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Epidemiological/serological evaluation of tropical yaws following  
mass penicillin campaigns\*

(Thailand, Philippines, Nigeria)

by

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The present summary report is based on epidemiological/serological survey material from Thailand, Philippines and Nigeria and has been obtained in co-operation between national health administrations and the World Health Organization. The data have been collected by the WHO Treponematoses Epidemiological team (Dr G. Antal, Teamleader; Mr J. D'Costa, Serologist; Mr J. Maxwell, field administrator). Serum specimen collections have been examined at the WHO Serological Reference Centre, State Serum Institute, Copenhagen (Director: Dr H. Aa. Nielsen), and Institut Alfred Fournier, Paris (Director: Professor A. Vaisman). The data have been collated and analysed by WHO Headquarters, Geneva (Dr T. Guthe, Chief Medical Officer, VDT, Dr J. de Vries, Medical Officer VDT; Dr S. Christiansen, WHO Consultant VDT and HSM; Mr K. Uemura, Chief Statistician and Dr B. Grab, Statistician, HSM).

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## 1. OUTLOOK

Yaws is a treponemal disease of childhood, highly prevalent in rural tropical countries until 15 - 20 years ago. Its manifestations in later life include destructive and invalidating bone and joint lesions which develop in ten per cent. of the patients during the natural course of the untreated disease. In the last 15 years some 150 million people have been examined and some 43 million treated, as clinical cases, latents and contacts, with long-acting penicillin (procain penicillin G in oil and monostereate - FAM, or dibenzylethyldiamine penicillin - DEED) in WHO and UNICEF assisted yaws projects in 42 tropical countries. A remarkably rapid and extensive regression of overt clinical lesions takes place following community-wide application of long-acting penicillin. This is illustrated by data from Indonesia, Haiti, in South Pacific islands and elsewhere. An extensive review of the WHO endemic treponematoses programme in this context has recently been published (1) and details are available elsewhere (2, 3, 4, 5).

With infectious lesions being reduced from some 20 - 30 per cent. to a fraction of one per cent. in the community and with extensive interruption of transmission being evident, the need became apparent for undertaking epidemiological/serological evaluations in the surveillance of this disease, particularly since persistence of infection was also observed in many areas. To investigate prevailing immunological patterns in a disease with an unknown potential of recrudescence following mass application of penicillin seemed of particular interest. However, the use of serological methods is only possible on a limited scale in developing rural areas of tropical countries. Sampling techniques must therefore be used whereby the findings in patterned surveys are referable to the population. The technical orientation of WHO in the continued surveillance of yaws following mass penicillin campaigns has therefore been to provide assistance in the

epidemiological/serological evaluation of yaws campaigns and to appraise statistical, serological and survey methodology on the basis of data collected so far in Thailand, the Philippines and Eastern Nigeria by the Inter-regional Epidemiological Team (TET). A further study is under way in Northern Nigeria. Regional teams for similar purposes have been established in the Western Pacific and African Regions of WHO, undertaking not yet completed epidemiological/serological evaluation surveys in the Western and Mid West Regions of Nigeria,<sup>1</sup> In Togo<sup>2</sup> and in Western Samoa<sup>3</sup>.

## 2. SURVEYS

In these epidemiological/serological surveys the sampling units were divisions, districts, villages and clusters of households. A stratified survey design related to geographical location of villages, population density, prevalence of infectious yaws and treatment at previous surveys in the mass campaign, has been the basis for the samples investigated. Details of the designs are available elsewhere (6, 7, 8, 9, 10). According to the survey design the resulting clinically examined sample is made up of all members of the selected cluster of households and the serologically examined samples comprise all children and 20 per cent. adults (15 years and over). The number of sampling points, the populations examined etc. in the TET surveys are given in the following table:

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<sup>2</sup> Medical Officer, Dr F. Vorst; Serologist, Mrs Heinze

<sup>3</sup> Teamleader, Dr W. Fröhlich; Serologist, Dr P. Wang

Country	No. of sampling points	Clinically exam. popn.	Serologically exam. popn.		
			VDRL	FTA	TPI
Thailand 1960-62	40	38 000	19 000	640	640
Philippines 1962-63	37	17 000	9 000	2 320	700
E. Nigeria 1963-64	56	9 500	5 000	1 200	1 200
N. Nigeria 1965-	50	8 500	5 000	3 500	3 500

The data and serum collections obtained are utilised also in the surveillance studies of several conditions other than yaws. Serum aliquots have been deposited at the WHO Serum Reference Banks in Prague and New Haven. Multisubject exploitation of sera originating from several treponematoses projects<sup>1</sup> have thus been undertaken and are the subject of separate communications from the WHO Communicable Disease division. The epidemiological/serological treponematoses surveys have also become a vehicle for other approaches to epidemiological research. Thus, in co-operation with the WHO Virus programme, the malaria programme and Human Genetics programme, a study is made of sera from Northern Nigeria in regard to arboviruses, malaria, immunofluorescent antibodies and

<sup>1</sup>

The sera from Thailand originated from an additional survey supplementing the original epidemiological team survey.

immunohaematological factors<sup>1</sup>.

The epidemiological/serological evaluation of yaws as a "disappearing disease", as well as multisubject exploitation of random collections of sera from rural tropical countries, were envisaged by the WHO Scientific Group on Haematological studies (24), were encouraged by the Scientific Groups on Treponematoses Research (25) and of Immunology (26), as well as by the WHO Advisory Committee on Medical Research in 1960 (27).

