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## EDITORIAL

# POSTGRADUATE MEDICAL EDUCATION IN MALAYSIA

ON 30th September 1978, Dr. Patrick A. Ongley, President of the China Medical Board of New York Inc., delivered the Third Tun Ismail Oration before the Academy of Medicine of Malaysia on the organizational responsibilities involved in the granting of postgraduate medical diplomas and degrees in Malaysia. As a leading cardiologist, physician and educationalist of international reputation who has the added advantage of being emotionally independent of the biases of vested interests in Malaysia, Dr. Ongley is able to objectively underline several critical features that are essential for the development of a needs-oriented postgraduate medical education programme for Malaysia. In the paragraphs that follow some of the highlights of his oration are quoted.

"One of the planning difficulties in developing countries is that small numbers of highly capable, highly motivated, and often highly articulate individuals, may, because of their personal drive and ambition, tend to develop semi-independent policies outside of the mainstream of government educational systems. Sometimes it is difficult for them to realize that their individual personalities and abilities may lead to the short-term success of their cause in spite of unsound, long-range planning, and that these unsound plans may cause great harm after they themselves are gone. It is important that these individuals participate in sound, thoughtful planning to develop systems which will survive after their time. This often requires considerable insight and submergence of personal drives and ambitions for the long-term benefit of the group."

### NEED FOR PREVENTIVE MEDICINE

"Throughout history more health benefits have been obtained from clean water supplies, sanitation

and improved nutrition than from general medical care. *Medicine has achieved its greatest benefits through immunization and the projected improvements in the health of our children are expected to come from improvements in the living circumstances of families and their children and not from individual medical care.* Canadians have shown that motor vehicle accidents, coronary heart disease, all other accidents, respiratory disease, lung cancer, and suicide, account for 50% of all years of life lost in Canada. Most of these respond best to health promotion measures designed to maintain health rather than to treat illness. The four major causes of death; namely, heart disease, cancer, stroke and accidents, are all highly influenced by physical and social environment."

### Physician's Function - Social and Preventive:

"During the past 50 years, Western-type, research-oriented medical schools have been highly successful in increasing knowledge and in understanding disease. This is the Flexner research model medical school which primarily develops cognitive skills. At the same time, some expensive technologies have been developed to treat disease and so there has been a great development of psychomotor skills. Nevertheless, this model has done little to prevent disease or to promote physical or mental well being and to address the social aspects of care. Only 1% of all medical graduates go into preventive medicine, occupational, or public health. The socioeconomic problems of health are complex and require that attention be paid not only to medical care for individual patients, but also to improvements in the environment by developing more healthful ways of living based on better education and the development of higher motivation towards health."

## POLITICAL DECISIONS

"While it would seem desirable that the medical profession should exercise a major control over the education and preparation of future physicians, nevertheless, the control of the functioning health care system has now assumed such political importance that the medical profession may well have lost its leadership role in medical education.

Since the government is the provider of most of the funds for medical education and health care, it must also assume a responsibility to ensure that these funds are spent wisely. *Instead of opposing the government, the medical profession should work with it so that planning will result from a careful analysis of needs, and appropriate judgments will be made for the benefit of the public.*"

## A NATIONAL ORGANIZATION FOR MEDICAL EDUCATION

"Malaysian medicine needs a National organization to which all qualified members of the healing arts and sciences belong. How it should be organized will require careful thought. This organization should control postgraduate and continuing education and issue appropriate degrees or diplomas. It must not be simply an examining body, although this will be one of its functions."

### Responsibilities of Examining Bodies:

"It is not sufficient, in 1978, for an examining body merely to decide who will or who will not pass a particular specialist examination and be admitted to an exclusive club or priesthood. Examining Boards today, and in the future, must include educators who can evaluate the content of examinations, the fairness of questions, the methods of examination, and they should also evaluate the quality of the examiners. Examiners should not simply be judges – they must be people who contribute significantly to the educational process, note strengths and deficiencies in the candidates, and communicate appropriate facts to the educational program directors. *Examiners must understand national needs and priorities; they must appreciate the limitations as well as the advantages of maintaining those "international standards" of which we hear so much – a primary purpose of which seems to be to allow doctors to move from one country to another without responsibility for the welfare of their own people. As noted by Dr. Ball at the 1977 Leeds Castle meeting at the Royal College of Physicians, the MRCP (UK) can be used as a loophole for economic or political refugees, or for the avoidance of carefully devised home training programmes which are found to be irksome. It encourages good*

young men to go overseas at a time when they could serve their country well in the course of their training and many of them never return."

### Responsibilities of the Postgraduate Board

*"Any Board established to deal with the issuance of postgraduate diplomas must concern itself primarily with national needs, and based on these needs the Board would consider:*

1. Training requirements, i.e., the curriculum.
2. Training programs, i.e., the quality of training.
3. Qualifications for admission to the training programs, i.e., the candidate's proved abilities.
4. Satisfactory progress of the graduate doctor until he has demonstrated an ability to justify his obtaining entry to the specialty group.
5. Methods of examination, including cognitive, psychomotor and attitudinal skills of the candidates.
6. Constant re-evaluation of the examiners and the examination methodology.
7. Certification.
8. Consideration for recognition of foreign specialist qualifications or for specific individuals with foreign credentials.
9. An overall coordination of all the above."

### Coordination Body:

"In Britain and in the United States, the principal boards of medicine, surgery and other specialties have grown closer and closer together in their respective countries, as it has been recognized in each country that a single coordinating body is essential. In the more recently developed and independent countries, this slow process of amalgamation can be avoided by an initial agreement in principle that there should be a national institution devoted to postgraduate medical education continuing medical education and medical care.

Those individuals wishing to adopt specific systems such as the British Royal Colleges, the American Specialty Boards or the Australasian College system should study the history of each of those systems and it will be seen that each was a product of its terms, established under specific educational, social and political systems and would certainly be modified if the opportunity arose to begin again. Since Malaysia has been influenced strongly by the British Colleges I would suggest *you read carefully the history of these colleges, see why they were established and why they do not try to introduce their system on other countries.*

When the Royal College of Physicians of London was formed on 23rd September 1518, there were universities on the continent and at Oxford and Cambridge but none in London. To raise the standard of medical practice and eliminate the many obvious charlatans practising medicine in those days a charter was applied for and granted by King Henry VIII."

### **Constituent Members of the National Organization**

"There must be a committee large enough to encompass the interests of government through the Ministries of Health and Education, the two medical schools, the membership of the Colleges of Surgery, Medicine, Obstetrics and Gynaecology, the College of General Practitioners, the Malaysian Academy of Medicine, the Malaysian Medical Association, and such other groups as the initial committee may consider advisable. Additional groups would include the basic sciences, the section on preventive medicine and public health, nursing, para-medical personnel, and such other specialist sections which may develop within the college. The number of representatives from each of these groups should not exceed two, and in many cases will be only one. The Board will form specialist committees for examinations and for other purposes as it sees fit. Each committee should have at least one representative from each of the medical schools, one from the Ministry of Health, one from a different specialty, and an equal total number from the particular specialty. This will ensure wide representation but will leave the practitioners of that particular specialty as its main controlling unit."

### **Sections**

"Within such an umbrella organization there should be sections for surgery, medicine, obstetrics and gynaecology, paediatrics, basic sciences, preventive medicine, public health and whatever specialties the coordinating council deems necessary. Also included should be sections or affiliates for nurses and for paramedical personnel. Some physicians and surgeons may not wish to include these two latter groups but since they will provide more health care than the doctors, it is imperative that

they be included and their education and their curriculum development should be an important responsibility of any doctor who considers himself an educator and who is interested in the health of the people."

### **Postgraduate Degrees**

"Obviously, this nation soon will conduct all of its postgraduate examinations. The University of Malaya has recently conducted educational programs and issued postgraduate degrees in psychological medicine, pathology, and preventive medicine. These degrees or diplomas could well be issued in conjunction with the specialty divisions of the National Organization.

Malaysia has recently opened a second medical school at the University of Kebangsaan and its teaching staff, students and facilities must be included equally with the University of Malaya, Faculty of Medicine, in any planning for postgraduate education."

### **NATIONAL PLANNING**

"Malaysia must determine its own needs in regard to doctors, nurses, nurse practitioners and other health professionals, and it must decide what it can afford financially, what it can attain intellectually and educationally, and what the public expects from the government and the health professions.

It is time for the government to decide just how many years of service each doctor must give to his country before he is permitted to go overseas. It should require that doctors pass the Malaysian specialty examinations before proceeding for further overseas training. *It should give priority to those holding Malaysian degrees and insist that those going overseas under government or university support learn to become expert in certain fields and not simply acquire more degrees.* A glance through the academic staff roll at the University will show that many, many people have two and three postgraduate degrees when all they required was one degree and, yet, the research productivity, whether clinical or basic, by the same individuals is quite limited."



# TREATMENT OF TUBAL OCCLUSION BY HYDROTUBATION

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TREATMENT OF tubal occlusion by hydro-tubation is a simple procedure that is gaining wider acceptance in infertility clinics. Preliminary report by the author, of the above technique at the 9th Malaysia Singapore Congress of Academy of Medicine in September 1974 in Kuala Lumpur (Thambu, 1974; Thambu, 1975) had shown that a study of 50 cases a pregnancy rate of 22 per cent was achieved. This prospective study is a continuation of that study.

## METHOD AND MATERIALS

The above study was carried out at the Department of Obstetrics and Gynaecology General Hospital, Malacca from August, 1973 to May 1976. The patients for the study were selected from the infertility clinics where the patients had been previously investigated for the following.

1. Examination under anaesthesia for genital tract abnormality.
2. Uterine size and uterine sound measurement for length of uterine cavity.
3. Diagnostic curettage for histology regarding ovulation.
4. Tubal insufflation for tubal patency.
5. Husbands semen analysis.

Hydrotubation is an outpatient office procedure with no patient preparation. No pre or post procedure sedation is used. The patient is placed in the dorsal position and after cleaning the vulva with Hibitane Solution, a cusco bivalve speculum is

introduced and the cervix visualised. Initially a volsellum was used to hold the cervix, but after the first 50 cases, no volsellum was used and the Leech Wilkinson was introduced directly. The solution used contains 20 cc of distilled water, 1 gram streptomycin, 25 to 100 mg hydrocortisone and 1 mega crystalline penicillin. The solution is injected slowly and pain resistance and spill of solution is noted. After the hydrotubation the patient returns home. The hydrotubation is carried out at weekly intervals.

## RESULTS

During the period of the prospective study a total of 280 cases with blocked fallopian tube received hydrotubation. However for this study 6 cases have been excluded because semen analysis of the husbands showed azospermia. A further 54 cases were excluded because of anovulatory cycles. Thus only 220 cases are presented for statistical analysis.

Table 1 shows that the majority of patients are in the age group 25 to 29 yrs. Table II shows that the majority in this study suffer from primary infertility. Table III shows that the majority have had 2 to 4 years of infertility before they came for investigations. Table IV shows that in 168 cases the tubes were blocked at tubal insufflation. Table V shows the pregnancy rates for the three groups. For tubal Co2 pressure of 100 to 150 there were 8 pregnancies for 28 cases giving pregnancy rate of 28.5 per cent. For 150 to 200 there were 9 pregnancies for 23 cases giving pregnancy rate of 39.1 per cent. For blocked tubes there were 46 pregnancies out of 169 cases giving a pregnancy rate of 27.2 per cent.

**Table I****Study population according to ethnicity and age**

Ethnic Group	Age in years					Total
	20-24	25-29	30-34	35-39	40+	
Malays	10	20	6	3	0	39
Chinese	20	80	36	16	1	153
Indian	5	13	7	2	1	28
	35	113	49	21	2	220

**Table II****Study population according to ethnicity and infertility**

Ethnic	Primary Infertility	Secondary Infertility	Total
Malays	23	16	39
Chinese	100	53	153
Indian	20	8	28
	143	77	220

**Table IV****Study population according to ethnicity and the tubal insufflation pressure when Co2 is passed**

Ethnic Group	Pressure when Co2 Passed		Fallopian Tubes Blocked	Total
	100-150	150-200		
Malays	5	6	28	39
Chinese	21	16	116	153
Indian	2	1	25	28
	28	23	169	220

**COMMENTS**

Fallopian tube occlusion as a cause of infertility accounts for 25 to 30 per cent of attendances at infertility clinics. The advent of laparoscopic visualisation of the ovary, fallopian tube and uterus, coupled with dye injection tests has been a great help in the investigation of infertility cases. But in centers where laproscopic diagnosis is not available or where there is delay in getting hysterosalpingogram, hydrotubation is a simple alternative in the diagnosis and management of cases of fallopian tube occlusion. Tubal occlusion is diagnosed by tubal

**Table III****Study population according to ethnicity and number of years of married or last pregnancy**

Ethnic Group	No. of years married or no. of years since last pregnancy						Total
	0-2	2-4	4-6	6-8	8-10	10+	
Malays	6	11	12	5	0	5	39
Chinese	29	69	27	19	3	6	153
Indian	7	6	4	5	3	3	28
	42	86	43	29	6	14	220

**Table V****Pregnancy rates according to insufflation pressure**

Tubal insufflation pressure	Number of Hydrotubations										Total no. of women	Total no. of resultant pregnancies
	1	2	3	4	5	6	7	8	9	10		
100-150	0	1	2	5	4	3	3	2	4	4	28	8 (28.5%)
150-200	1	1	2	3	3	3	4	2	2	3	24	9 (37.5%)
Blocked tubes	4	5	15	23	24	24	13	12	8	40	168	46 (27.3%)
Total	5	7	19	31	31	30	20	16	14	47	220	63 (28.6%)

**Table VI**  
**Pregnancy rates by the number of**  
**hydrotubations made**

No. of hydrotubations	No. of women	No. and % of resulting pregnancies
1	5	2 (40.0%)
2	7	3 (42.8%)
3	19	7 (36.8%)
4	31	10 (32.2%)
5	31	13 (41.9%)
6	30	7 (23.3%)
7	20	7 (35.0%)
8	16	5 (31.2%)
9	14	3 (21.4%)
10	47	6 (13.0%)
Total	220	63 (28.6%)

insufflation test and treatment by hydrotubation can be carried out as an office procedure by any doctor even in a busy gynaecology clinic. The technique is so simple that even the most junior doctor is able to do hydrotubation.

#### SUMMARY

In the above prospective study a total of 220 cases were given hydrotubations for tubal occlusion. These cases were followed up and 63 cases subsequently became pregnant, giving a pregnancy success rate of 28.6 per cent.

#### REFERENCES

- Johan Thambu (1974) Proceeding's of 9th Malaysia-Singapore Congress of Academy of Medicine 1974, Kuala Lumpur.
- Johan Thambu (1975) Treatment of tubal occlusion by hydrotubation, *Med. J. Malaysia* 30, 66-70.

# TRIGGER FINGER, A REPORT ON A SERIES OF CASES

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## INTRODUCTION

IT APPEARS to me that the trigger finger is not a rare condition at all. Since 1970 I had collected a series of twenty-nine cases. It seems worthwhile to make a report on the clinical data and response to treatment of the condition.

