960). Burnett (1960a) in reviewing these concluded that the epidemiology of filariasis had remained relatively stable for a considerable period. The results of our surveys did not contradict this opinion.

Epidemiological groupings associated with climate and local geography

Symes (1960) pointed out the differences between the prevalence of microfilaraemia among Fijians north of the main divide on Vanua Levu and the prevalence on the southern side. He also noted a lower prevalence in inland villages. The differences, confirmed and more closely defined by our survey, can be attributed to the climate which on the northern side is drier and has a longer season with low rainfall. Whether north or south of the main divide the difference between coastal

Table 5. Mean expected and observed numbers of microflaraemic individuals in households of different sizes expressed as proportions of the total number of occupants

Area		Number of occupants in the household									
		1	2	3	4	5	6	7	8	9	10
Taveuni and Koro	No. households	20	11	16	21	22	23	15	19	12	6
	P. obs.*	0.400	0.318	0.229	0.262	0.209	0.254	0.210	0.211	0.241	0.200
	P. exp.†	0.450	0.318	0.208	0.209	0.218	0.181	0.210	0.237	0.231	0.150
S. Vanua Levu, coastal	No. households	20	26	33	43	44	33	24	31	14	10
	P. obs.	0.400	0.308	0.232	0.209	0.191	0.126	0.155	0.157	0.111	0.150
	P. exp.	0.250	0.385	0.303	0.209	0.177	0.121	0.173	0.153	0.135	0.250
S. Vanua Levu, inland	No. households	11	13	14	13	9	12	17	2	8	4
	P. obs.	0.091	0.115	0.119	0.096	0.200	0.125	0.118	0.062	0.181	0.125
	P. exp.	0.091	0.231	0.095	0.115	0.111	0.153	0.168	0.062	0.152	0.100

* Proportion observed.

† Proportion expected from stochastic simulation.

and inland areas can be noted within a mile of the coast. The change is probably due to the decline away from the coast of the numbers of the mosquitoes of the species *Aë. polynesiensis* and their replacement by smaller numbers *Aë. pseudo-scutellaris*.

There appears to be little or no transmission among Indians living among the sugar plantations on northern Vanua Levu.

Table 6. *Percentage of total of households containing specified number of individuals with microfilaraemia*

Area	Total no. households		Percent total containing <i>n</i> infected individuals					χ^2 <i>P</i>
			<i>n</i> = 0	1	2	3	4	
Taveuni and Koro	165	O	35	32	17	11	5	< 0.01
		S	27	41	23	8	1	
S. Vanua Levu, coastal	278	O	39	43	11	6	1	< 0.01
		S	36	39	19	5	1	
S. Vanua Levu, inland	103	O	54	33	9	3	1	0.7
		S	52	33	11	3	1	

O = Observed number. S = Expected number from stochastic frequency.

Differences between ethnic groups

Different prevalences of microfilaraemia in distinct ethnic groups may be easy to demonstrate, but are usually difficult to evaluate owing to numerous and often ill-defined variations in the dress, habits, and customs of the groups. In our survey the prevalence of microfilaraemia was always higher among Fijians than among Indians living in similar geographical and climatic situations: even when the prevalences in the two ethnic groups living in settlements were compared, that among Fijian males was found to be slightly higher than among Indian males. Nevertheless, the fact that the maximum prevalence among Indian males was reached at a young age, the observation that elephantiasis among Indians was more prevalent than among Fijians (Mataika *et al.* 1971) and the report by Maguire *et al.* (1971) that the prevalence of dengue antibodies among Indian males was no less than among Fijian males under comparable circumstances suggest that the lower prevalence in Indians could be due to a higher recovery rate, a situation perhaps similar to that producing the differences between the two sexes in Fijians (see below).

Sex differences

Differences in prevalence between the sexes have been shown in most surveys on Bancroftian filariasis as well as in other filarial infections (McCarthy & Fitzgerald, 1955; Jachowski & Otto, 1955; Beye *et al.* 1963; Crosskey, Crosskey & Macnamara, 1959). These differences have been attributed usually to the different ways of life of the two sexes (McCarthy & Fitzgerald, 1956) although this view has been questioned in some instances. Jordan (1955) suggested that in East Africa women were less susceptible than men to Bancroftian filariasis, but did not

define what was meant by the term susceptible. Moreover, it is known that in experimental infections with some filariae in laboratory animals the female hosts have acquired infection less readily than males (Haley, 1958).

The most marked sex difference was shown in our surveys among Indians on southern Vanua Levu. The difference here may readily be attributed to the differing habits of the two sexes. The women are extensively covered by their clothes and they do not work appreciably in the plantations or farms. Their lower exposure to mosquito-borne disease is also demonstrated by the prevalence of dengue antibodies among them; it being 4% compared with 10% in males (Maguire *et al.* 1971).

Whereas it may be easy to explain the lower prevalence in Fijian women than in men by the greater coverage with clothes and their customs of either working within the village or fishing on the reef, this may not be the entire explanation. Women have acquired dengue antibodies at least as frequently as their men folk and presumably from the same species of mosquitoes as those transmitting filariae (Maguire *et al.* 1971). Rates of recovery from filarial infection which were higher in women than in men could result in the observed differences in prevalence of microfilaraemia.