## 2.1 Immunological aspects

2.1.1 "False" seroreactors: In treponematoses the advent of chemically defined cardiolipin-lecithin antigens and the subsequent establishment by WHO some years ago of international reference preparations for the cardiolipin and lecithin components, as well as for human reactive antisera, represented steps forward in obtaining a measure of uniformity in serological methods in this field. Experience has shown that, when properly used, reagents referable to these standards will give a relatively small number of so-called "biologically false positive" reactions (BFP) in European and American hospital patients and other selected populations. It was assumed initially that, within limits, cardiolipin antigens would also be suitable in studies of tropical yaws, although their use in the tropics had previously been confined mainly to selected case material of syphilis and yaws. These antigens had not been used in organised sample surveys in rural areas. However, evidence of the existence of a considerably higher number of reagin reactors than anticipated in tropical countries - and non-related to treponemal infection on the basis of treponemal immobilisation testing (TPI)- commenced to accumulate in syphilis studies from Ethiopia in 1960 (11), Morocco in 1961 (12) and in 1964 with FTA as the reference test also in

<sup>1</sup> These studies are undertaken in co-operation with the virus unit of the Laboratory of Epidemiology and Public Health, Yale University, New Haven, USA, the Nuffield Institute for Medical Research, London, and the International Reference Centre for Abnormal Haemoglobins, London.

Ethiopia (13). Applying for the first time TPI testing in proper sampling of rural populations, WHO made similar observations in yaws, beginning in Thailand in 1960. The findings in North-East Thailand on the basis of TPI results among a subsample of VDRL reactions are shown in the following summary table:

Age groups	VDRL Tested	VDRL Reactives		TPI Reactives	
		No.	%	No.	%
2 - 14	3945	732	18.6	205	7.2
15 yrs. & over	1089	384	35.3	302	33.3

The excess reagin reactivity by VDRL in children is brought out in this table as compared to TPI testing, computed on the basis of the examinations of 3945 VDRL tested sera with a subsample of 723 TPI tested.

These aspects are further illustrated by age distribution in the following table and in fig. 1, comprising 1184 sera from rural areas of Eastern Nigeria and examined comparatively for immobilising (TPI), fluorescent (FTA), complement fixing (CWMR) and flocculating antibodies (VDRL). The sera for TPI testing were drawn at random from a serological sample of 4389 sera, according to the survey design:

Tests Age in years	TPI			FTA			CWRM			VDRL		
	Tested	Reactive		Tested	Reactive		Tested	Reactive		Tested	Reactive	
		No.	%		No.	%		No.	%		No.	%
less than 5	168	18	10.7	181	18	9.9	173	4	2.3	167	34	20.4
6 - 10	436	75	17.2	454	50	11.0	416	24	5.8	433	109	22.8
11 - 14	162	59	36.4	165	51	30.9	157	21	13.4	155	58	37.4
Children	766	149	19.4	800	119	14.9	746	49	6.6	755	201	26.6
15 - 29	118	63	53.4	119	55	46.2	113	28	24.8	112	61	54.5
30 - 44	140	82	57.2	147	88	59.2	137	29	21.2	141	106	75.2
45 - 59	80	55	68.7	85	58	68.2	77	16	20.6	84	66	78.5
60 - v	30	18	60.0	33	20	60.6	30	4	13.3	31	23	74.2
Adults	368	218	59.2	384	221	57.6	357	77	21.6	368	256	69.6
Total sera	1134 <sup>a</sup>	367	32.7	1184	340	29.2	1103 <sup>b</sup>	26	11.4	1123 <sup>b</sup>	457	40.6

<sup>a</sup> The smaller number of TPI tests as compared to FTA arises from inconclusive readings, etc.

<sup>b</sup> The smaller number of CWRM and VDRL tests as compared to FTA and TPI arises from unreadability, not enough serum, etc.

Thus in these studies in rural tropical areas high reagin rates in cardiolipin lecithin flocculation tests were found as compared to immobilising antibody. Accepting immobilising antibody reactivity as near specific in treponemal infections the excessive reagin reactor rates may be due to cross-reactivity from other infections, infestations, vaccinations, etc. to nutritional or genetic conditions. The findings suggest the considerable limitations of lipoidal antigen testing for screening purposes in random populations of rural tropical areas. This does not imply that

cardiolipin tests (quantitative technique) are not useful in the diagnosis, management and control of individual clinical cases of yaws (and syphilis).

On the other hand, a strikingly low complement fixing antibody reactivity by the cardiolipin Wassermann reaction (CWRM) is observed from the table and fig. 1, a phenomenon possibly due to (i) small-aggregate particles characterising the antigen in complement fixation as contrasted to the giant antigen particles used in flocculation tests and reacting differently with serum, (ii) differences in test sensitivity in relation to stage and duration of disease, (iii) differences in reactivity patterns in yaws as compared to syphilis etc., aspects which are further considered in the detailed analysis of this type of material to be published later.

#### 2.1.2 Treponemal antigens, fluorescent and immobilising antibody:

No significant titre differences have been found in laboratory studies between T. pertenue strains when exposed to homologous (pertenue) and heterologous (syphilis) serum, and vice versa (14), based on immobilising antibody technique (TPI). Neither have laboratory studies using fluorescent treponemal antibody technique (FTA) with T. pallidum, respectively T. pertenue, so far shown significantly different results (15, 16). Pathogenic T. pallidum (Nichols) appears to be as sensitive to yaws antibodies as is T. pertenue and standard TPI testing based on pallidum antigen has been accepted as a specific reference procedure in epidemiological/serological surveys of yaws. Since significant correlation between the occurrence of immobilising and fluorescent antibodies in yaws has been found in tropical populations (figs. 1 and 2), the less complex FTA test can also be utilised in immunological studies of this condition. Studies based on gradually increased FTA samples of the population thus justified the determination of FTA reactor rates as an expression of yaws infection in the current Northern Nigerian survey. FTA testing is also gradually being introduced in the field and recommended for use in tropical countries.

2.1.3 Antibody deterioration and specimen transport: Flocculating antibodies (reagens) as determined by cardiolipin-lecithin tests (VDRL) deteriorate easily during tropical transport, under adverse temperature exposures and variations as contrasted to fluorescent and immobilising antibodies. Extensive studies have been undertaken of these problems: (a) Dried blood transport by mailing of blotting paper discs (rondelles) was found suitable for FTA testing of the eluent. This simple antibody preservation method, useful under field conditions, is based on finger prick blood without venipuncture (17, 18)<sup>1</sup>.