## ANATOMY AND PATHOLOGY

To understand the pathology of the trigger finger it would help to review the anatomy of the tendons of the digital flexors in the palm. In the wrist the tendons of the flexors digitorum superficialis and flexors digitorum profundus, together with the median nerve, form a rather tight bundle and pass through the carpal tunnel, which is formed by the strong fibrous band called the flexor retinaculum and the carpal bones. Coming out of the carpal tunnel into the palm, the tendons of the digital flexors spread out separately to lie in the five osseo-aponeurotic canals formed behind by the metacarpal and proximal phalangeal bones and by fibrous bands, the digital fibrous sheaths, which arch across the tendons anteriorly and are attached to the margins of the metacarpal and phalangeal bones and to the palmar ligaments of the metacarpophalangeal and the interphalangeal joints. Each of the five osseo-aponeurotic canals is lined by a synovial sheath which is reflected on to the contained tendons. It should be realised that the distal part of the palm actually contains a proximal part of the digits, that is, almost half of the proximal phalangeal bone is included in the palm. It is in this part of the palm, the distal part, that we find the pathology of the trigger finger.

In Bailey and Love's "Short Practice of Surgery" the trigger finger is described as a stenosing tenovaginitis of unknown aetiology. The sheath of a flexor tendon of the digit in the distal palm thickens, apparently spontaneously, so as to entrap the tendon. Pain and limitation of movement result. In spite of the constriction of the osseo-aponeurotic canal due to the thickening of the tendon sheath, the digital flexor muscles are sufficiently strong to continue forcing the tendon through the diminished gap in the canal. The flexor tendon as a consequence gradually develops a constriction under the tendon sheath and a bulge distal to it. Finally the flexor muscles may force the bulge through the sheath but the digital extensor muscles may be insufficiently powerful to extend the finger thereafter. The finger now snaps as it passes through the constriction and then gets locked in a position of flexion from which attempts passively to extend the finger are painful. The authors state that the trigger finger can be cured by dividing the appropriate sheath surgically.

In the "Current Surgical Diagnosis and Treatment" by Dunphy and Way, the pathology of the trigger finger, described as a stenosing tenosynovitis, is also said to lie in the pulley or tunnel of the digital flexor tendon in the distal palm, resulting in a disproportion between the clearance inside the tunnel and the diameter of the tendon. The smooth gliding movement of the tendon through the tunnel is impeded. The stenosis of the proximal digital flexor tunnel causes local tenderness and pain and frequent locking of the digit in flexion with a painful jog as it goes into extension, as the bulge in the flexor tendon passes through the tight pulley.



## CLINICAL HISTORY

The typical complaint is that the afflicted finger gets locked or jammed in a position of flexion and cannot be straightened spontaneously. It has to be pulled out of the locked position by the other hand with force. The rescuing action is painful and is accompanied by a clicking sound. There is also pain in flexion and extension of the finger, especially in the morning after waking, a feature which is common in rheumatic conditions such as osteoarthritis of the knee. A considerable degree of disability results because of the painful movements of the finger and its jamming. The pain sometimes radiates up to the upper arm and shoulder region. In order to keep the hand in a comfortable position the fingers are always kept in a flexed position. The condition may have lasted for a few days or for as long as a couple of months.

## CLINICAL FINDINGS

Examination of the afflicted finger reveals that it is being kept in a flexed position but shows no visible signs of inflammation such as redness, swelling, and immobility. Both passive and active movements of the finger are painful and resisted. The patient will volunteer to demonstrate the locking of the finger and then a click can be heard when it is passively straightened. The most constant sign that can be elicited is that when pressure is applied in the distal palm on the proximal phalangeal bone of the afflicted digit near but just beyond the metacarpophalangeal joint very severe tenderness will be experienced by the patient, so much so that he will immediately withdraw his hand from the pressure. The tenderness is well localised and confined to the small area overlying the proximal phalangeal bone of the digit. There is no tenderness when the pressure is applied to the metacarpophalangeal joint of the digit nor to the related metacarpal bone which lies in the middle part of the palm, nor to the distal segment of the proximal phalangeal bone of the digit that lies in the first part of the finger just as it arises from and beyond the distal palm. This very well localised and exquisite tenderness can be considered to be pathognomonic for the diagnosis of the trigger finger. The location of the clinical sign correlates well with the pathological findings described by the authors of the two books just quoted.

## SEX DISTRIBUTION

The present series of twenty-nine patients suffering from the trigger finger includes only those cases that had been treated and were available for followup. There were two male patients among them, showing that the female sex predominates by

93 per cent. I think there is a similar female predominance in other soft-tissue and joint rheumatic conditions.

## AGE DISTRIBUTION

In the age distribution there is predominance of cases who were above the age of 50, at 79.3 per cent. Only six patients were aged below 50, i.e., one was aged 35, one 36, two 40, one 41, and one 46. Among the 23 patients who were 50 years of age or over, sixteen were in the 50 to 59 age group, six in the 60 to 69 age group and one was aged 80.

## DISTRIBUTION OF THE AFFLICTED FINGER

It appears that the fingers of the left hand are as much affected as the fingers of the right hand. In the majority of cases (72 per cent) only one digit, either of the left or right hand, was afflicted. Seven patients presented with triggering of two digits, which were found in the same hand or in the other hand. One patient was afflicted in four digits, in both hands. The middle finger and the thumb are the most affected fingers. Thus the middle finger was involved in twenty times (twelve times in the right hand and eight in the left) while the thumb was involved eighteen times (eight times in the right hand and ten in the left). The least affected was the ring finger which was involved in five times (three times in the right hand and two in the left). No patient had ever presented so far whose index finger or the small finger was involved. The index and small fingers seem, curiously enough, to be immune to the disease.

## THE PRESENCE OF OTHER RHEUMATIC CONDITIONS

There is a high incidence of rheumatic conditions among the patients who suffer from the trigger finger. Fifteen of them, about 52 per cent, also complained of other rheumatic conditions. Five patients had the tennis elbow or epicondylitis, four had the frozen shoulder, four had the lumbago, three had osteo-arthritis of the knee, three had pain in the shoulder, two had the sciatica, two had pain in the hip, two had the plantar fasciitis or pain in the heel under the os calcis and one had the achilles tendinitis. Many of them seemed to, be suffering from multiple rheumatic ailments including the trigger finger.

## OTHER SIGNIFICANT CLINICAL DATA

In contrast to the high incidence of rheumatic conditions among the patients afflicted with the trigger finger, there was a low incidence of other clinical findings of significance among them. There were five patients who were mildly hypertensive, in the range from 150/100 to 170/100, and two who

were significantly hypertensive, in the range from 170/100 to 220/120. One patient was diabetic. None of them had albuminuria.

### TREATMENT

All the patients were given an injection of a mixture of one ml. of 2% xylocaine with adrenaline and one ml. of suspension of prednisolone acetate containing 25 mg. of the corticosteroid per ml. In hypertensive cases the 2% xylocaine solution without adrenaline was given. The mixture was well mixed in the syringe and injected through a fine needle deeply into the tender spot found in the distal palm on the proximal segment of the proximal phalangeal bone of the afflicted finger just beyond the metacarpo-phalangeal joint. The point of the needle should be made to hit the bone and then withdrawn a little bit (say one or two millimeters) to get it out of the periosteum. The injection was then made slowly. No attempt was made to hit the tendon or its sheath. The patient will experience some pain when the mixture is being introduced into the tissue but the pain soon disappears as soon as the local anaesthetic takes effect. The patient was instructed to come back for follow-up after two weeks. If more than one digit is involved the more severely afflicted one is treated first.

### RESULTS OF TREATMENT

The results of the treatment described in the previous section can best be analyzed by referring to the treated digit as a unit instead of the patient himself because a patient may have one or two or even three digits afflicted, all at the same time or at different times and the response to treatment of a particular digit may differ from that of another digit. Altogether thirty-nine digits were treated.

The follow-up period ranged from at least four months to eight years. Thirty-four digits received only one injection and five received repeated injections. Twenty-eight digits were completely cured after one injection without any recurrence. Six digits suffered a recurrence of the triggering but refused to have a repeat injection. Of the five digits that underwent repeat injection because of recurrence after the first injection, two got a complete cure without recurrence after receiving a second injection, one got a complete cure after receiving the third injection, but the remaining two had persistent recurrence of the triggering after having received an injection for the fifth time. The last two digits that did not respond to the treatment repeatedly were the right middle finger and left middle finger. Therefore a total of thirty-one digits obtained a satisfactory result from the treatment, i.e. 79.4 per cent. Apart from the initial pain experienced at the time of injection, none of the patients reported any side-effect or untoward reaction from the treatment, either locally at the injection site or systemically.

### SUMMARY

The trigger finger is not a rare condition and afflicts predominately the female in the menopause. Although a minor soft-tissue rheumatic condition it gives rise to considerable degree of pain and disability. It has the pathognomonic sign of severe and well-localised tenderness in the distal palm just beyond the metacarpo-phalangeal joint of the afflicted digit. An injection of a mixture of 2% xylocaine and suspension of prednisolone acetate introduced deeply into the tender spot was found to be an effective treatment.

# THE CARDIO-OESOPHAGEAL ANGLE – A QUANTITATIVE RADIOLOGICAL ASSESSMENT

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## INTRODUCTION

A MULTIPLICITY OF factors are believed to play a part in the prevention of gastro-oesophageal reflux. However, the actual mechanism is still uncertain. The diaphragmatic crura have been noted to provide an anti-reflux mechanism by narrowing the oesophageal hiatus by means of a "pinch-cock" mechanism. The right crus of the diaphragm splits to encircle the lower oesophagus, and reinforces the circularly-arranged muscle fibres in the oesophagus and the stomach, but others have recorded evidence against this view (Atkinson *et al.*, 1957a). Another factor of some importance is the phreno-oesophageal ligament, which is a condensation of extra-peritoneal connective tissue inserted into the supra-cardiac portion of the oesophagus. This "ligament" merges with the oesophageal musculature and helps to maintain the intra-abdominal position of the cardio-oesophageal junction. The mucosa of this junctional area exhibits folds and together with a hypothetical lower oesophageal sphincter could form a barrier against reflux, (Fyke *et al.*, 1956). The acute angle of entry of the oesophagus into the stomach, is now being recognised as being of major importance since it can provide a flap-like mechanism to resist gastric reflux. This study was designed to quantitate this angle in a representative sample of our patient population.

## MATERIALS AND METHODS

A prospective study was undertaken of one hundred patients undergoing Barium meal examination at the University Hospital, Kuala Lumpur, for some gastro-intestinal disorder. They were carefully screened to exclude patients with hiatus

hernia and those with symptoms of gastro-oesophageal reflux. An erect, antero-posterior radiograph was taken, and the cardio-oesophageal angle was measured by dropping a perpendicular line through the lower oesophagus, and a tangential line from the convex fundic area of the stomach which meets the oesophagus.

Of the one hundred cases studied, 16 were Malays (9 males, 7 females), 51 were Chinese (29 males, 22 females), and 33 were Indians (22 males, 11 females). This forms a rough cross-section of the total number of patients seen in the Radiology Department of our hospital.

## RESULTS

The total number of cases studied was 100 (60 males and 40 females). It was found that the mean (average) cardio-oesophageal angle was  $63.8^\circ$ , with a standard deviation of  $10.6^\circ$ , and a range ( $85^\circ - 33^\circ$ ) of  $52^\circ$  (Fig. 1).

The mean cardio-oesophageal angle amongst males and females was  $65.3^\circ$  and  $61.5^\circ$  respectively. Although the angle appears to be smaller in females, statistical analysis reveals that there is no significant difference in the cardio-oesophageal angle between males and females.

The mean cardio-oesophageal angle among the 16 Malays, 51 Chinese and 33 Indians examined were  $62.9^\circ$ ,  $64.0^\circ$  and  $63.9^\circ$  respectively. It is interesting to note that statistical analysis indicates that the cardio-oesophageal angle shows no significant difference in the three major racial groups in Malaysia. It would be worthwhile to pursue this

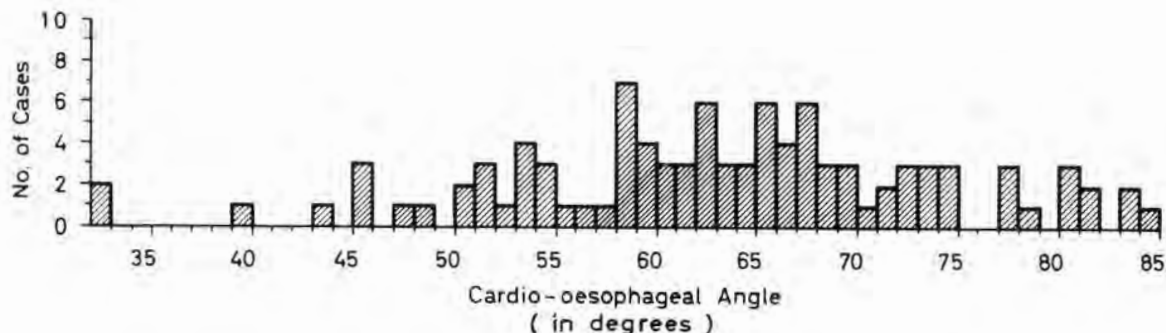


Fig. 1. Distribution of cardio-oesophageal angles in 100 cases examined radiologically.

matter further and relate the incidence of hiatus hernia in the various ethnic groups with the magnitude of this angle.

If the level of significance is set at  $p = 0.05$ , there is no significant difference in the cardio-oesophageal between Malay and Chinese males and females. However, it is found that a significant difference exists in the Indian population where the females tend to have a smaller angle when compared to males (Table 1).

## DISCUSSION

The problem of gastro-oesophageal reflux is one which continually faces the physician, though it is our impression that this problem is relatively rare in Malaysia. It was an attempt to define what constitute the normal cardio-oesophageal angle in our population, and in the two sexes, and various ethnic groups that prompted us to embark upon this study. The angle at which the oesophagus enters the stomach is known as the angle of His, and seems to be of great importance. The acuity of this angle could provide a flap-valve mechanism adapted to resist gastric reflux. There are variations

in this angle as seen in radiological examination, and our study showed that it could range from 33 degrees to 85 degrees. Where this angle is obtuse or non-existent, as in infants, and in some types of hiatus hernia, reflux commonly occurs.

However, it must never be forgotten that other factors may also play an important role in providing a barrier against reflux. The existence of a cardio-oesophageal sphincter has been a subject of considerable controversy. Though it has not been demonstrated anatomically, sufficient evidence has accumulated by means of radiology and manometric measurements to confirm the existence of a function sphincter in this area. It is felt that the sphincter maintains a higher pressure in the distal oesophagus than in the gastric fundus, provided that the distal oesophagus remains in an intra-abdominal position. Atkinson *et al.* (1957b) first noted the correlation of low sphincter pressure with gastric reflux, although other studies failed to demonstrate any relationship (Hammond and Daramen, 1962). Edwards (1967) believed that the anatomical disposition of the oesophagus at its passage through the diaphragm is of the nature of a flutter-valve which can be opened

Table 1

Mean cardio-oesophageal angle in the various ethnic groups by sex distribution

Malays n = 16		Statistical Analysis	Chinese n = 51		Statistical Analysis	Indians n = 33		Statistical Analysis
Males n = 9	Females n = 7		Males n = 29	Females n = 22		Males n = 22	Females n = 11	
61.1°	65.1°	t = 1.08 p > 0.1	65.6°	61.9°	t = 1.20 p > 0.1	66.6°	58.4°	t = 2.21 0.05 > p > 0.02



easily from above, but the flaps of which close with increase in intra-abdominal pressure. Other authors feel that the lower oesophageal sphincter plays an active part in maintaining a normal cardio-oesophageal angle.