Age differences

The general pattern of age prevalence parallels that of earlier surveys and of surveys elsewhere in the Pacific region. Microfilaraemia was virtually absent among those under 5 years of age. Between 5 and 15 years of age the incidence remained low. From 15 years of age the prevalence increased rapidly reaching a maximum in the 40+ year age groups. Hayashi (1962) and Hairston & Jachowski (1968), regarding the principles presented by Muench (1959), presented mathematical models to elucidate the picture. In agreement with the conclusions of Hairston & Jachowski, we found that Muench's reversible catalytic models were most similar to the observed data. Table 4 presents rates of acquiring infections and rates of recovery for Fijian males over 15 years old, used in deriving mathematical models which in Fig. 1 are compared with the observed data shown above in Tables 1 and 2.

The derivation of models comparable to the observed prevalence rates in females was not simple, since among females the observed data suggest a rise in prevalence after the age of 7.5 years followed by a plateau of prevalence between the ages of 17 and 40 years, whereafter a further rise may be indicated.

Such a plateau of prevalence among females aged 20–40 is not peculiar to our surveys and is discernable in the data of Jachowski & Otto (1955) in American Samoa, of Marshall & Yasukawa (1966) in the Ryukyu islands, and of Sasa, Mitsui & Sato, (1963) in the Amani islands. It is not evident, however, in surveys in Western Samoa nor in the Cook Islands (McCarthy & Fitzgerald, 1956; McCarthy, 1959). If it is assumed that the plateau in the 17–40 age group is a balance between the rate of acquiring infection and the rate of recovery, and that in females the rate of infection is the same as that in males, then recovery rates in females in this age group may be derived. Models have been constructed and are compared with the observed data in Fig. 1, for three areas of different risk of infection. Table 4

presents the parameters used in deriving these models. Nevertheless, it should be realized that, in making comparison between observed data or phenomena and the parameters of the models, the models indicate only average rates, and that there could be wide variations from these averages in individual experiences. Moreover, recovery rates should be related to the production of microfilariae and not necessarily to the average life of the filarial parasite.

Hairston & Jachowski (1968) on analysing their Samoan data have indicated that from their models they would not expect uniform recovery rates owing to clustering of infections. Our models suggest that although there may be clustering, a factor which certainly is not excluded, such clustering does not greatly affect mean recovery rates.

The point of origin of the curves for females is 7.5 years for the two areas, Taveuni/Koro, and coastal southern Vanua Levu. For inland southern Vanua Levu, however, the origin is at 10 years. This delay for the area of lower infection risk can be explained by the need for multiplicity of infections, probably about two, required to induce a recognizable microfilaraemia.

In northern Vanua Levu, among Fijians there appear to be both low rates of acquiring infection and very low rates of recovery. Nevertheless, in this area there is less information on the stability of the population or of the epidemiology, both of which factors might, if irregular, confuse the picture.

Infections in Fijian households in villages

Size of household

The investigation the results of which are shown in Table 5 was designed to determine to what extent transmission of filariasis was intrafamilial; the argument being that, if it were, large households, with a greater chance of one of their numbers introducing the disease, would show a higher prevalence of infection (microfilaraemia) than would small households. This was shown not to be the case, since the proportions of the total occupants in households who were observed to be infected were very close to those which could have been expected by chance in a random distribution of the population of similar age/sex composition and risk of infection.

The conclusion that transmission is not predominantly intrafamilial enhances the opinion that *Culex fatigans*, a peridomestic mosquito in Fiji, is relatively insignificant as a vector in this area, (Burnett, 1960*a*). These findings may be contrasted with those of Omori (1965) in areas where periodic nocturnal Bancroftian filariasis is prevalent.

Clustering of infected households

This investigation was to determine whether some households, irrespective of size, had more or less than their random share of infection. From Table 6 and in Fig. 2 it is seen that on Taveuni and Koro and in coastal villages of southern Vanua Levu, the spread of the observed distribution of households with specified numbers of infected individuals was greater than could be expected, indicating that some houses do have more than their random share of infections while others

go free. Although the differences between observed and expected numbers are statistically significant on Taveuni, and Koro, and in coastal villages of southern Vanua Levu, the differences are by no means large, and in inland villages are not statistically significant. The epidemiological import of the differences is probably slight.

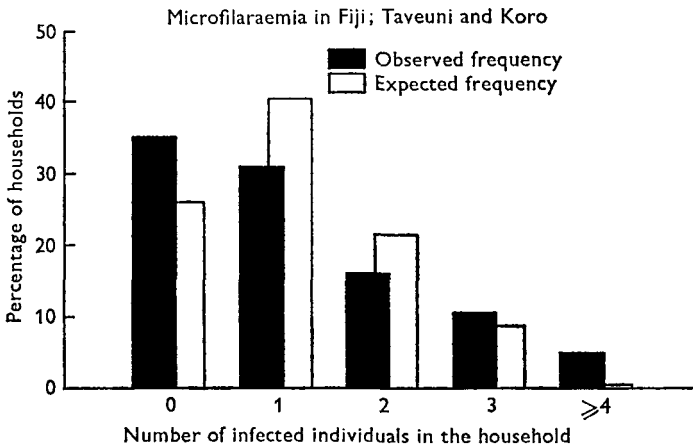


Fig. 2. Household infections.

Effects of housing density

Prevalences of microfilaraemia in Fijian settlements in southern Vanua Levu were lower than in coastal villages, and were so similar to those in inland villages that the results were combined in Tables 1 and 2. Nevertheless, a very high proportion of 'settlements' in southern Vanua Levu are close to the coast and similar in other respects to village houses, except for their degree of isolation. It may be concluded that the existing tendency to establish settlements is beneficial in regard to risk of exposure to filariasis of the inmates.

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