An example of a comparative study of rondelle eluent (FTAR<sub>100</sub>) and serum (FTAS<sub>100</sub>) in a random rural population from six sample points in Eastern Nigeria is illustrated in the following table:

FTAR <sub>100</sub>	FTAS <sub>100</sub>		TOTAL
	Reactive	Non-reactive	
Reactive	107	1	108
Non-reactive	7	303	310
Total	114	304	418

Concordance:  $\frac{\text{Reactivity } 410}{\text{Non-reactivity } 418} = 98 \text{ per cent.}$   
Co-positivity =  $107/114 = 93.8 \text{ per cent.}$   
Co-negativity =  $303/304 = 99.7 \text{ per cent.}$   
Prevalence of fluorescent treponemal antibody: 23.6-24.8 per cent.

1

Such absorbent paper procedures are available also for neutralisation tests in poliomyelitis etc., for haemagglutination inhibition testing in mumps, and lately for rubella (see 17 and 18).

(b) Deep freezing of sera in liquid nitrogen at minus 150-196°C was established as an optimal method for preservation and transport of specimen collections from the field to overseas laboratories. The details of this method have been described elsewhere (19, 20). Prior experience in transport of large serum collections from tropical countries to overseas laboratories had shown use of carbon-dioxide ice to be impractical and that "normal" shipping procedures from tropical rural areas often entailed risk of specimen infection and/or antibody decay. The latter was brought out particularly in a study in North-East Thailand (21) where a very wide range of time/temperature exposures and differing thermo-regimens were established and which affected the thermo-sensitive reagins but apparently not the fluorescent and immobilising antibodies. Subsequent laboratory experiments (22, 23) have confirmed this in regard to absolute temperature exposure as well as to temperature variations. The shipment of frozen serum collections by LR-10A-6 refrigerator transporters at minus 150-196°C in liquid nitrogen from tropical countries to overseas reference laboratories has increasingly been found to be a practical, efficient, safe and economical method to "bring the field into the laboratory" for immunological investigations of unaltered material. This procedure is gradually being used also in other working areas (e.g. parasitic diseases, bacterial diseases, diarrhoeal diseases and subsequently as part of the methodology in WHO Surveillance and Serum Reference Bank Programmes).

2.2 Epidemiological aspects

2.2.1 Clinical findings: In the sample populations examined clinically in the three completed surveys the following manifestations were found:

lesions	Thailand		Philippines		Eastern Nigeria	
	No.	%	No.	%	No.	%
Infectious Yaws	19	0.05	4	0.02	6	0.07
Other yaws* lesions	1886	-	417	-	1146	-
Total persons with yaws	1905	4.9	421	2.4	1152	13.5
Clin. popn.	38280		17000		8500	

\* Includes hyperkeratosis, gumma or gangosa, late bone lesions, juxta-articular nodes, sabre tibiae, depigmentations and scars.

Some observations as regards infectious yaws will be discussed briefly in the following: (a) In Thailand 15 of the infectious lesions and 143 of "other yaws lesions" were observed in Southern Thailand. Only four infectious and as much as 1743 of "other yaws" were diagnosed in North-East Thailand. All infectious cases were in children. (b) In the Philippines infectious and other active lesions in children in the islands of Samar and Cotabato pointed to the need for antiyaws measures in these areas, although the Philippines in general had been a low level prevalence area for a long time. (c) In Eastern Nigeria infectious yaws was diagnosed in four different village foci. The fact that they were found through a random cluster sampling procedure based on a small sampling fraction suggested that yaws may be more widespread than assumed, particularly in the Southern and South-Eastern part of Eastern Nigeria.

The clinical material collected in these three completed surveys - although comprising only a small number of infectious cases - confirms on the

one hand the results of the mass campaigns to the effect that infectious yaws has been reduced from 5 - 15 per cent. prevalence to a fraction of one per cent., but signals clearly on the other hand that transmission of infection has not ceased and that focal cases of infectious yaws continue to occur in children. The clinical findings above cannot, however, explain the extent of the yaws problem and the epidemiological characteristics of residual infection. This emphasises the need for epidemiological/serological evaluation.

2.2.2 Serological findings: In the natural course of yaws in endemic areas very few cases occur in the first year or two of life. The attack rate may reach its peak at 5 - 7 years depending on the endemicity level and ecological factors. In many areas of Thailand, the Philippines and Eastern Nigeria the initial treatment surveys commenced more than ten years before the present epidemiological/serological evaluations. Most of the children with recent yaws infection at the time when the mass campaigns started would now be 15 years old or more. The relatively small amounts of long-acting penicillin administered in the campaigns could not be expected to influence substantially sero-reactivity in yaws cases of long duration, a duration which would increase with increasing age. If the mass campaigns suppressed infectiousness completely in the young and interrupted transmission, the young age groups should now show little or no immunological evidence of infection. Those below 15 years of age must therefore hold our particular attention in the surveillance studies of yaws.

The age specific prevalence of treponemal antibodies (by FTA and TPI)

in the three completed surveys are summarised below:

Age	N.E. Thailand <sup>1</sup>	Philippines <sup>2</sup>	E. Nigeria <sup>3</sup>
1 - 15 yrs	11.5 %	3.5 %	13.2 %
Over 15 yrs	30.9 %	17.5 %	55.0 %

<sup>1</sup> Estimated prevalence on the basis of a TPI subsample of VDRL examined sera

<sup>2</sup> Estimated prevalence on the basis of a large FTA subsample confirmed by TPI test

<sup>3</sup> FTA prevalence confirmed by TPI test on a statistical subsample.