Our study shows that the mean cardio-oesophageal angle is 63.8 degrees, and that there is no significant variation between males and females of Malay and Chinese origin. However, it is seen that this angle is significantly smaller in Indian females compared to Indian males. It would be interesting to see how our figures compare with studies from other centres. It is also suggested that the cardio-oesophageal angle be routinely measured at Barium meal examinations in radiographs taken in the antero-posterior position - a practice not usually undertaken at present. It is felt that a cardio-oesophageal angle which is obtuse or greater than ninety degrees would be more compatible with a diagnosis of gastro-oesophageal reflux than an angle which is acute. In the repair of hiatus hernia, associated with reflux, it would be appropriate for the surgeon to attempt to restore the acuity of this angle.

#### SUMMARY

The cardio-oesophageal angle was measured, from Barium meals, in a prospective study involving 100 subjects. The results were analysed to obtain the average angle in all subjects and in the two

sexes. Further analysis was done to measure the angle in the various ethnic groups in Malaysia, and also in the sexes of the ethnic groups. The average angle were found to be 63.8 degrees. No significant difference was noted in the cardio-oesophageal angle, between males and females, and between the major ethnic groups of Malays, Chinese and Indians. There was also no significant difference between males and females of Malay and Chinese origin, but a significant difference was noted between Indian males and females.

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# METHYL ALCOHOL POISONING

## A REPORT OF 20 CASES

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### INTRODUCTION

LITTLE WAS known about the toxicity of methyl alcohol until the turn of the century and it was reported as late as 1910 that many wines, whiskeys and brandies sold on New York East Side contained between 24 to 43% of methyl alcohol. In 1914 even Ehrlich used methyl alcohol as a solvent for Salvarsan and until Reif demonstrated in 1923 that a group of dock-workers in Hamburg had been poisoned by chemically pure methyl alcohol that the toxicity of wood alcohol was generally accepted as a fact.

Ingestion is not the only cause of morbidity. Brown (1911) described a case where a factory worker spilled a gallon of methanol down his trouser leg was dizzy the next day and woke up after a nap, totally blind. Inhalation also has its dangers.

Pure methanol is colourless and smells differently from ethanol with a specific gravity of 0.81 and boils at 65°C. The extreme variation in the dosage which causes death is one of the main reasons why methanol was only recognised as toxic since the beginning of this century. The ingestion of 4 litres of 40% methanol by six Russians caused only slight gastrointestinal irritation but no deaths or blindness. Wood and Buller pointed out that two teaspoon has caused blindness though Duke-Elder (1945) mentions blindness after only 4 millilitres. One report has 12 deaths in 200 cases and only 50 of the 200 became ill.

The remarkable variation in dose-toxicity has not yet been explained. This report is based on 20 cases admitted to Seremban General Hospital in

January 1977. Of these, 15 were very ill on admission and died within 24 hours of admission and had blood methanol levels of 65 mg.% to 180 mg.%. There were 5 survivors all of whom were admitted in a satisfactory condition.

### THE CASES

The youngest victim was 33 years of age and the oldest was 68. There were 15 males and 5 females and all of them were Indians including one Indian Moslem. Of those that died, the shortest time interval between admission and death was 20 minutes and the longest 24 hours. In those whom the blood was estimated for methanol the highest recorded was 180 mg.% and the lowest was 65 mg.%. In one of the survivors both ethanol and methanol were present in the blood.

### THE CLINICAL SIGNS AND SYMPTOMS IN GENERAL

In six cases no history was available at all either from the relatives or friends as they were comatose. In the 14 who gave history only 9 said that they had taken any alcoholic drinks prior to admission. Five patients denied taking alcohol. However, this is not unusual as alcohol drinking is frowned upon and denial frequent.

The commonest symptoms were blurring of vision, abdominal pain including back pain, vomiting and diarrhoea. Giddiness, headache and chest pain were not common even though one early case was diagnosed as myocardial infarct on the basis of his chest pain and cold and clammy extremities but the E.C.G. was normal. The presence of unspecified

aches and pains in most parts of the body including a severe abdominal and back pain which some observers attribute to pancreatitis is one of the features which these unfortunate victims present.

**Table I**

**Symptoms among the 14\* patients admitted for Methyl Alcohol poisoning**

Symptom	No. of patients with symptom
Giddiness	4
Blurring of vision	8
Vomitting and/or diarrhoea	10
Abdominal pain	7
Headache	3
Chest pain	3

\* 6 were comatose and no history was available.

Most of the patients were cold and clammy on admission even in those who later survived and this does not mean that they were in shock as other features like the pulse and blood pressure were within normal limits.

Those who admitted to alcohol imbibing claimed to have taken the alcohol at least the night before, some the day before (that is about 24 hours earlier). This latency in the toxic manifestations is one feature which points to the metabolic byproducts of methanol rather than methanol as the toxic agent.

In the study carried out by Chew *et al.* (1946) on 26 cases, the time between ingestion and onset of symptoms was from one to 40 hours.

Of the 14 patients who gave any history 8 patients had complaints of blurring of vision. Of 58 severely acidotic patients seen by Roe (1946), 45 complained of cloudy or diminished vision. Among 26 survivors reported by Chew *et al.* (1946) visual disturbance was a symptom in 15 but permanent impairment in the form of contracted fields or scotomata remained in only two patients. The five patients who survived in our series showed no permanent visual impairment. The development of visual disturbances in any person after a drinking bout should immediately arouse the suspicion that methanol has been ingested.

Methyl alcohol exerts a profound effect upon the central nervous system producing symptoms ranging from those of an ethanol "hangover" to convulsions or profound coma. Three of our patients had generalised fits and 6 were comatose.

Headache was a complaint in 62% of the 323 cases reported by Bennett *et al.* (1953) and dizziness in 30%. Headache and dizziness were present in 3 of our 14 patients who could give any history. Even though focal neurologic disturbances have been reported, we found no instance of these in our cases. Many reviews emphasised amnesia as a feature but we did not ask the patients about this and we are unable to give the incidence.

Even though Bennett *et al.* (1953) reports that constipation were common and actual emesis is rare, we noted that 10 of our 14 patients who gave history either had vomiting and diarrhoea or diarrhoea per se. Roe (1946) comments that vomiting often becomes persistent and violent and we agree with him.

Headache was present in 3 of 14 patients whereas abdominal pain sometimes very severe was present in 7 and chest pain in 5. In the series by Bennett *et al.* (1953), 67% had severe excruciating upper abdominal pain.

The association of Kussmaul respiration with acidosis is well known and this was noted in two patients. We did not have the opportunity to measure the bicarbonate level in our cases but Bennett *et al.* (1953) observed that dyspnoea is a poor indication of the severity of acidosis and that Kussmaul respiration were unusual even in patients with marked reductions of serum bicarbonate.

## PHYSICAL FINDINGS

As in the series by Bennett *et al.* (1953), we noted that the skin was cool with profuse perspiration and in the comatose patients, moist, clammy extremities suggested profound shock but generally cardiovascular functions were well-maintained until terminally. Kussmaul respiration was infrequent and only 25% of patients with plasma bicarbonate of less than 10 mg. had sighing respirations.

Dilated, poorly reactive pupils were present in most of our cases as in the other series. Ophthalmoscopic examination were done in only a few of our patients and there was hyperaemia of the optic disc and retinal oedema in six patients. Disc injection subsides after about 3 days and the swelling is peripapillary and spreads radially as grayish streaks throughout the retina. We did not have any case of blindness in our five survivors.

## CARDIOVASCULAR

The pulse rate was within normal limits in most patients and the blood pressure levels were within normal limits in all patients until terminally.

The description by Merritt and Brown (1941) is typical; "On arrival the patient was still in a state resembling shock. He was cyanotic and his extremities were cold. The systolic blood pressure was 160 mm of Mercury and the diastolic 100 mm."

### NEUROLOGIC SIGNS

Changes in the sensorium were frequent in the acidotic patients and confusion, amnesia, lethargy, stupor and deep coma are among the common neurologic disturbances. Thirteen of our patients were comatose on arrival. One of the early cases with vomiting, neck stiffness, Kussmaul respiration was diagnosed as encephalitis and a lumbar puncture done. The cerebro-spinal fluid was normal.

### MODE OF DEATH

Bennett *et al.* (1953) observed that the prime cause of death was a peculiar cessation of respiration. Coma deepened and respirations gradually become shallower and less frequent and despite clammy extremities there was normal blood pressure with full volume pulses. Manual artificial respiration, tracheostomy and endotracheal intubation were found ineffective by Bennett *et al.* (1953) when respiration ceased and seven of their patients admitted in coma and treated with alkali and supportive measures failed to recover consciousness and all died within three to seven days with signs of massive cerebral damage.

### TREATMENT

Massive alkalinization is the mainstay of treatment in methanol poisoning and Bennett *et al.* (1953) noted that even though seven of their severely acidotic patients died despite relief of acidosis, in every other instance in which plasma bicarbonate was restored to normal their patients survived.

In our series, patients were given 7.5% sodium bicarbonate by intermittent injections intravenously. Overtreatment with sodium bicarbonate may give rise to intense thirst and transient numbness and tingling of the fingers and lips.

### ETHYL ALCOHOL

Chew *et al.* (1946) administered whiskey to 26 patients in his series and all recovered. Agner *et al.* (1948) reported that in both their patients the blood methanol concentration remained relatively constant under the influence of ethyl alcohol. Bennett *et al.* (1953) administered ethyl alcohol to one patient and use only alkalinization as the mainstay of treatment. In this series we use a dilute 5 to 10% ethanol in conjunction with alkalinization.

Spinal drainage, injections of A.C.T.H. or B.A.L. were not found to have any value in the series by Bennett *et al.* (1953). A fair number of our cases had blood glucose determination and none were hypoglycaemic but intravenous glucose were administered in some patients without any effect.

### LAB FINDINGS

In the cases where the haemoglobin, electrolyte, blood urea and blood sugars were determined they were normal. However, as noted previously, we were unable to determine the carbon dioxide combining power.

The review of all electrocardiographic tracings showed that they were within normal limits in our cases.

### PATHOLOGY

No pathological findings were made available to this author. Reviewing the literature, we find that there are no pathognomonic lesions but variable cerebral oedema with meningeal and subarachnoid petechiae, congestion of lungs, epicardial haemorrhages, occasional mild fatty infiltration of the liver, gastritis and general congestion of the abdominal viscera. Bennett *et al.* (1953) also noted pancreatic necrosis in 13 of the 17 cases examined at necropsy and are of the opinion that the pancreatic damage was secondary to vascular injury and damage.

### THEORETICAL CONSIDERATION OF THE MECHANISM OF METHANOL POISONING

When methanol is ingested, it can persist for one week in the body with body distribution corresponding to that of water. High levels are attained in the humours of the eye, the cerebrospinal fluid and gastric secretions. Methyl alcohol is oxidized in the body at less than one-fifth the rate of ethyl alcohol with a small proportion excreted unchanged in the urine and a larger proportion lost in the expired air.

Oxidation of methanol proceeds to formic acid, probably via formaldehyde. Pohl showed in 1893 that wood alcohol ingestion increased urinary formic acid and various workers have confirmed this finding. Bartlett (1950) found that the rate of destruction of methanol labelled with C<sup>14</sup> was 25 mgm per kilo of rat per hour as contrasted with 175 mgm of ethanol per kilo per hour. Within 48 hours, about 86 per cent of the administered dose was recovered, 65 per cent as carbon dioxide in expired air, 14 per cent as methanol in expired air, 3 per cent as formic acid in urine and 4 per cent fixed in the tissues.



It has been shown that if ethanol and methanol are injected simultaneously into rabbits, the concentration of methanol in the blood remains almost unchanged until the ethanol has been oxidized. It has also been demonstrated that alcohol dehydrogenase is able to oxidize methanol at one-ninth of the rate for ethanol and ethanol in equimolar concentration completely inhibits the oxidation of methanol and there is increased urinary methanol when volunteers are given ethanol and methanol.

Using C<sup>14</sup> labelled methanol in rats, Bartlett (1950), showed that ethyl alcohol produced a striking depression of the oxidation of methanol in the intact animal as well as in isolated liver slices. This has formed the basis of treatment in human beings.

The acidosis produced by methyl alcohol is very severe and in the Atlanta outbreak there were 30 patients with plasma bicarbonate below 10 m Eq. and in 4 patients the plasma CO<sub>2</sub> combining power by the Van Slyke and Neil method (1924) was zero. The mechanism of acidosis is not clear and formic acid only accounts for a fraction of the acidosis. Other organic acids like lactic acid were demonstrated in the urine and blood of methanol poisoned patients. Van Slyke and Neil (1924) noted increased urinary excretion of lactic as well as formic acid in a patient but most of the urinary acids were unidentified. Ketosis has been suggested as playing a role in the acidosis and in the Atlanta cases, of 43 patients tested, acetonuria was present in 10 cases.

We would like to conclude our article with a few comments which the author himself cannot elucidate:

(a) This is the third time an epidemic of methanol poisoning has occurred in Seremban whereas moonshine liquor can be found throughout Peninsular Malaysia.

- (b) There must have been sporadic cases of methanol poisoning which are missed and in fact the author is of the opinion that had only two or three cases been admitted the diagnosis would not have been made.
- (c) Methanol is added to give a better "kick" but why should only drinkers in Negri Sembilan be involved most of the time?

#### ACKNOWLEDGEMENTS

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# SUSPECTED CONTAMINATED MARGOSA OIL POISONING

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## INTRODUCTION

MARGOSA OIL, an extract from the seed of the Indian neem tree *Azadirachta indica* is a yellow offensive oil with a bitter taste. It is occasionally used by the Indians as a general household remedy. Although large doses can cause nausea and diarrhoea, other side effects have so far not been reported.

Four infants admitted within a period of one month to the University Hospital, Kuala Lumpur with convulsions following the ingestion of commercial margosa oil form the basis of this report. The

main features of the patients are summarised in Table I.

All four infants were Indians living in Kuala Lumpur. There were 2 males and 2 females, whose ages ranged from 3 to 8 months. The infants were given 5 to 30 ml of margosa oil. The indications were constipation in one case and mild cough in the others. All 4 infants had been otherwise healthy. All of them developed severe tonic clonic convulsions within 2 hours of ingesting the oil and were admitted to the University Hospital.