Thus also the serological findings confirm that infection with T. pertenue persists in the age group below 15 years of age many years after penicillin mass campaigns in rural tropical areas, and that transmission continues in the child population at a considerably higher level than incidental clinical cases would suggest. These aspects are considered in some further detail in the following: In table 1 and figs. 3 and 4 the age specific antibody pattern in North and South Thailand is illustrated by total VDRL seroreactors, sera titres of 8 dils, 16 dils and more. Partially reactive and low titre sera are particularly apt to be non-specific reactors in yaws, whereas it is rare for a serum reactive in dilutions e.g. 1:16 or more to be non-specific. The Thailand yaws surveillance study was the first of its kind and only very limited sub-sampling was part of the survey design for direct comparison of TPI results to age-specific reagin titre curves. In fig. 2 from the Philippines immunological profiles estimating flocculating (by dilution) fluorescent and immobilising antibodies can, however, be compared by age groups. The findings are compatible with the Thailand experience in regard to the level at which VDRL reactivity may possibly be considered as a meaningful expression of treponemal infection in the rural tropical community -

as contrasted to individuals without history or signs of yaws. In a previous table as well as in fig. 1 immunological age profiles e.g. on the basis of FTA testing from Eastern Nigeria were already illustrated on the basis of a random TPI subsample. In the following table a further FTA profile is compared to the age antibody patterns of complement fixation (CWRM) and flocculation (VDRL) covering all 3984 random sera examined in the FTA test. The pattern is similar to that in fig. 1. The table shows that considerable fluorescent antibody reactivity is present in children in the age groups 0 - 4, and 5 - 7 years, with a steep rise (almost double) towards the 8 - 10 and 11 - 14 years age groups.

Age Groups	FTA			CWRM			VDRL		
	Exam.	React.	%	Exam.	React.	%	Exam.	React.	%
0 - 4 years	802	61	7.6	765	21	2.7	760	166	21.8
5 - 7	821	72	8.8	867	54	6.2	989	277	28.0
8 - 10	737	120	16.3	692	75	10.8	725	233	32.1
11 - 14	625	141	22.6	599	77	12.8	620	253	40.5
15 - 27	324	147	45.4	305	80	26.2	313	176	56.3
30 - 44	360	211	58.6	237	81	34.2	349	256	73.4
45 - 59	214	122	57.0	216	43	19.9	219	173	79.0
60 +	100	66	66.0	87	17	19.5	93	73	78.6
Total	3983	940	23.8	3768	448	11.8	4068	1607	39.5
Children: 15	2985	394	13.2	2923	227	7.8	3094	929	30.9
Adults >15	998	576	55.0	845	221	26.2	974	678	69.6

The assessment of the outcome of mass campaigns depends on several factors taken into account in the survey design, including geography, population density, previous prevalence of infection, extent of treatment etc., aspects already briefly referred to but which are evaluated in extenso in reports under preparation. However, it is believed to be of some

interest in the present summary report to seek answers to some questions of particular interest<sup>1</sup>.

Was the sampling design adequate in relation to previous yaws prevalence to judge the outcome of the mass campaign and was yaws in fact distributed in different population groups as reported from the campaigns? Has a substantial reduction taken place in relation to strata of infectious lesions at that time?

It was already indicated that a measure of the outcome of mass campaigns by definition is the prevalence of FTA (and TPI) seroreactivity in children below 7 - 8 years of age. Seroreactivity in older children and adults implies acquisition of infection before that age. The following data from Eastern Nigeria shows correlations permitting an affirmative answer in regard to the yaws distribution in different population groups as reported by the mass campaigns.

Percentage infectious yaws found initially in mass campaign surveys	Percentage FTA sero-reactors in children 8 - 14 years	Percentage FTA sero-reactors in adults 15 years and over
1. 5% prevalence	56%	83%
2. 2 - 5% North East	59%	83%
3. 2 - 5% North West	12%	55%
4. 2% Resurveyed areas	14%	55%
5. 2% not resurveyed areas	6%	25%
6. No campaign, previously "no yaws"	1%	5%

<sup>1</sup> Special acknowledgement is made to Dr S. Christiansen, Scientific Adviser to the WHO Serological Reference Centre, State Serum Institute, Copenhagen for some of the considerations presented in this and other contexts.

The low rate in (3) North West is explained by the fact that the mass campaign started first there, 11 years prior to the epidemiological/serological survey and was persistent and intensive. All children treated between ages 1 - 7 would now be 10 - 17 years or over. Furthermore, accepting a peak attack rate at 5 - 7 years, nearly all children with recent infection at the time would be 15 years or more at the time of the present study.

The following material (also from Eastern Nigeria) permits an affirmative answer in regard to whether or not a substantial reduction of yaws has taken place in the populations where it was reported prevalent at the time of the mass campaign:

Percentage infectious yaws at the time of mass campaign	Percentage FTA seroreactors in children 1 - 7 years
1. 5% prevalence	7.6%
2. 2 - 5% North East	17.5%
3. 2 - 5% North West	3.0%
4. 2% resurveyed	5.6%
5. .2% not resurveyed	6.1%

Except for North East an acceptable reduction in the prevalence of recent yaws is considered to have taken place. FTA reactivity can, of course, not be directly equalled to infectious lesions. The early untreated yaws outbreaks of lesions last for a considerable time and lesions may subsequently disappear. Relapses are likely to occur one or more times. Infectious lesions found on inspection of a community represent therefore only a fraction of the number of early infections in the population. The FTA test will pick up close to all early infections present.

### 3. RELATIONSHIP BETWEEN YAWS AND SYPHILIS

Experimental research in humans has demonstrated a large measure of protective cross-immunity between yaws and syphilis (29). As a result of the penicillin mass campaigns against yaws the number of seronegatives in rural tropical populations has increased substantially as compared to 10 - 15 years ago. At the time seroprevalence below 15 years of age exceeded 50 - 60 per cent. in some areas, with only 40 - 50 per cent. of those reaching puberty being susceptible to infection with venereal syphilis. In the Philippines, Northern Thailand and Eastern Nigeria it was shown in the epidemiological/serological evaluation surveys that 3.5 per cent., 11.5 per cent. respectively 12.2 per cent. below 15 years of age were FTA seroreactive and that conversely some 96.5 per cent., 88.5 per cent. respectively 87.8 per cent. of those reaching puberty are now seronegative.

The relative protective cross-immunity from yaws possessed by the previous generation against venereal syphilis is thus present to a much lesser extent in the age groups now reaching puberty and an increasing large number of adolescents are thus susceptible to infection with T. pallidum at a time when urbanisation, migration, industrialisation, and rapid socio-economic and other ecological changes are taking place, aspects known to favour spread of venereal syphilis. In one tropical area, the occurrence of venereal syphilis in previous yaws regions has been reported. Health administrations may wish to consider these aspects in their future communicable disease planning, particularly in view of the manifest recrudescence of venereal syphilis in many developed countries already recognised (1).

### 4. MASS CAMPAIGNS AND GENERAL HEALTH SERVICES

With decreasing number of clinical yaws cases being found by mobile teams in the mass campaign in Thailand, trials to decentralise epidemiological vigilance as a function of growing rural health services were unsuccessful in 1956-58. Subsequent efforts became, however, the

basis for expanding assimilation of the surveillance activities by rural health services in 40 provinces based on training of personnel and focusing attention on the younger age groups through school programmes (28, 30). In the Philippines the mass campaign itself was from 1953 part of the activities of the rapidly expanding rural health services, supported by special anti-yaws teams. With the observed regression of yaws, only two such teams remained by 1962. In Eastern Nigeria advantage was taken by the widespread disappearance of yaws lesions in the early stages of the campaign for the creation of a number of rural health centres by popular support. At the same time gradual decentralisation of vigilance through local yaws and newly trained health scouts attached at the rural health service level took place.

In Thailand, the Philippines and Eastern Nigeria a number of other activities were undertaken as part of the mass campaigns or of the postcampaign activities. Thus in Thailand, 12 million smallpox vaccinations 250 000 anticholera vaccinations etc. were undertaken 1959-63, and in Eastern Nigeria more than a million smallpox vaccinations have, in the last few years, been undertaken in co operation with the yaws programme, on the structure of which much of the smallpox eradication programme is planned to go forward.

The yaws programmes in Thailand, the Philippines and Eastern Nigeria demonstrate the difficulties involved in the transfer of responsibilities for the terminal stage of mass campaigns to growing local health services. Continued and adequate vigilance in the community is required to diagnose and treat rapidly new cases (indigenous and imported cases, relapses), and contacts. Otherwise further outbreaks of the disease must be expected to occur. The recrudescence potential of yaws following community-wide application of long-acting penicillin in mass campaigns is likely to build up further with time if such vigilance is not exercised and general epidemiological services remain inadequate, from lack of

facilities, personnel and personnel training, and little or no improvement of environmental conditions (28).

5. SUMMARY

(i) The findings in epidemiological/serological surveillance of tropical yaws following mass penicillin campaigns against this treponematosi s of childhood in Thailand, Philippines and Eastern Nigeria are discussed on the basis of large scale clinical and immunological studies based on stratified random samples of the rural population.

(ii) A substantial reduction of the number of infectious cases to a fraction of one per cent. prevalence, as well as important decreases in the prevalence of infection - as measured by immunological tests (VDRL, WR, FTA, TPI) - is described following such campaigns. However, low level transmission of T. pertenue is shown to continue 10 years or so after the beginning of the campaigns, along with focal outbreaks of infectious yaws cases, mainly in children. The serological findings reinforce the outlook that much higher levels of infection prevail than can be estimated from incidental clinical cases diagnosed at rural health centres or reported to health services. Fluorescent treponemal antibody (FTA) seroreactor rates in children below 15 years of age were 3.5 per cent. in the Philippines, 11.5 per cent. in Thailand and 12.2 per cent. in Eastern Nigeria, it having been established that FTA reactivity is very close to treponemal immobilising antibody (TPI) reactivity, the latter being considered as a specific immunological test in yaws.

(iii) The epidemiological/serological evaluation of yaws following penicillin mass campaigns is emphasised as being of direct importance to health administrations (a) by indicating immediate action needed in the health programme when focal outbreaks of disease or high seroprevalence areas are recognised, (b) by providing knowledge to determine the nature and extent of the infection as a basis for emphasis needed in the surveillance of the infection and as part of the planning process in communicable

disease control and public health administration, (c) by furnishing valuable material in the study of "disappearing disease" and epidemiological methodology.

(iv) The advent in tropical countries - following mass penicillin campaigns - of a new generation now reaching puberty without the relative cross-immunity from yaws possessed by the previous generation against venereal syphilis is discussed. While only 40 - 50 per cent. of those over 15 years of age were susceptible to syphilis 10 - 15 years ago 96.5 per cent., 88.5 per cent. and 87.8 per cent. in rural Philippines, Thailand respectively Eastern Nigeria are now susceptible to infection with T. pallidum, an aspect which health administrations may wish to consider in future communicable disease control planning in view of prevailing urbanisation, migration, industrialisation and other ecological changes known to favour spread of venereal disease and in the light of the recognised general recrudescence of syphilis in many countries in recent years.

(v) Methods used for transport of dried blood specimens in absorbent paper (rondelles) and of deepfrozen serum specimens by liquid nitrogen refrigerators at minus 150 - 196°C are briefly reviewed in this summary report. The utilisation - in addition to immunological examination for yaws - of the serum collections from rural tropical areas for multisubject exploitation at WHO reference centres or laboratories collaborating with WHO in its virus, malaria, human genetics, serum reference bank and global surveillance programmes is described. Such information is of value to health administrations e.g. in the planning of surveillance of communicable diseases, in determining the need for, or extent of, vaccination programmes (e.g. poliomyelitis, measles) in gauging the nature and extent of preventive (e.g. streptococcal infections) measures etc. Immunological information of this type can obviously be obtained on the basis of sera from a wide variety of sources. The experience described in the present summary report on the utilisation of large scale serum collections based on stratified random sampling from rural tropical populations demonstrates, however, that multi-subject exploitation can usefully be organised in addition to the primary purpose of the epidemiological/serological activity.