**Table I**  
**Summary of cases admitted**

Patient	1	2	3	4
Age (mths)	5	8	3	4
Sex	Female	Female	Male	Male
Chief complaint	Convulsions	Convulsions	Convulsions	Convulsions
Amount of oil ingested	2 tablespoon	2 tablespoon	2 teaspoon	1 teaspoon
Time interval from ingestion to fits (hr)	2 hours	2 hours	2 hours	2 hours
Management	sedation *IPPR in †ICU	sedation intubation †ICU	sedation intubation †ICU	observation
Recovery	complete	complete	complete	complete
Duration of hospitalization (days)	9	28	4	4

\*IPPR - intermittent positive pressure respiration.  
†ICU - Intensive Care Unit.

The 1st case who received the largest dose of margosa oil (30 ml) had severe intractable convulsions which did not respond to intravenous valium and dilantin. She had respiratory depression with respiratory acidosis which required ventilatory support with an intermittent positive pressure respirator. Convulsions in the 2nd and 3rd cases responded to intravenous valium. However both infants had copious pharyngeal secretions and needed intubation for airway protection. The 4th case also had convulsions which had been controlled by a general practitioner with intramuscular paraldehyde. This patient did not require intensive care, and was discharged after a few days of observation. Case 2 and 3 had been given margosa oil on previous occasions using different samples, without any harmful effects. All four infants recovered completely.

## INVESTIGATIONS

The investigations carried out in the four patients are summarised in Table II. Apart from severe respiratory acidosis in case 1, and mild leuco-

cytosis in all 4 cases, no other abnormalities were detected.

## Toxicity Tests

Margosa oil obtained from various shops in Kuala Lumpur as well as the samples used by the patients were tested for toxicity in mice. The studies have revealed the presence of a toxic component. Further investigations are in progress to identify the toxin.

## DISCUSSION

Although margosa oil has been in use for generations in Indian households, convulsions have so far not been reported. All the cases reported here have been infants. It may be possible that the dose given to the infants may have been excessive in relation to their size, as compared with that of adults. Two of the infants had been given the oil on previous occasion with no ill effects suggesting that the previous stocks had been either completely

Table II  
Results of investigations on admission

Case	1	2	3	4
Haemoglobin gm/dl	10	13.1	8.2	12.7
Total White Count per cumm	21,000	17,100	18,200	15,400
Differential Count (%)	N 67 L 29 M 4	N 82 L 13 M 3 E 2	N 32 L 67 M 1	N 65 L 34 M 1
Blood Sugar mg%	68	280	39	73
Blood Urea mg%	20	26	35	16
Serum Na mE/L	142	136	144	146
Serum K mE/L	5.2	5.1	4.0	5.2
Serum CL mE/L	101	92	97	108
SGOT IU/L	36	24	60	Insufficient
SGPT IU/L	Insufficient	Insufficient	20	Insufficient
Serum Alkaline Phosphatase IU/L	112	Insufficient	180	180
pH	6.99	7.41	7.44	
pCO <sub>2</sub> (mmHg)	78	35	36	Not done
Base Excess (mE/L)	-9.0	-1.5	+0.5	
Blood Bicarbonate mE/L	17.5	22	24.5	
pO <sub>2</sub> (mmHg)	159	71	123	
Cerebro spinal fluid	Not done	Normal	Normal	Normal

free of toxins or contained less toxins than the batch of oil under investigation.

Margosa oil is manufactured in India, imported in metal drums and repacked locally into cans and bottles. Hence there are many sources of possible contamination. A definite answer awaits the identification of toxins.

#### **SUMMARY**

Four infants with suspected contaminated margosa oil poisoning and presenting with convulsions are reported. Toxicity studies reveal that the oil is toxic to mice. The identity of the toxin is in the process of being established.

#### **ACKNOWLEDGEMENTS**

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# THE USE OF OPERATIONS RESEARCH IN HEALTH

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## INTRODUCTION

OPERATIONAL RESEARCH (O.R.) techniques seem to have gained popularity in the field of health practice research for the past ten years and the health field has also begun its parallel development of O.R. and its application to complex problem of coordination and control. Health practice research has been defined by Grundy and Reinke (1973) as the formalized investigation of some aspects of the organisation and administration of health services in relation to objectives and socio-economic circumstances with the objective of achieving optimal use of a system for the delivery of health care services.

## WHAT IS OPERATIONS RESEARCH?

To a lot of people, O.R. simply means "A scientific technique whose purpose is to improve efficiency that has been well-defined". Ackoff and Sasieni (1968) stressed that the definition of O.R. ought to cover the following essential characteristics:-

1. It is system-oriented. The essence of it lies in the systematic research for significant interaction in evaluating actions or policies of any part of the organisation.
2. It uses an interdisciplinary team to subject the team's work to critical review from the widest variety of these disciplines that are not represented on the team.
3. It applies scientific method to problems of control. In other words, the researcher constructs representations of the system and its operations (model) on which he conducts his research. Once

the model has been constructed, it can then be used to find the optimal values of the controlled variables i.e. we can derive a solution to the problem from the model. A solution can be extracted from a model either by conducting experiment on it, i.e. by simulation or by mathematical analysis.

Therefore basically O.R. is a discipline that helps a decision-maker to decide which course of actions will yield the best measure of effectiveness. O.R. is not only concerned with how to make the best decisions but is also concerned with every facet of the decision-making process from actually defining the problem to determining what the best decision really is.

## HEALTH PROBLEMS

Though there is no hard and fast rule in classifying problems in the realm of O.R., Ackoff and Rivett (1963) have suggested that many of the problems seem to fall in a classification similar to the eight areas listed below:-

- |                |                  |
|----------------|------------------|
| 1. Allocation  | 2. Waiting lines |
| 3. Scheduling  | 4. Inventory     |
| 5. Competition | 6. Replacement   |
| 7. Search      | 8. Sequencing.   |

As an illustration on the application to health practice research, two examples, one on linear programming, and another on transportation technique are given. The application mentioned merely helps to demonstrate where and how can some of the techniques be applied.

## RESOURCE ALLOCATION AS AN EXAMPLE

This is part of resource allocation decision, dealing with the problem of determining the most efficient way to use resources to accomplish objectives. There are three elements which must be incorporated:-

- Specification of an objective function
- Alternative ways to accomplish the objective
- Constraints on the decision

When confronted with a problem of this type, the decision-maker must seek the optimal solution i.e. the solution which maximizes the result that can be produced with a given set of resources or minimizes the resources that must be used to produce a given result.

In fact, in the case of linear programming problems, the most difficult aspect of this technique is in the specification of the objective function which can be expressed in terms of a set of decision variables, and finally the constraints that limit the acceptable value of the decision variables.

Supposing a health planner wishes to determine the maximum number of health centres to be constructed during some period of time, given fixed health resources, and that there are four types of health centres:-

- $X_1$  Main Health Centre (MHC)
- $X_2$  Health Sub Centre (HSC)
- $X_3$  Maternal and Child Health Centre (MCHC)
- $X_4$  Midwife Clinic Cum Quarter (MCQ)

The decision-makers have to determine the optimal number of each type of centres to be built and  $X_s$  are the decision variables.

Therefore the objective function becomes

$$\text{Max. health centres} = X_1 + X_2 + X_3 + X_4$$

and it will determine the combination of the health centres.

Now also assume that the amount allocated to the different type of services for each type of health centres are as follows:-

	<i>Types of services offered</i>			
	<i>Maternal and Child Care</i>	<i>Clinical service</i>	<i>Health Education</i>	<i>School Health</i>
MHC	10,000	8,000	3,000	2,000
HSC	7,500	6,000	2,000	1,000
MCHC	15,000	7,000	2,000	2,000
MCQ	5,000	2,000	1,000	=

Finally, the capacity of the resources for the period of time under consideration can be estimated from past output levels.

Assume again that the following resources have been allocated to each type of service.

- Maternal and child care  $C_1 = 200,000$
- Clinical service  $C_2 = 150,000$
- Health education  $C_3 = 50,000$
- School health  $C_4 = 30,000$

With all the information available, the problem can then be expressed as follows:-

$$\text{Max. health centres } Z = X_1 + X_2 + X_3 + X_4 \quad (1)$$

Subject to

$$10,000X_1 + 7,500X_2 + 15,000X_3 + 5,000X_4 = 200,000 \quad (2)$$

$$8,000X_1 + 6,000X_2 + 7,000X_3 + 2,000X_4 = 150,000 \quad (3)$$

$$3,000X_1 + 2,000X_2 + 2,000X_3 + 1,000X_4 = 50,000 \quad (4)$$

$$2,000X_1 + 1,000X_2 + 2,000X_3 = 30,000 \quad (5)$$

$$\text{where } X_1, X_2, X_3 \text{ and } X_4 \geq 0 \quad (6)$$

Equation 1 is the objective function. Equation 2 to 5 are constraints which state the total quantity of each service consumed by different type of establishment cannot exceed the capacity of the corresponding resources. Equation 6 represents non-negativity constraints. Since it is not my intention to illustrate the computational part of the problem, interested readers can refer to any elementary text of O.R. for reference. The solution to this problem would indicate the combination of health centres that would be built in order to maximize the total number of health centres.

Of course this example has oversimplify the realistic situations where in fact much more factors and constraints would have to be considered. This particular technique of linear programming is applied to situation where, because of limited capacity of facilities, limitations of finance, manpower and other kinds of restrictions, it is necessary to calculate what mixture of activities or allocation of resources would best meet a defined objective. Wolfe (1965b) has applied linear programming to the assignment of nursing personnel to the activities that must be performed on a nursing unit. The problem is to determine the assignment pattern that minimizes

personnel cost subject to a number of constraints reflecting the value of assigning different categories of personnel to different tasks and the requirement that every task be performed. Holland (1970) has worked on developing methods to evaluate the locations of hospital in rural areas.

### AN ASSIGNMENT PROBLEM AS AN EXAMPLE

Another example is on the referral relationship between the scattered health centres and hospitals. Assuming that there are six centres where patients can be referred to three hospitals, with clinical referral loads and hospital capacities for acceptance of referred as shown in Table I. Certain referral patterns are likely to be more costly than others due to factors of transportation and inconvenience. Assuming that the cost differentials can be quantified and are constant, we can then use transportation technique to solve the problem.

The optimal assignment is shown by this technique as displayed in Table II. The actual mechanics of this technique are discussed elsewhere. The important element is that it provides an economical basis for allocation of resources in the fact of limiting constraints.

Table I

#### Data for assessing clinic-hospital relationship

Hospital	Health Centres						Hospital Capacity
	a	b	c	d	e	f	
	"unit cost for health centres to hospital"						
A	1	8	1	4	15	8	60
B	4	9	2	5	2	5	100
C	5	12	10	13	4	4	70
Referrals	20	30	60	50	40	30	230

### CONCLUSION

The O.R. approach is not an easy road to problem solving because health systems, particularly, present difficulties not found in industrial situations where O.R. has been applied. Difficulties include,

Table II

#### Optimal solution for referral

Hospital	Health Centres						Hospital Capacity
	a	b	c	d	e	f	
A	20	-	40	-	-	-	60
B	-	-	20	40	40	-	100
C	-	30	-	10	-	30	70
Referrals	20	30	60	50	40	30	230

the number of decision-makers, social and psychological features have a considerable bearing on the effective operation of the system, objectives are frequently ill-defined and often the subject of controversy or conflict. All these factors cause health care systems to settle into a state of relative stability from which it may be difficult to shift them. Secondly, in health systems, we are dealing with open systems which means that the individual components i.e. staff and patients are frequently changing thereby altering the system characteristics. Such complex considerations usually cannot be fully reflected in a model. Hence it would be necessary to give careful and explicit consideration to the manner in which models are to be used.

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# INFECTIOUS MONONUCLEOSIS OR TOXOPLASMOSIS?

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## INTRODUCTION

IN Malaysia, since 1954, a total of 1,916 suspected cases of infectious mononucleosis (I.M.), mostly with typical clinical and blood pictures, has been investigated. Of these, 1,813 were Asians of all ages; 101 were Caucasians, aged 13 to 61 years; and 2 were Eurasian children (both with Indian fathers and European mothers). All the Asians examined were found negative but 25.2% (26/103) of the Caucasians and the two Eurasians examined were confirmed positive both serologically and haematologically. The positive Caucasians were all foreigners but the two Eurasian children were Malaysian-born.

In 1967, attention was drawn to the apparent absence of I.M. with heterophile antibodies among Asians in Malaysia (Tan, 1967). The explanation for this was subsequently obtained when Malaysian children were tested and found to have a high antibody prevalence to Epstein-Barr Virus (EBV) which has now been accepted as the cause of I.M. (Henle & Henle, 1972). The vast majority of Malaysian children acquire antibody to EBV in the first years of life. Thus, few if any are still susceptible when they reach adolescence when I.M. is the likely result of delayed primary EBV infections (Tan & Henle, 1972).

As the clinical manifestations of I.M. are similar to those of toxoplasmosis which has an antibody ratio of 13.9% in Malaysians (Tan & Zaman, 1973), it was thought that some of the suspected cases of I.M. could have been toxoplasmosis. It was decided, therefore to test the I.M.-negative sera for toxoplasmosis to detect what proportion of I.M.-like cases were in fact toxoplasmosis.

## MATERIALS AND METHODS

Paired sera from 136 patients and single convalescent sera specimens from 25 patients with fever, lymphadenopathy and/or sore throat were tested for heterophile antibodies of I.M. by the Ortho-monospot test and confirmed by the Paul-Bunnell and Davidsohn's tests. The full blood count of each case was also performed. The sera were subsequently tested for toxoplasmosis antibodies by the Indirect Haemagglutination (IHA) test. The sensitized cells for IHA were prepared according to the method of Jacobs and Lunde (1957).

## RESULTS

Of a total of 161 sera, paired and single convalescent, of I.M.-negative cases examined, 18 (11.1%) were positive for acute toxoplasmosis and 21 (13.0%) had residual antibodies indicating previous infection (Table I).

**Table I**

**Results of toxoplasmosis IHA test**

Specimen	Total Exam.	Positive	Previous Infection
Paired Sera	136	15@	15†
Single convalescent	25	3*	6**
<b>Totals:</b>	<b>161</b>	<b>18(11.1%)</b>	<b>21(13.0%)</b>

@ ≥ 4-fold rise in titre

† Stationary or < 4-fold rise in titre

\* Titre : ≥ 1 : 12,800

\*\* Titre : ≤ 1 : 6,400

Malays had the highest rate of infection (50%) followed by the Indians (28%) and Chinese (22%). The majority of cases were 0-10 years of age (66.6%), with 16.7% aged 11-20 years and 16.7% over 20 years of age. In terms of sex distribution, males predominated (94.4%) (Table II).

**Table II**  
**Age, sex and racial distributions of positive toxoplasmosis cases**

Age group	No. Pos.	% Pos.	Race	No. Pos.	% Pos.
0-10	12	66.6	Malay	9	50.0
11-20	3	16.7	Indian	5	28.0
20+	3	16.7	Chinese	4	22.0
Totals:	18	100.0	Totals:	18	100.0
Male	17	94.4			
Female	1	5.6			

The blood pictures of 46 cases were examined. In both toxoplasmosis-positive and negative cases, about half gave a picture typical of viral or I.M. infection (Table III).