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Epidemiological serological evaluation  
 Thailand, 1960-62. Clinical and serological  
 sample population. VDRL seroreactor rates, etc.

Southern Thailand

North East Thailand

Age	North East Thailand				Southern Thailand				
	Clinical exam. serol.exam.	% serol. tested	No. sero-reactive	% sero-reactive	Clinical exam.	Of these serol.exam.	% seroi. tested	No. sero-reactive	% sero-reactive
0 - 4	4036	67	348	12.9	2253	1197	53	85	7.1
5 - 7	2390	99	488	20.5	1559	1574	95	197	12.5
8 - 10	2145	99	586	27.5	1383	1359	98	230	16.9
11 - 14	2460	99	951	38.7	1496	1476	99	338	22.9
15 - 29	5330	19	588	56.8	3555	723	20	254	35.1
31 - 44	3538	20	446	64.5	2686	514	19	261	50.8
45 - 59	2016	21	322	77.1	1740	327	19	179	54.7
60 +	827	17	115	82.4	766	156	20	102	65.4
Total	22 742	56.8	3 844	32.6	15 538	7 326	47.2	1 546	22.5
Children under 15	11 031	87.5	2 373	24.6	6 791	5 606	82.5	850	15.2
Adults over 15	11 711	19.5	1 471	64.4	8 744	1 720	19.7	796	46.3

TABLE

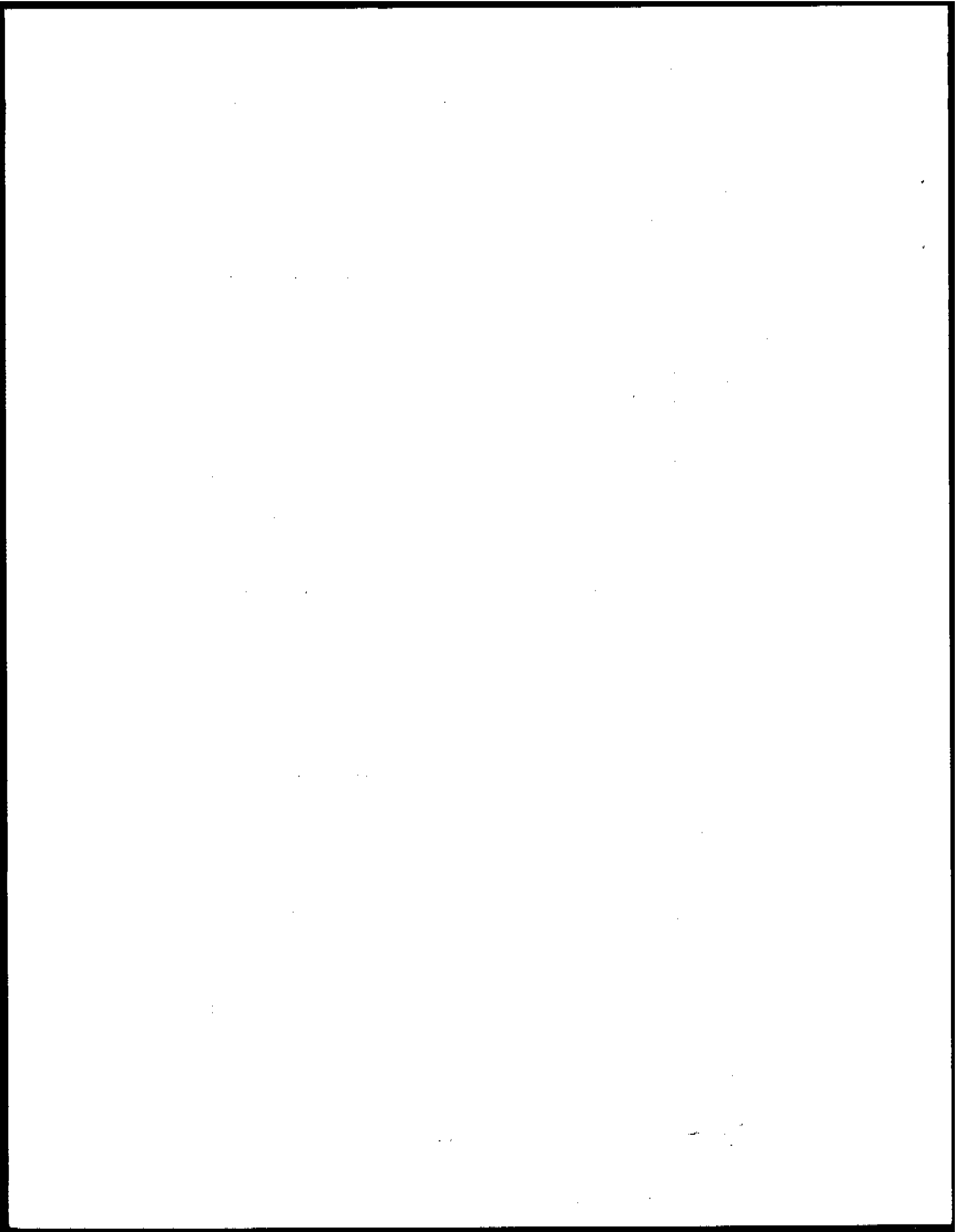


FIG. 1

SEROREACTORS BY AGE GROUPS IN 1134 RANDOM SAMPLE SERA EXAMINED BY THE TPI TEST.  
Eastern Nigeria epidemiological serological study of yaws. Several years after mass penicillin campaign

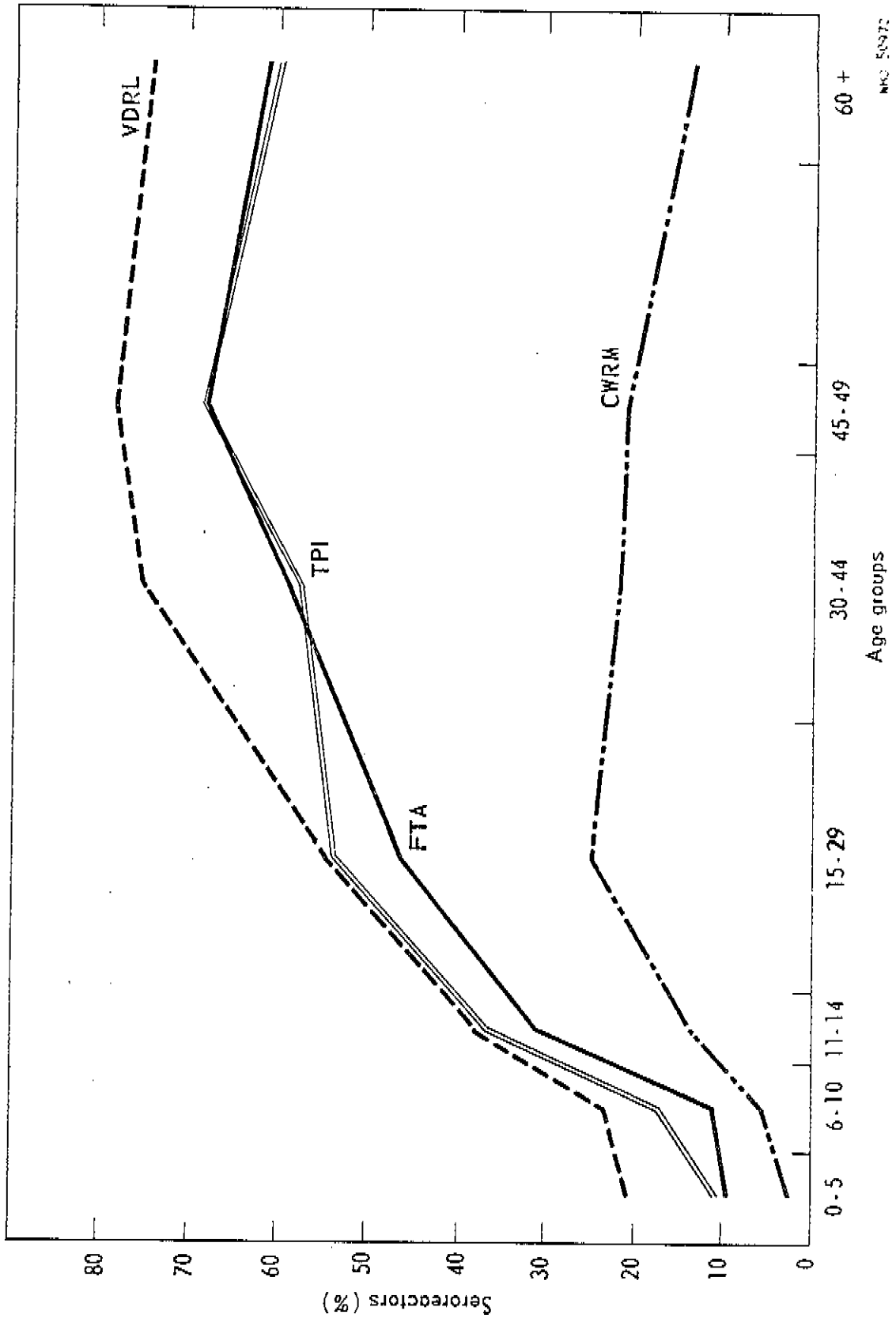


FIG. 2

EPIDEMIOLOGICAL SEROLOGICAL EVALUATION OF YAWS 10 YEARS AFTER MASS PENICILLIN CAMPAIGNS : PHILIPPINES

Prevalence patterns of reagin, fluorescent and immobilising antibodies based on 4447 random sera