**Table III**  
**Blood picture of IM-negative cases tested for toxoplasmosis**

Group	Total Exam.	Blood Picture Reading*	
		+ (%)	- or ? (%)
Toxo-positive	10	5 (50)	5 (50)
Toxo-negative	36	19 (52)	17 (48)
Total:	46	24 (52)	22 (48)

\* + : "Suggestive of Viral Infection".  
? : Doubtful.

## DISCUSSION

*Toxoplasma gondii* is an intracellular protozoan which is widely distributed in nature and is capable of infecting all orders of mammals. However, only members of the cat family (Felidae) are capable of producing oocysts, which along with the tissue cyst, is the infective stage of the parasite. Humans acquire the infection by accidental ingestion of oocysts from cat faeces or by eating improperly cooked meat containing tissue cysts. The meat could be from any animal.

In Malaysia, although the report that toxoplasmosis was prevalent in 13.9% of the population was published in 1973 by Tan and Zaman, toxoplasmosis is usually not looked for in PUO cases, and patients with fever and lymphadenopathy with or without sorethroat are often suspected of having I.M. instead, although I.M. is rare in Asians in this country. It is probably because the symptoms of toxoplasmosis are generally accepted as being usually negligible that, apart from its importance as a cause of congenital diseases and eye infection, it is often overlooked.

The results obtained from this study showed that 11.9% (18/161) of cases suspected to be I.M. turned out to be toxoplasmosis instead. They also serve to confirm the results of the survey performed by Tan and Zaman in 1973 in which Malays were found to be most highly infected and the infection, acquired early in life. Males appeared to be more susceptible to the overt form of the disease, for some obscure reason. Residual antibodies indicating previous infection were found in 13.0% of the PUO cases tested.

The blood picture does not give a clear indication of whether a suspected case is I.M. or toxoplasmosis as, even in toxoplasmosis, 50% of cases examined showed a picture "suggestive of viral infection". In I.M. the blood picture readings are almost always indicative of the infection.

In view of the above findings, the authors wish to remind physicians that toxoplasmosis can cause PUO and manifest itself like I.M. Instead of investigating such cases for I.M. they should give greater priority to toxoplasmosis which is currently being studied in the Division of Filariasis in the Institute for Medical Research, Kuala Lumpur.

## SUMMARY

A total of 161 I.M.-negative cases were examined for toxoplasmosis. Of these, 18 (11.1%) were positive. Most of the cases were Malays, males and 0-10 years of age. Previous infections with toxoplasmosis, evidenced by residual antibodies, were detected in 13.0% of the PUO cases. The blood picture in 50% of confirmed toxoplasmosis cases were "suggestive of viral infection" and is therefore not regarded as reliable in the differentiation of toxoplasmosis from I.M. Physicians are advised to give greater priority to toxoplasmosis than to I.M. in their investigation of PUO in Malaysia.



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# A RE-SURVEY OF THE PREVALENCE OF MALAYAN FILARIASIS IN SOUTH-WEST SABAH, MALAYSIA

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## INTRODUCTION

IN Sabah endemic Malayan filariasis is closely associated with fresh and brackish-water swamp areas in the southwest and northeast parts such as the swampy delta areas at the mouths of the Klias, Padas, Sugut, Labuk and Kinabatangan rivers. The primary parasite is *Brugia malayi* in its sub-periodic form while the less common *Wuchereria bancrofti* infections are found to be endemic in the hilly areas of the primary forests in the southwest, northeast and upper Kinabatangan regions, the areas of maximum rainfall in the country (Barclay, 1969).

Detailed prevalence studies on Malayan filariasis in the south-west part of Sabah (the Mempakul area of Kuala Penyu district) had previously been reported by Barclay (1965, unpub. report 1968). The total filariasis infection rate was 4.9% (microfilaria positive rate) and the microfilaria were of nocturnal subperiodicity with the peak at 2400 hours. No mosquito vectors were incriminated there and then. In 1965, twenty cases of *Brugia malayi* infections were treated with diethylcarbamazine in the Kilugus area (Barclay, unpub. report 1968).

Further information from this area was provided in July and August, 1977 when a malaria microscopist in Menumbok dispensary detected two positive microfilaria carriers (one male and one female) in daytime blood films. In order to determine the current status of filariasis in Kuala Penyu district, a parasitological survey was carried out in October, 1977 by the Vector Control team from the Department of Medical Services of Sabah. This paper reports the results of the blood surveys for filariasis.

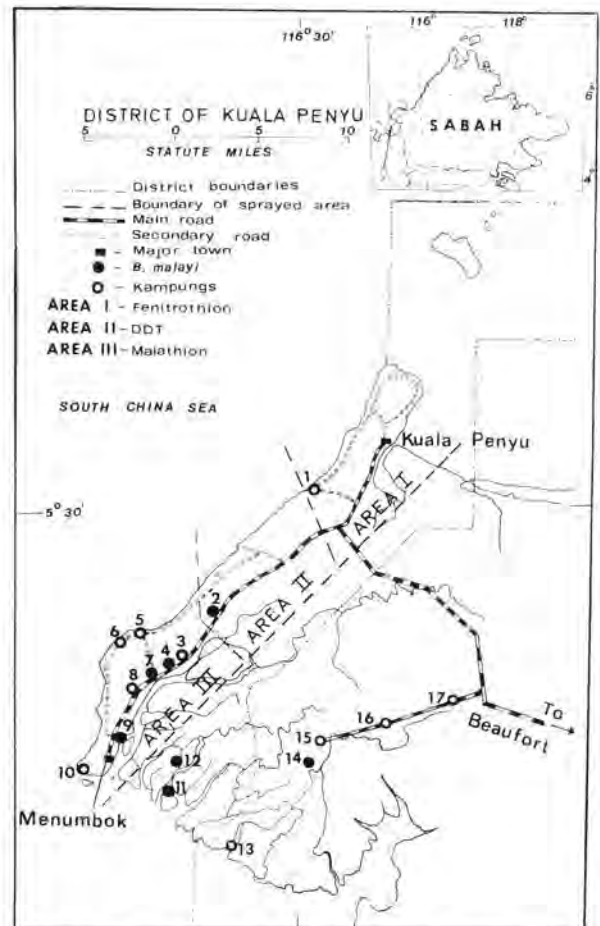


Fig. 1. Map showing Kuala Penyu district and distribution of *Brugia malayi* in surveyed areas. (Kampung Nos. 1 to 17 are referred in Table 1)

## MATERIALS AND METHODS

Fig. 1 shows the area surveyed. A brief description of this area and other relevant data have been reported by Barclay (1965). The general socio-economic status of the population who are mainly Bisaya (Malay stock) seemed to be better than in 1960-1965 due to the opening up of new land for rural and agricultural development. Communication between the main town (Menumbok) and other villages in this area is now mainly by land and river. There is now a main road connecting Menumbok to Kuala Penyu townships and vehicles can now reach the kampungs at any time of the year.

Fifteen kampungs with a total population of 4747 inhabitants were selected for the surveys. The method used was to visit the kampung and explain to the *ketua kampung* the purpose of the survey. The Information unit gave assistance by screening several documentary films during the night surveys. A census of the population was obtained from the district malaria office. 20 c.mm

finger blood samples were collected from the village people between 1900 to 2100 hours. The quantity of blood per film was not measured but it was estimated to be about 20 c.mm. The films were spread evenly onto a clean microscope slide and dried overnight. They were stained the following morning as per routine with dilute Giemsa (35 drops in 100 ml buffered water, pH 7.2) and later examined thoroughly for microfilaria with 6X oculars and 10X or 100X objective.

Two carriers who were first detected in the Menumbok dispensary were traced and additional finger blood samples were collected at 2 hour intervals for 24 hours using a modified Sinton's pipette.

### Microfilarial periodicity

In all thick blood films the microfilariae showed the irregular curves and kinking form characteristic of *Brugia malayi*. Most retained their sheaths, which stained bright pink after Giemsa staining. The results of the periodicity studies are shown in Fig. 2.

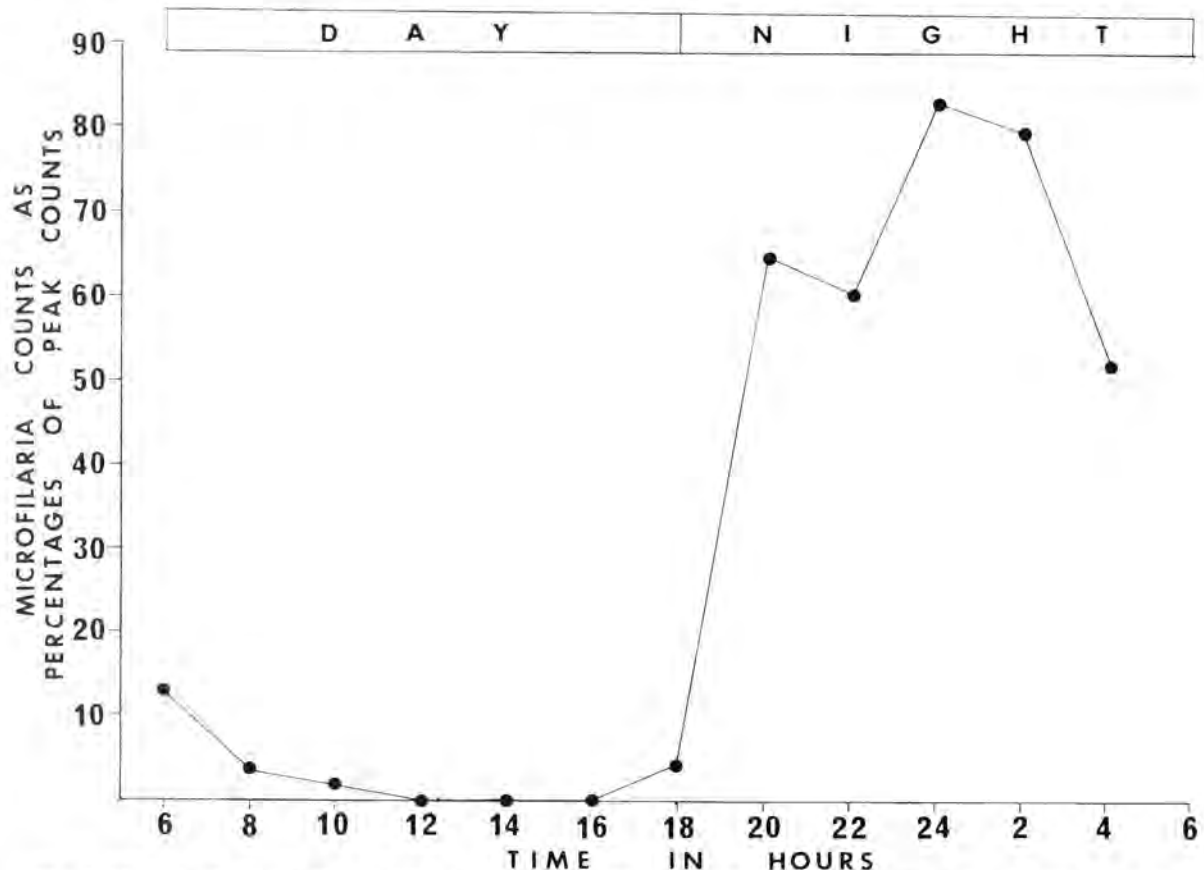


Fig. 2. Showing the periodicity of *Brugia malayi* microfilariae in Kuala Penyu district (based on 2 carriers).

### Microfilarial prevalence rate

The prevalence rate of *B. malayi* microfilaria among those examined in the 15 kampungs ranged from 1.6 to 4.9% with an infection rate of 0.84% (Table I). Table I also compares microfilaria rates with Barclay's (1965) results.

The age group and sex distribution of the positive microfilaria cases are shown in Table II.

### Microfilarial density

Among 11 microfilarial positive cases six (54.5%) had an average of 1 to 10 microfilaria per 20 c.mm. blood and more females than males were affected (Table II). The mean microfilarial density among positive carriers was 18.5 per 20 c.mm. blood.

### Disease manifestations

No elephantiasis of the limbs were seen in the present surveys. There were, however, a few

Table II

Distribution of *Brugia malayi* infections by age and sex in Kuala Penyu district

Age group (years)	Sex	Year	
		1965	1977
0-15	Male	2 (12)	4* ( .409)
	Female	1 ( 7)	3 ( .369)
≥ 16	Male	10	1 ( .255)
	Female	0	3** ( .272)
Total		13 (145)	11 (1305)

\* one male (13 years) from Kg. Sungai Bubos

\*\* one female (17 years) from Bandungan (both detected at Menumbok dispensary)

Table I

Distribution of microfilarial carriers by kampung in 1964 (after Barclay, 1965) and 1977 in Kuala Penyu and Beaufort districts, Sabah, Malaysia.

Serial no.	Kampung	Population		Number examined		Number with microfilaria		Microfilaremia Rate	
		1977	1964	1977	1964	1977	1964	1977	
1	Tempurung	189	-	93	-	0	-	0	
2	Kilugusan	280	198	123	4	1	2.0	1.6	
3	Jungkon	91	-	37	-	0	-	0	
4	Manggis	149	-	81	-	4	-	4.9	
5	Tg. Aru	220	-	116	-	0	-	0	
6	Sangkabok	127	-	60	-	0	-	0	
7	Malikai	299	32	113	1	2	3.1	1.8	
8	Paringan	80	-	69	-	0	-	0	
9	Barangkok	150	-	87	-	1	-	1.6	
10	Mempakul	117	-	51	-	0	-	0	
11	Sg. Bubos	-	-	-	0	1*	-	-	
12	Bandungan	-	-	-	0	1*	-	-	
13	Bongkuduan	-	-	58	-	0	-	0	
14	Bangkalalak	128	138	60	12	1	8.7	1.7	
15	Padas Darmit	141	218	72	11	0	5.1	0	
16	Gadong	138	76	188	1	0	1.3	0	
17	Limbawang	2678	-	97	-	0	-	0	
TOTAL		4747	662	1305	29	11	4.4	0.84	

\* detected by malaria PCD post at Menumbok dispensary.

anecdotal reports of the occasional individual past or present with a big leg or hydrocoele. Three cases reported intermittent fever, lymphadenitis and lymphagynitis.

### Spraying status

The Sabah Malaria Control Programme has maintained DDT spraying operations from 1959 to 1965, in 1968 and from 1969 to 1976, with two breaks in 1966–1967 and 1969–1970. In October 1976 to 1977, the Kuala Penyu district was divided into three areas and sprayed with fenitrothion, DDT and malathion (Fig. 1) as part of an insecticide trial to determine the effects of each insecticide on the interruption or reduction of malaria transmission.

### DISCUSSION

Results of this study suggest that filariasis may not be a great important public health problem in the fifteen *kampungs* surveyed. Although infections with subperiodic *B. malayi* were detected in several villages the microfilaria rate was low and clinical manifestations were rare, being limited to those cases coming to the dispensary for treatment. As few clinical examinations were performed in the survey future work should include this aspect. Several endemic foci were reported by Barclay (1965) but they did not remain as serious areas.