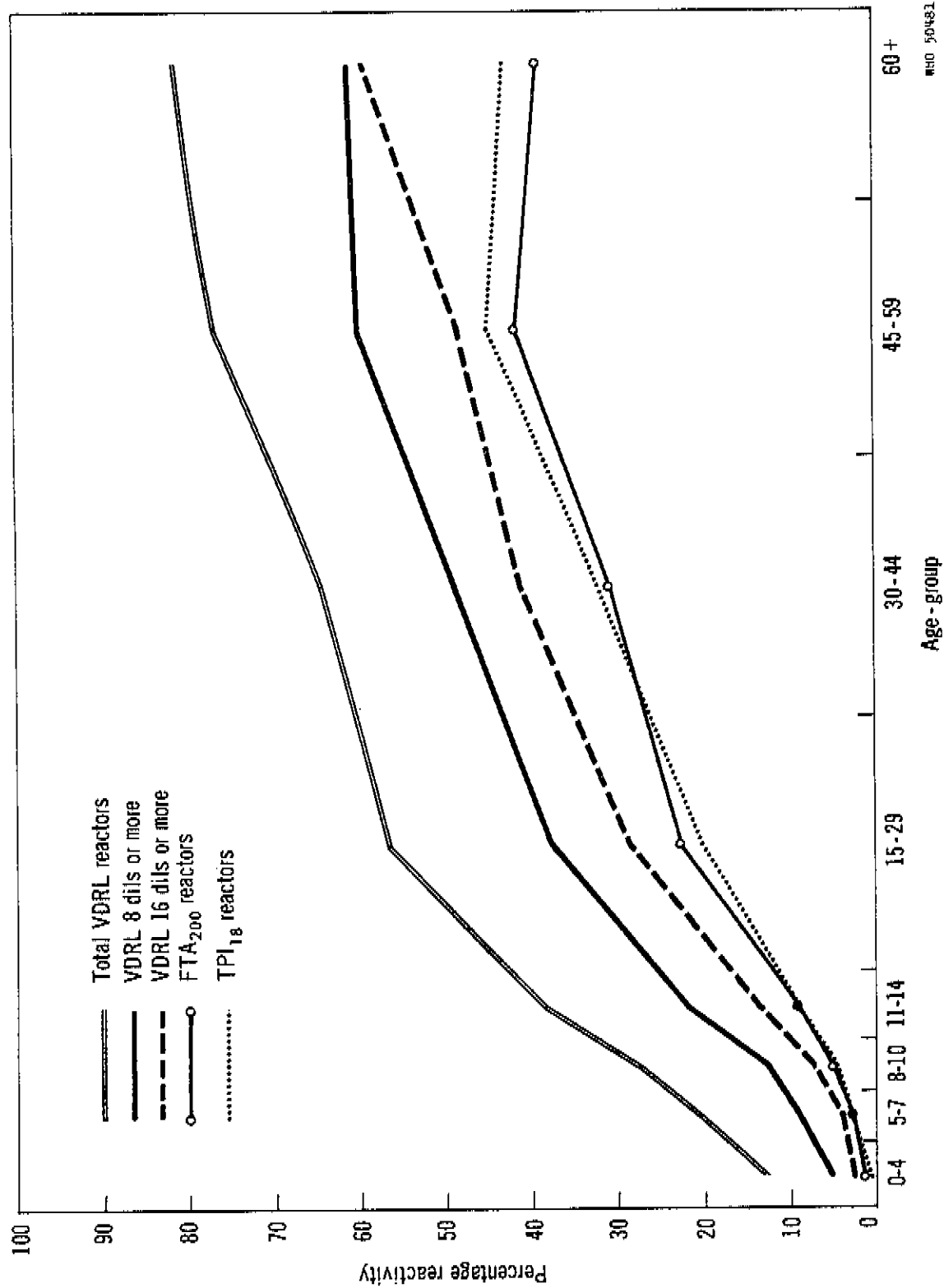


FIG. 3 SEROREACTOR RATES, VDRL  
NORTH EAST THAILAND (Survey 1-24)

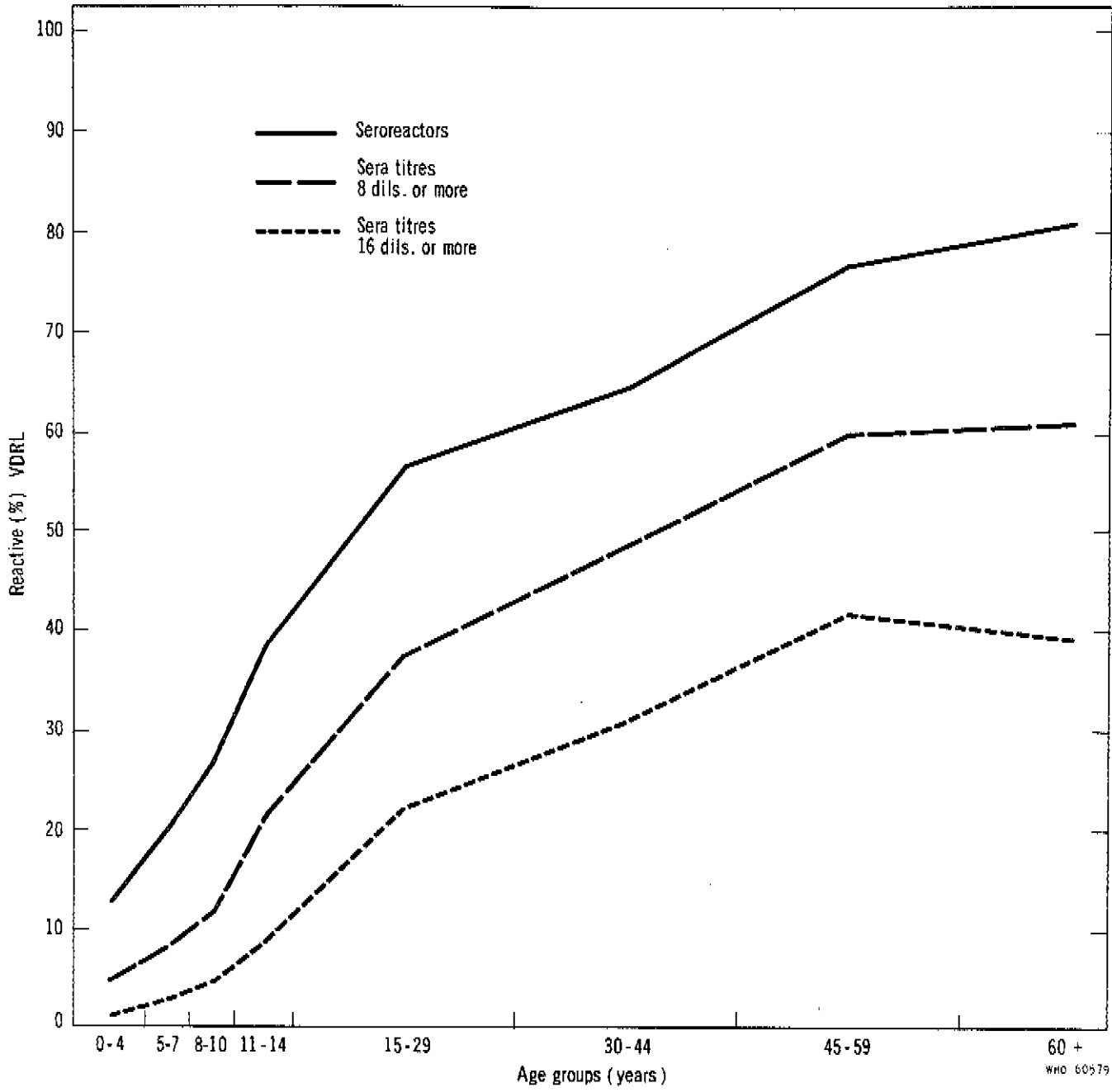


FIG. 4 TOTAL SURVEY POPULATION SEROL. TESTED - SOUTHERN THAILAND  
(1-16 Survey)