The findings in this survey might have indicated that without mass drug administration for filariasis treatment a marked reduction (80.5%) in microfilaria rates had taken place in the district during the 13-year period from 1964 to 1977. Treatment of cases using diethylcarbamazine in 1965 by Barclay (unpub. report, 1968) had been on parasitological and symptomatic criteria with probable re-infection on return home. It was unfortunate that there are no reliable records for population census and surveys made in 1964 so that case detection could be carried out to find the number of individuals converting from microfilaria positive to negative. However there was a marked reduction in the number of positive microfilaria carriers from 29 to 11.

The common mosquito species found in this area are *Mansonia bonnea*, *Mansonia uniformis*, *An. balabacensis*, *An. donaldi* and culicines. Future work to identify the important filarial vectors is planned by the Vector Control Unit. DDT spraying

could have resulted in a reduction of the vector population or the longevity and survival rate. Harinasuta and Sucharit (1977) assumed that the reduction in the filariasis in Chumphon Province of south Thailand was due to the interruption of transmission of filariasis cycle in the mosquitoes resulting from DDT spraying operations. Similarly Webber (1975) also found that the apparent decrease of microfilaria positives of *W. bancrofti* infections in Solomon Islands and the control of filariasis has been achieved by vector reduction through the Malaria Eradication Programme. No filariasis campaigns have had any persisting success with vector control methods alone, but concomitant reduction of filariasis in other Malaria Eradication Programmes have been observed (Iyengar *et al.*, 1959; van Dijk, 1964).

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# CLOSTRIDIAL GANGRENE: A CASE REPORT

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## INTRODUCTION:

IN AN ERA OF sophistication when antiseptic and asepsis is more or less taken for granted, physicians today tend to neglect the time tested principles in primary wound care.

A case was recently encountered where a traumatic wound following primary surgical care led to clostridial infection of one half of the body, associated with severe toxæmia together with renal and cardiac decompensation. A review of the literature is presented and this led us to the belief that a similar case has not been reported before.

## CASE REPORT:

On 2nd January 1978, a 26 years old Chinese male was admitted to the district hospital, Batu Pahat. He had sustained a deep parang inflicted injury on the postero medial aspect of the left thigh in a coconut plantation.

When brought to the hospital, he was in a state of shock and was resuscitated with seven pints of blood. At an emergency exploration a very deep linear incised wound about a foot long was found in the middle third of the left thigh, exposing cut muscles and vessels. After adequate debridement and hemostasis, primary wound closure was done leaving a corrugated drain in situ. Six hourly intramuscular injection of Penbritin 500 mg. was instituted simultaneously.

On 4th January 1978, the patient was referred to the Department of Surgery at General Hospital, Kuala Lumpur. At the time the limb was tense

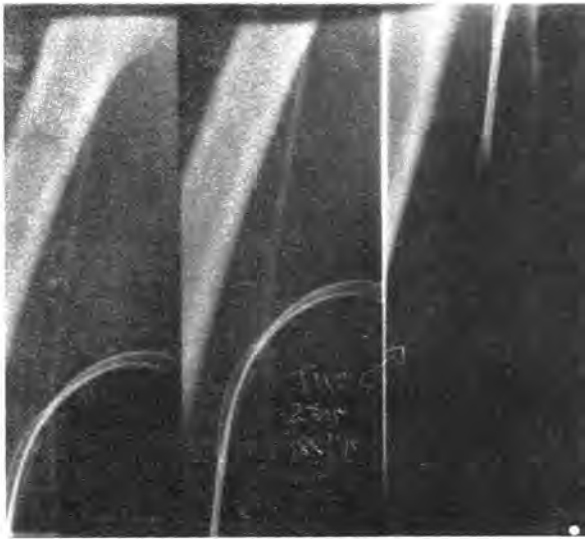
and painful with sluggish venous return. The accompanying laboratory results showed: Hb - 9.5mg.% blood urea - 67mg.% sodium - 137.5 me/L. potassium - 4.2 me/L chloride - 103.6 me/L.

On physical examination he was toxic and pale but not jaundiced. His extremities were cold and clammy and the left leg was oedematous with cyanosis of the nail beds. The dressing was noted to be drenched with a foul smelling serosanguinous discharge. A repeat laboratory investigation on admission revealed:- Hb - 10.2gm.% PCV - 28% and a total leucocytic count of 2,000 cm.

A second emergency exploration of the wound was performed. It revealed massive tissue necrosis with an intact sciatic nerve and a femoral artery. The femoral vein could not be visualised. After extensive debridement of the wound and generous insufflation with hydrogen peroxide the wound was dressed and left open. Release incisions were made over the calf to combat the intense swelling of the leg.

On 5th January 1978, a venogram study showed a complete obstruction of the femoral vein at its middle third. The laboratory results now showed:- Hb - 9.2gm.% PCV - 33% and a total leucocyte count of 10,000.

On 6th January 1978, the patient was referred to the orthopedic unit whence on examination, he was found to have crepitus in the left leg associated with marked toxæmia and tachycardia that did not correspond to his temperature. The classical sero-sanguinous discharge and foul smell permeated the



**Figure 1**

**Note air in tissue spaces in the venogram.**

room. A diagnosis of gas gangrene was made and the patient was immediately started on intravenous injection of crystalline penicillin 6 mega units 6 hourly. Empirically, intravenous polyvalent gas gangrene antitoxin was also given in divided doses of 75,000 units 6 hourly for a single day. Blood study at this stage showed:- Hb - 8gm.% PCV - 28% ESR - 110mm/1st hour with an urine output of 400 mls. in 24 hours.

On 7th January 1978, the urinary output fell further to 292 mls./24 hours and serum analysis revealed urea concentration of 282 mg.% and potassium of 7.2 me/L. The urine was loaded with red blood corpuscles and pus cells. Palpable crepitus in the leg became more pronounced and swab from the discharge revealed gram negative rods and gram positive cocci and grew both *Klebsiella* and *Enterobacter*. The tissue culture subsequently yielded a growth of *Clostridium welchii*, *Pseudomonas* and *Klebsiella*. A high above knee guillotine amputation was done under general anaesthesia and in view of his increasing ureamia and hyperkalemia he was referred to the urology unit in the immediate post operative period. He was put on Resorinium A retention enema, a restricted protein diet and a strict fluid input/output chart.

On 8th January 1978, the patient was noted to have developed a soft boggy diffuse swelling of the left side of the body, extending from the region of the stump up to the left axilla associated with crepitus. His blood urea continued to rise to

292 mg.% with serum Creatinine of 11.5 mg. Peritoneal dialysis was started during which he was given one unit of fresh packed cell transfusion. The haemoglobin continued to fall despite the blood transfusions.

On 12th January 1978, the haemoglobin was less than 3 gms. The blood urea at this time was 190 me/L, total leucocyte count of 27,000 and urinary output measured 100 mls./24 hours. To combat the acute renal failure a second peritoneal dialysis was instituted and he had to be given another unit of fresh packed cell transfusion. During this period he developed yet a further complication of congestive cardiac failure that needed digitalisation. By 15th January 1978, his renal functions started showing evidence of improvement. The urine output was 1050 mls./24 hours, serum creatinine 5 mg. and the boggy swelling with crepitation on the whole of the left side subsided. On 17th January 1978, the patient regressed to a state of mental depression with violent behaviour. Largactil in doses of 50 mg. b.d. on a sliding dose for one week helped to control this behavioural disorder.



**Figure 2**

**A mobile patient on crutches.**

On 6th February 1978, under spinal anaesthesia autogenous split skin graft was applied over the granulating stump. On 21st February 1978, the skin graft was noted to have taken well. The blood urea was now recorded at 21 mg.%, and serum creatinine at 1.4 me/L. Besides plasma expanders he received in all 16 pints of blood, and two sessions of peritoneal dialysis. On 3rd March 1978, he was discharged ambulant on crutches.

#### DISCUSSION:

In cases with history of trauma especially those sustained in an agricultural area the possibility of primary infection by clostridial organisms must always be borne in mind.

Relatively little attention is now given to gas gangrene and it is seldom remembered that fulminating gangrene can follow elective surgery or present as a primary infection. (Altemeier *et al.*, 1971). Hence, a high index of suspicion must be stimulated to be constantly aware of this threat.

In this case a significant point to note is that primary closure of the wound was done despite gross soil contamination. Also, that there was a lapse of 48 hours between the time of injury and the development of local complaints of severe pain. This would seem to confirm Mac Lennan's (1962) observation on clostridial infections and myonecrosis, that unsatisfactory primary surgical treatment and inadequate debridement are the routine findings in such cases.

The incubation period of *Clostridium welchii* varies between 24 hours and 3 days. The two factors that are needed to initiate the process are the contamination of tissue and tissue hypoxia and once initiated it follows a relentless course usually leading to a fatal end, as given in a communication by Demello (1970, 1974) and Hitchcock (1970). It is fortunate that while both these factors coexisted in this case, the end result was not fatal. However, other conditions are known to mimic gas gangrene and hence should be considered. These are as described by Michael Barzar of Boston; clostridial cellulitis, anaerobic streptococcal myonecrosis, necrotizing fasciitis and synergistic necrotizing cellulitis. Of these infections gas gangrene exhibit the severest form of toxæmia, local pain and swelling.

Taylor (1954), Altemeier (1957) and Langley (1945) outlining the current regime for treatment for clostridial infections recommend that immediate exhibition of an antibiotic is a must even on a suspected diagnosis. Penicillin, being the drug of choice is given parentally in divided doses of 20,000,000 units daily.

Aldrette and Judd (1965) state that antitoxin have a definite value and to be effective the therapeutic dose of the polyvalent antitoxin should be given intravenously, at least 75,000 units and may be repeated every 4-6 hours according to the response of the patient. The prophylactic dose recommended is 25,000 units intramuscularly. (Martindale Extra-pharmacopia 1975).

More recently, hyperbaric oxygen is considered a useful adjunct in the treatment but it should be remembered that this must not replace surgical excision and debridement. This view is supported by Mc Swain, Sawyers and Lawler (1966). Case analysis of 133 instances of proven gas gangrene by Hitchcock (1975) record 9 deaths from cardiac failure, 8 from renal failure, 3 from progressive pneumonia, 1 from pulmonary embolus, 3 due to uncontrolled infection, 1 due to hepatic failure and 1 death resulting from toxicity of hyperbaric oxygen therapy. This case was proven to be gas gangrene clinically and bacteriologically. The cardinal complication of acute renal failure as seen in this case could have been the result of hypovolaemic shock in view of the fact that massive fluid transfusions were needed to resuscitate the patient. The alpha exotoxins could possibly have further aggravated the situation. However, the accompanying ureamia secondary to renal failure was promptly recognised and adequately managed soon afterwards. The severe anaemia during the acute period despite the frequent transfusion of packed cells shows the devastating effects of the exotoxins - especially the alpha toxin that causes hemolysis with all its attending complications, and theta toxin that is both hemolytic and cardiotoxic. The cardiac failure may have been the result of the latter. The events in this case, conclude and reaffirm that surgery is the cornerstone in the treatment of gas gangrene and that decompression and proper debridement is mandatory as cited by DeHaven *et al.*, (1971).

#### CONCLUSION:

This affidavit is presented to remind us of the ever present dreaded infection of gas gangrene and its devastating action on target organs distant from the site of primary infection. Furthermore, with early suspicion of the disease process the time tested surgical intervention combined with appropriate antibiotics and supportive measures still remain the sheet anchor in its management.

#### ACKNOWLEDGEMENT:

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# THE PROBLEM OF SOIL TRANSMITTED HELMINTHS IN SQUATTER AREAS AROUND KUALALUMPUR\*

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## INTRODUCTION

INTESTINAL HELMINTHIASIS is a very common infection in this country especially among children in the low socio-economic group. Several researchers have investigated this phenomenon these past 60 years. Russel (1934), Schacher & Danaraj (1960), Lie Kian Joe (1964) and Sulaiman *et al.* (1977) carried out studies on stool samples of in-patients in various government hospitals in Singapore and Peninsular Malaysia to provide a general assessment of the problem in this region. Desowitz *et al.* (1966), Balasingham *et al.* (1969) and Lie Kian Joe (1971) approached different communities to ascertain the influence of environmental factors in the incidence of intestinal worm infection.

The aim of this survey is to:

- (i) investigate the incidence and types of infection in children of the 4-6 years age group in the Kuala Lumpur-Petaling Jaya region.
- (ii) assess the relationship between the age and incidence of infections in squatter settlements.

This survey was carried out in March-April 1978.

## MATERIALS AND METHODS

Four kindergartens, two in Kg. Gandhi (referred to as Gandhi and Devi) one each in Kg. Medan and

Kg. Pinang were approached (Fig. 1). Bottles were distributed to each child in these kindergartens together with letters of introduction and instructions to their parents. Bottles were recollected each subsequent morning. 211 faecal samples (a response of 75.4%) were thus obtained.

The Methodist Kindergarten, a kindergarten attended by upper middle class children was approached similarly and 40 faecal samples were collected.

House-to-house visits were carried out in Kg. Sentosa (C), another squatter settlement and 243 faecal samples were collected from individuals of various ages. Interviews were also carried out during these visits.

The brine flotation technique was used to concentrate the eggs for identification. Approximately 3 gm. of faeces were mixed with saturated sodium chloride, of S.G. 1.20, and left to stand for  $\frac{1}{2}$  to 1 hr. before being examined microscopically. Only *Ascaris lumbricoides*, hookworm and *Trichuris trichiura* eggs were specifically looked for. The procedure was carried out only once for each faecal sample. Beaver's technique was used to estimate the density of eggs in all the faecal samples shown to have helminthic ova by the brine flotation method. Due to the lack of time Beaver counts were only done in triplicate for every 5th sample, each of the remaining samples being counted once only.

All individuals infected with *Ascaris* were treated with pyrantel pamoate (Combantrin<sup>®</sup>) and those whose faecal sample had greater than 5000 *Trichuris* eggs/cm<sup>3</sup> and/or 1000 Hookworm eggs/cm<sup>3</sup> (both arbitrary levels) were given a full course (1 tablet b.i.d. for 3 days) of mebendazole (Vermox<sup>®</sup>).

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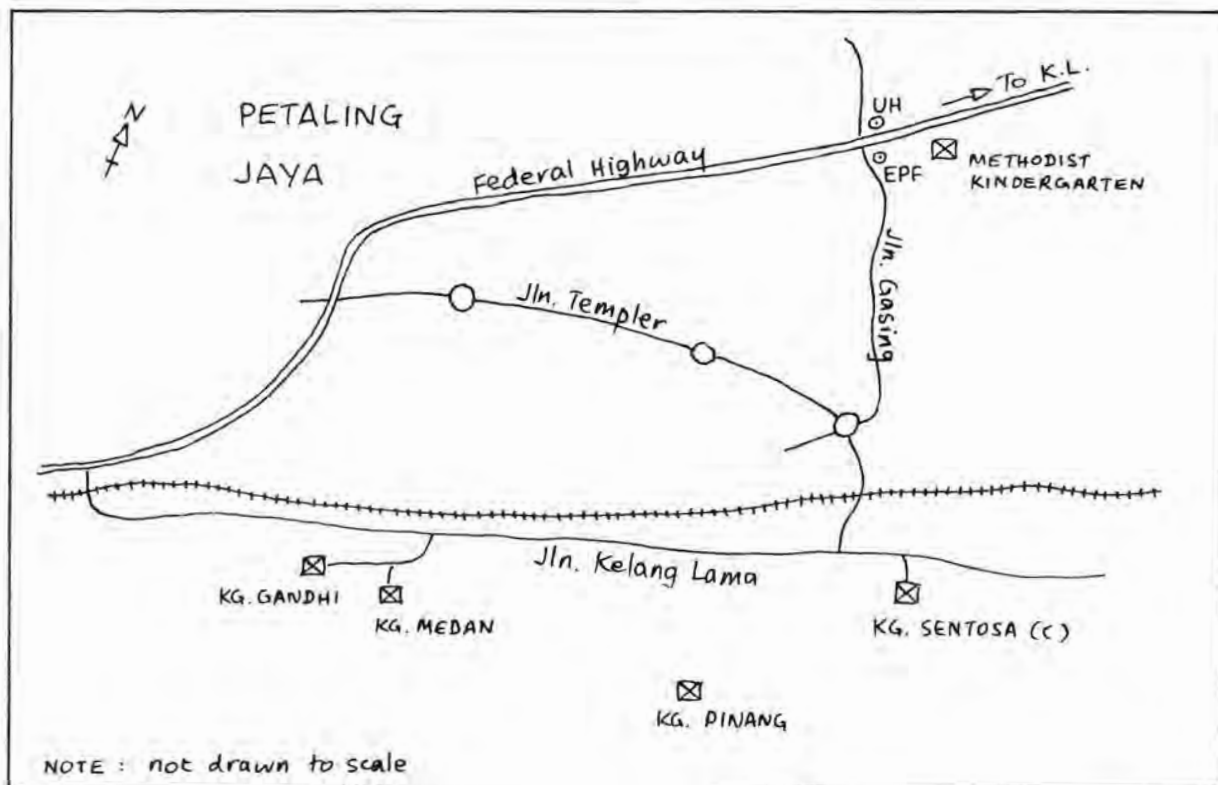


Figure 1. Sketch Map showing Areas studied.

The Chi-square test was used to analyse data statistically. The level of significance, alpha ( $\alpha$ ), was set at 0.05.

#### SOCIO-ECONOMIC & ENVIRONMENTAL CONDITIONS IN KG. SENTOSA (C)

As interviews were only carried out in Kg. Sentosa (C), the following section is based mainly on data from Kg. Sentosa (C).

Kg. Sentosa (C) is a squatter settlement which began more than 10 years ago. It is built on swampy land and many houses (on short stilts) have water below them all year round. About 90% of the individuals with employment are workers in factories, the Jabatan Kerja Raya and in construction sites. The average house-hold income is less than \$250/- per month for the majority of the families. The level of schooling was found to be very low among the children. Less than 10% of the children reach Form 4.

Kg. Sentosa (C) consists of about 200 families, yet does not have even a single stand-pipe. The people depend largely on wells for their water supply.

A small number of families obtain pipe water for drinking and cooking purposes from nearby non-squatter houses. This holds true for the other squatter settlements studied. In Kg. Pinang, however, drinking water is obtained from the 6 stand-pipes that serve a population of about 1 200 families.

Facilities for faecal disposal in Kg. Sentosa (C) were found to be: (sample size,  $n = 90$ )

- |  |     |
|--|-----|
| (1) Pit latrines   | 72% |
| (2) Latrines emptying into the swamp directly                    | 14% |
| (3) Latrines emptying into a large drain skirting the settlement | 12% |

It was also found that most of the latrines were shared. Sometimes as many as 5 to 7 families used a latrine. In Kg. Sentosa (C), as well as in Kgs. Pinang, Medan and Gandhi, most of the children who are less than 10 years of age were allowed to defaecate indiscriminately into the area surrounding their houses. It was also noted that the majority of children below 10 years of age went around without wearing shoes or slippers.

The majority of people interviewed in Kg. Sentosa (C) knew that intestinal helminthiasis is a common health problem in their area. But a number (37%, n = 79) mistakenly believed that their own children were not affected. Parents reported giving anthelmintics to their children as follows:

(sample size, n = 60)

(1) Every 2 months or less	13.3%
(2) Every 2 - 4 months	18.3%
(3) Every 4 - 6 months	11.7%
(4) Irregularly	33.3%
(5) Do not give	18.0%

Ridto, a piperazine preparation, was the drug most commonly administered (62.5%, n = 40), probably because it is one of the cheapest. Combantrin<sup>®</sup> (pyrantel pamoate) was the next most common (10%, n = 40).

Though the people perceived intestinal worms as a common health problem among their children, very few of them know how infections were acquired. In the course of the interviews we asked the parents how children become infected. The following responses were elicited:

(sample size, n = 68)

(1) Hands soiled by eggs from the ground	4.4%
(2) Percutaneous, through bare feet	5.9%
(3) From eating sweets	5.9%
(4) From powdered milk	8.8%
(5) Eating fish	7.3%
(6) From other foodstuff	14.7%
(7) Do not know	42.6%

It is very likely that the people of the other squatter areas studied are equally unaware of the mode of transmission of intestinal helminths.

## RESULTS

### (A) Infection Rates in the Kindergartens

It can be seen from Table I that the most common infection in all kindergartens sampled was due to *Trichuris trichiura*, followed by *Ascaris lumbricoides* and hookworm. The hookworm levels were particularly low, averaging only 5.1% for the squatter kindergartens as a whole.

Though there appears to be some degree of variation between the different squatter kindergartens with Medan having 95.9% of the children with at least 1 worm infection and Pinang having only 76.9% of the children with at least 1 worm infection, the Chi-square test ( $\alpha = 0.05$ ) did not show significant differences ( $0.10 > p > 0.05$ ) in the rates and types of infection between the different kindergartens.

In the Methodist Kindergarten, out of a sample of 40, only 10.0% were found to be infected. Of these, 2.5% had Ascariasis, 7.5% Trichuriasis, and none had hookworm infection. There were no double or triple infections, and the level of eggs in the faeces were low in all the four children with infection. When compared with the rates and types of infections of the squatter Kindergartens taken as an aggregate (Table I), the differences were shown to be significant ( $p < 0.001$ ) by the Chi-square test. This indicates that intestinal helminthiasis are predominantly a problem of children from the low socio-economic group, where poor sanitary conditions exist.

In all kindergartens the differences in rates and types of infection between the different sexes were insignificant ( $0.95 > p > 0.90$ ). This may be accounted for by the similar (unhygienic) habits of children of both sexes in the 4-6 yrs. age group.

Table I

Infection Rates in the Squatter Kindergartens including children of the 4-6 yrs. age group of Kg. Sentosa

Kindergartens	total no. samples	% positives	% double infections	% triple infections	% <i>Ascaris</i>	% Hook worm	% <i>Trichuris</i>
Pinang	52	76.9	34.6	5.8	48.1	5.8	65.4
Medan	49	95.9	61.2	4.1	71.4	4.1	83.7
Devi	44	97.7	72.7	0.0	75.0	2.3	95.5
Gandhi	66	89.4	53.0	3.0	51.5	10.6	83.3
Sentosa	42	97.6	81.0	0.0	83.0	0.0	95.2
Squatter K'gartens combined	253	90.9	58.9	2.8	64.0	5.1	83.8

## (B) Ethnicity and Infection Rates

Infection rates and patterns in different ethnic groups were also investigated (Table II).

### (i) The same ethnic group in different areas :

In a comparison of Indian children in Kg. Pinang and Kg. Gandhi, it was shown statistically that there was no significant difference ( $0.10 > p > 0.05$ ) in infection rates. Similarly when Malay children in Kg. Medan and Kg. Gandhi were compared with children of Kg. Sentosa (C) (4-6 yr. age group), no significant difference was shown ( $0.20 > p > 0.10$ ).

No comparison could be made of the Chinese population as all our samples of Chinese children were from Kg. Pinang.

### (ii) Different ethnic groups in the same areas :

The infection rates in the Malay, Chinese and Indian children attending Kg. Pinang kindergarten were compared. The Chi-square test did not show any significant difference ( $0.20 > p > 0.10$ ) in the rates and types of infection.

When variation of the infection rates in Malay and Indian children in Kg. Gandhi kindergarten was investigated by the Chi-square test, it was also shown that the difference was insignificant ( $0.50 > p > 0.30$ ).

Hence this survey indicates that infection rates are not significantly influenced by ethnicity for populations sharing similar environments.

## (C) Level of Infections

The Beaver technique was used to assess the density of eggs (no./cm<sup>3</sup>) for all faecal samples shown to have helminthic ova by the brine flotation method. Analysis of the counts done in triplicate revealed that the coefficient of variation (C.V. =  $100 s/x$ ) was 70.7 for *Ascaris* and 95.3 for *Trichuris* counts. For reasons pertaining to scientific objectivity it should be noted that this compares unfavourably with Dr. Beaver's assessment of this technique (1950). Though our estimation of each individual egg density is not accurate we decided to present the data on egg density in aggregate form in Figs. 2 and 3 as it is not unreasonable to assume that errors would tend to cancel themselves out in a large sample.

It is seen that for the 162 children with Ascariasis the mode of distribution of egg densities is in the 10,000-49,999 eggs/cm<sup>3</sup> category (32.1%). In the case of the 212 children with Trichuriasis, 57.1% were in the 0-2999 eggs/cm<sup>3</sup> category. We did not

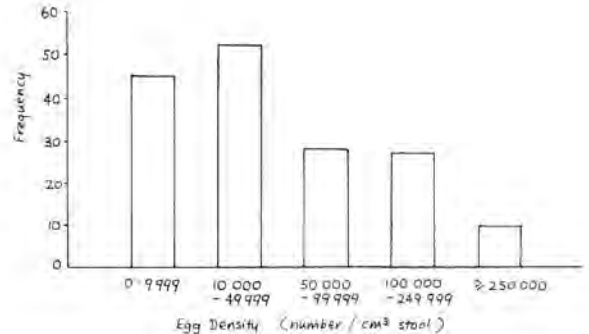


Figure 2. Level of *Ascaris* Infection in Squatter Kindergartens including children of the 4-6 yrs. age group of Kg. Sentosa.

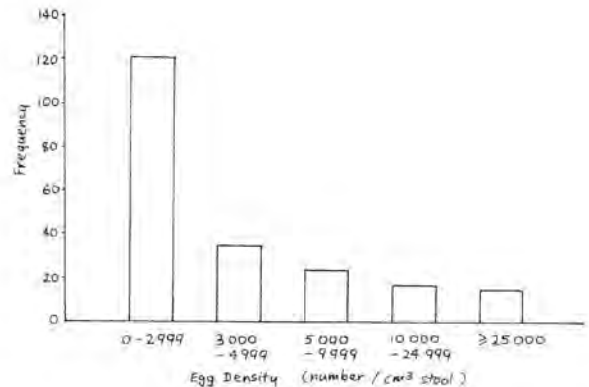


Figure 3. Level of *Trichuris* Infection in Squatter Kindergartens including children of the 4-6 yrs. age group of Kg. Sentosa.

attempt to assess the worm load on the basis of these egg densities because several other researchers have commented that no definite relationship exists between these 2 parameters (Lie, 1971). Distribution of Hookworm egg densities is not presented here as the large majority of infections were low, having a density of less than 1000 eggs/cm<sup>3</sup> of faeces.

## (D) Influence of Age on Infection Rates

Fig. 4 shows the prevalence rates of the 3 main soil-transmitted helminths in the different age groups in Kg. Sentosa (C). Trichuriasis is the most common infection for all age-groups except the 0-1 year age group, in which there is a slight predominance of Ascariasis. The youngest infant found to be infected by *Trichuris* and *Ascaris* was eight months old. The oldest person infected was a lady of 60 years who had both *Trichuris* and *Ascaris*. The rate of *Trichuris* infection increased from 34.4% in the 0-1 yr. age group to 88.5% in the 2-3 yrs.

**Table II Rate of Infection by Ethnic Groups in Squatter Kindergartens including the 4-6 age group of Kampung Sentosa**

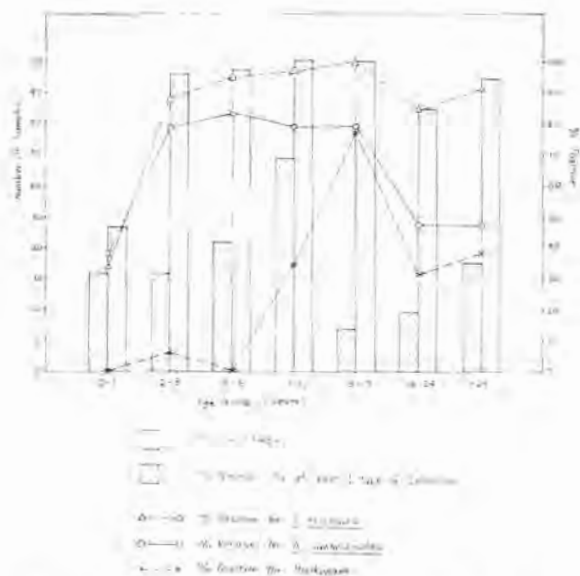
	Malays				Chinese				Indians						
	Total No. samples	% +ve	% A	% H	% T	Total No. samples	% +ve	% A	% H	% T	Total No. samples	% +ve	% A	% H	% T
Pinang	5	100.0	60.0	0.0	100.0	23	65.2	26.1	0.0	52.2	24	79.2	62.5	16.7	66.7
Median	49	95.5	71.4	4.1	83.7	-	-	-	-	-	-	-	-	-	-
Devi	*	-	-	-	-	-	-	-	-	-	44	97.7	75.0	2.3	95.5
Gandhi	48	87.5	54.2	14.6	81.3	-	-	-	-	-	18	94.4	44.4	0.0	88.9
Sentosa	36	97.2	80.6	0.0	100.0	-	-	-	-	-	6	100.0	100.0	0.0	100.0

\* (-) indicates that that particular ethnic group is not represented.

A *A. lumbricoides*

H Hookworm

T *T. trichiura*



**Figure 4. Rates of Infection by Age Group in Kg. Sentosa.**

age group. Similarly the rate of *Ascaris* infection increased from 37.5% in the 0-1 yr. age group to 78.1% in the 2-3 yrs. age group. These increase were found to be significant ( $0.01 > p > 0.001$ ).

Thereafter, the level of Trichuriasis remained high, reaching 100% in the 13-15 yrs. age group. The level of *Ascaris* infection did not exceed 80% for any age group and appeared to decrease more markedly than Trichuriasis after the age of 16. However the Chi-square test revealed that this decrease was not significant statistically ( $0.5 > p > 0.3$ ).

Hookworm infection levels remained low until the age of 6 yrs. Then the level of infection rose and remained above 30% for all subsequent age groups. We were unable to explain why the level of hookworm infection was low for preschool children. As most of these children go around without adequate footwear it would seem that this age group is even more exposed to infection than adults. The peak of 78.6% observed for the 13-15 yrs. age group was found to be statistically significant ( $p < 0.001$ ). This remains unaccounted for.

The scatter diagrams (Figs. 5 and 6) indicate that:

- (a) The variation in egg densities was greater in the lower age groups.

- (b) Children tended to have higher egg densities in their faeces than did adults. This may be due either to a higher worm load or the fact that children excrete a lesser amount of faeces per day than do adults.
- (c) Infants (<1 year) had few if any eggs in their faeces.
- (d) On the average, *Ascaris* egg densities were very much higher than *Trichuris* egg densities. Even after correcting for the fact that a percentage of *Ascaris* eggs are unfertilised and therefore non-viable, and that prevalence rates for Trichuriasis were slightly higher than Ascariasis, the number of viable *Ascaris* eggs reaching the soil would still have been in excess of the number of *Trichuris* eggs. One would therefore expect a higher rate of infection for *Ascaris*. The lower prevalence level of Ascariasis in the population may be due to the following factors:

- (i) About 80% of the parents reported administering anthelmintics to their children either regularly or otherwise. This widespread use of anthelmintics of which most are more effective against *Ascaris* than *Trichuris* may be a factor tending to reduce the level of Ascariasis.
- (ii) The longer lifespan of *T. trichiura* may contribute to the higher prevalence of Trichuriasis.

However the above two factors do not adequately explain the more marked decrease in *Ascaris* infection in adults. It is possible that some other factors are also operating.

#### (E) Incidental findings

Out of the examination of 494 faecal samples, 2 *Strongyloides stercoralis* larvae (one rhabditiform & one filariform) were observed. It appears that infection rate for *S. stercoralis* is very low in the population surveyed. This may not be an accurate reflection of the true level of *Strongyloides* infection as the proper diagnostic methods were not employed.

Several *Enterobius vermicularis* eggs and adults were observed. Since no method appropriate for *E. vermicularis* egg detection was used, no numerical data is presented.



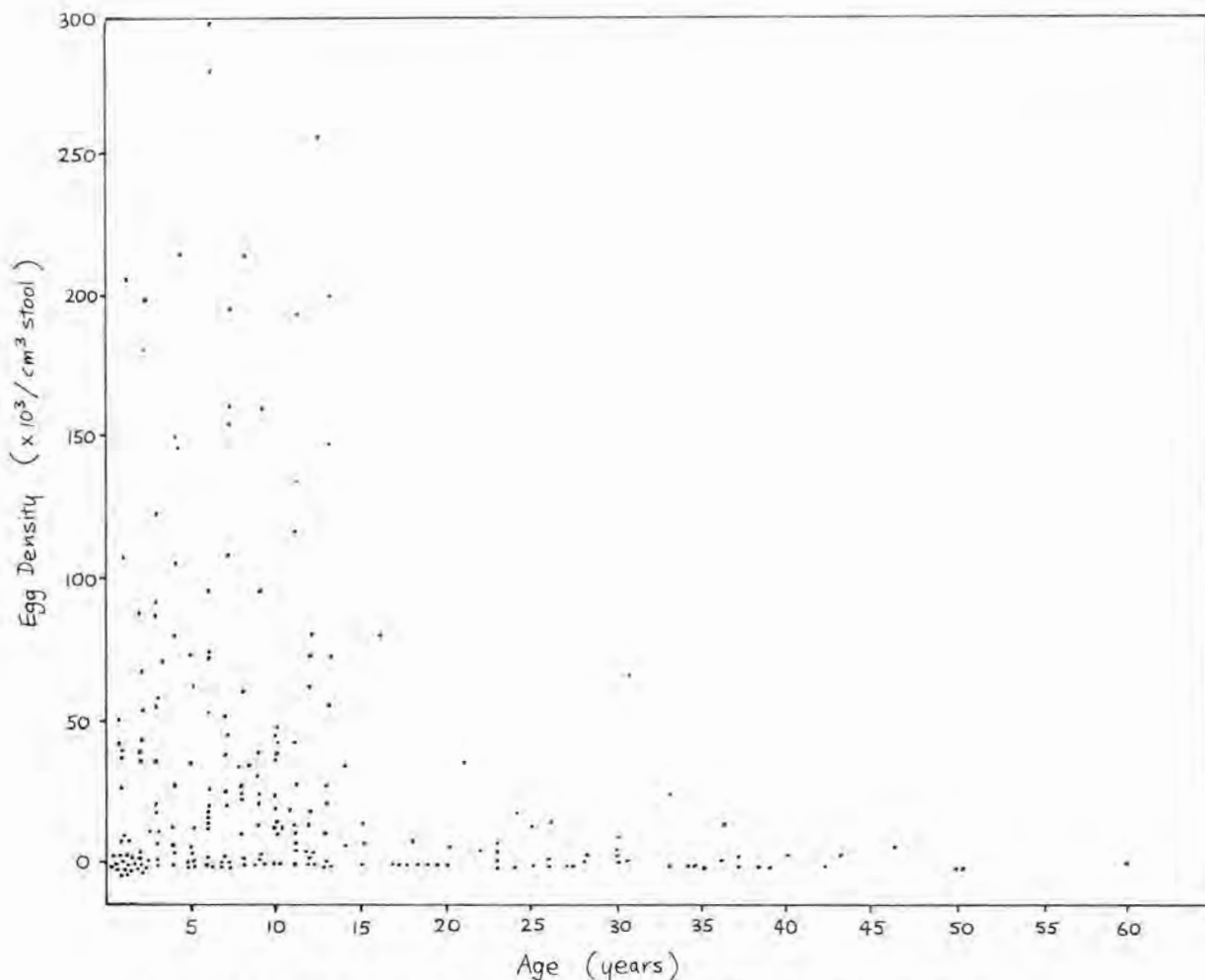


Figure 5. The Age-*Ascaris* Egg Density Relationship of the Population in Kg. Sentosa\*

- \* 1. Eight readings with egg densities above 300 000 were omitted.
- 2. One reading, positive for Brine Flotation method but having zero count for Beaver's method, was also omitted.
- 3. Each dot represents one sample.

Several protozoan trophozoites and cysts including *Giardis lamblia*, *Entamoeba histolytica* and *Dientamoeba fragilis* were also noted. As we were not specifically looking for these protozoans, no meaningful numerical data was obtained.

Forty children from the squatter kindergartens with mixed infections were treated with mebendazole. Out of ten children contacted after treatment, 3 reported migration of *Ascaris* up the oesophagus and nasopharynx. In subsequent treatment of individuals with mixed infections, in Kg. Sentosa (C), this was avoided by first administering pyrantel pamoate.

In Kg. Sentosa (C), a small number of parents told us that their children experienced abdominal pains and bouts of vomiting after being given pyrantel pamoate. On further inquiry, we found that all these cases had high *Ascaris* loads (more than 20 worms were passed out from each child subsequently).

## DISCUSSION

### Comparison with other studies

The level of intestinal helminthiasis was found to be high in Kg. Sentosa (C) (Fig. 2). This pattern of infection was observed in Bukit Ho Swee Squatter area in Singapore by Kleeven's (1966). Lie (1971)

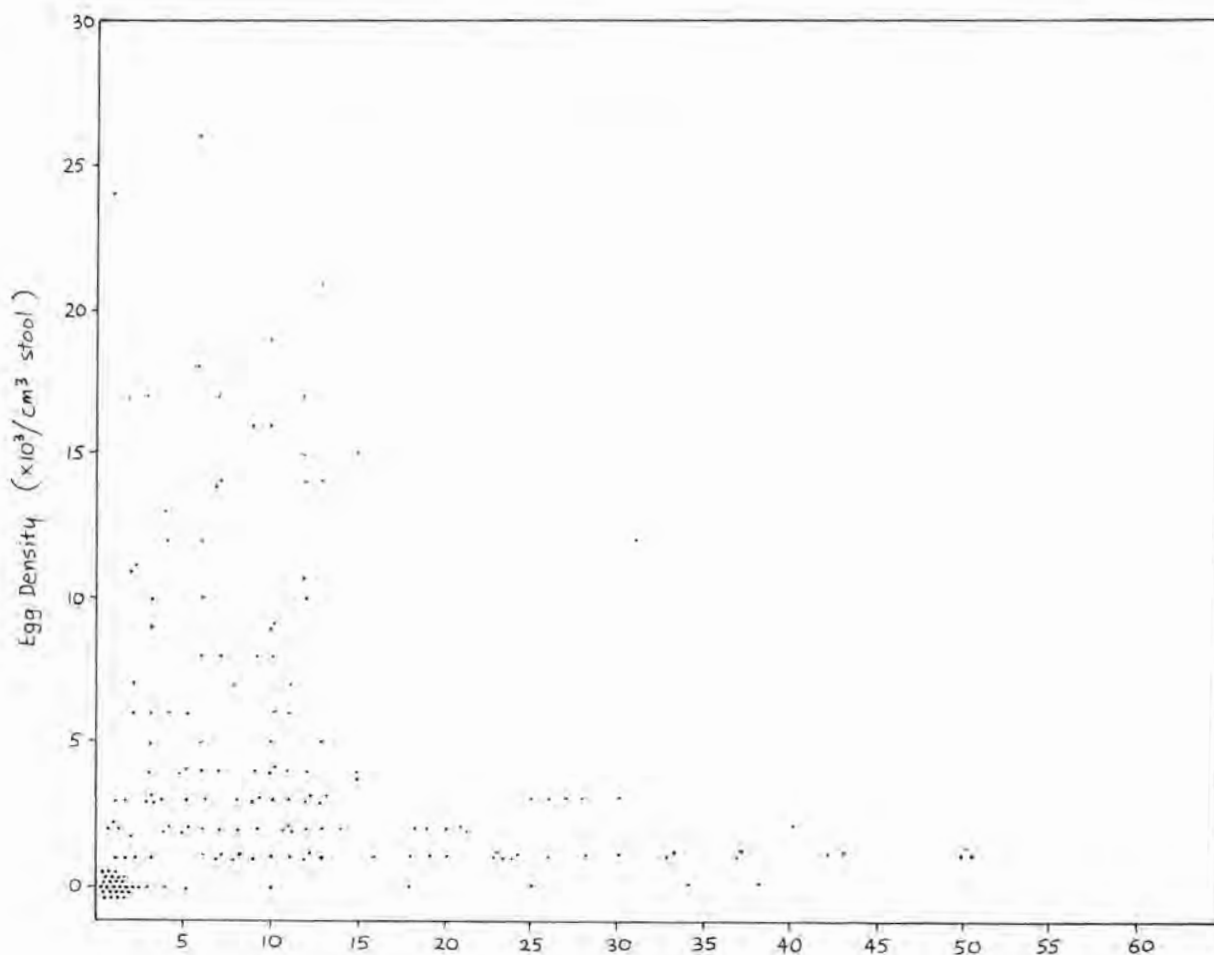


Figure 6. The Age-*Trichuris* Egg Density Relationship of the Population in Kg. Sentosa\*

- \* 1. Seventeen readings with egg densities above 30 000 were omitted.
- 2. Twenty readings, positive for Brine Flotation method but having zero count for Beaver's method, were also omitted.

demonstrated that a similar pattern existed among families engaged in vegetable gardening in Ampang, Kuala Lumpur. It is interesting that the level of infection in squatter areas is comparable to that obtained for communities using night soil as manure.

#### Ethnicity and Infection Rates

Several researchers have investigated prevalence and types of infection among the different ethnic groups in West Malaysia. Russel (1934), in the 5 years or less age group and Lie (1964) in the 0-9 years age group, observed significant differences in infection rates among the 3 major ethnic groups. No mention or correction for environmental factors were made. Schacher and Danaraj (1960)

made a similar observation but the population studied consisted of people from all age groups. Itam Sulaiman *et al.* (1977) reported that there were significant differences in infection rates among children of different ethnic groups, considered to come from the lower socio-economic class, investigated in the third class pediatric ward in the General Hospital, Pulau Pinang. No level of significance was mentioned in their report but on statistical analysis based on data from Table 2 of their report (omitting *Strongyloides* infection), it was found that  $0.20 > p > 0.10$ ; a level we have set as significant for our report. This figure was in fact similar to our probability range for Kg. Pinang ( $0.20 > p > 0.10$ ). Our findings do not indicate any significant

differences in infection rates among children of 4-6 years of age of different ethnic groups living in squatter areas. It therefore appears that ethnicity is much less important than environmental conditions as a determining factor of the level of intestinal helminthiasis, as shown by our comparison of squatter kindergartens to a middle class kindergarten. These findings are in accordance with those of Desowitz *et al.* (1961).

### Prevention

In the course of our investigation in Kg. Sentosa (C), it was found that the majority of adults (89.7%) did not know how intestinal helminthiasis were transmitted. It is clear that they will be unable to implement any effective preventive measures until they acquire a better understanding of the phenomenon. It was also observed that children less than 10 years old defaecated indiscriminately into the areas surrounding their houses. Parents probably allow their children to do so because existing latrine facilities are unsafe for young children to use on their own. Faecal disposal in the case of adults was relatively more sanitary (e.g. into pits or buckets). Children, therefore, serve as the main source of infection for the community.

A comprehensive worm control programme would necessarily include the following features:

- (i) Raising the awareness of the community as to how intestinal helminthiasis are transmitted, and ways of limiting transmission.
- (ii) Reducing the contamination of the soil by young children. Providing safe and sanitary facilities for faecal disposal is the best solution. However if this is not possible in the near future, parents could be advised to encourage their children to defaecate into small containers which could then be emptied into the pits or buckets used by the adults.
- (iii) Periodic deworming of the susceptible population, perhaps every 3 months, to minimise the egg contamination of the soil.

The measures suggested require the cooperative effort of the entire community, since even a small number of infected children can serve as a reservoir of infection for the whole community. If cooperation is attained, the measures mentioned above can greatly reduce the level of infection at a reasonably low expenditure.

This type of cooperative endeavour may be difficult to elicit for several reasons. Certain squatter families may be facing more pressing problems such as low per capita income, unemployment, alcoholism, and drug dependence on the part of the Youth. Furthermore their perception of impermanence of residence and the possibility of eviction probably dampen any inclination to embark on a cooperative effort to improve their common living conditions.

Any attempt to reduce helminthiasis among squatter populations will have to be integrated into an overall approach to the problems of squatters. Such an approach would include giving the squatters some sense of permanence by granting them some legal rights to occupy the land. It should also include the provision of basic utilities such as piped water (at least stand-pipes), proper drainage and paved roads.

### SUMMARY

Results from the study on children of the 4 to 6 years age group revealed that 90.9% of those from the squatter kindergartens were infected with one or more intestinal helminths. Trichuriasis was the commonest infection (83.8%), followed by Ascariasis (64.0%) and hookworm infection (5.1%). In contrast, only 10.0% of the children from an upper-middle class kindergarten in P.J. were found to be infected. This indicates that intestinal helminthiasis is predominantly a problem of children from the low socio-economic group, where poor sanitary conditions exist. No significant difference in infection rates was observed among children of different ethnic groups or sex living under similar conditions.

In the study of the entire age range of a squatter population, it was observed that people from all age groups were infected. Infection rates were low in the 0-1 year age group, and rose to about 80 to 90% for Ascariasis and Trichuriasis. The rates remained thus and declined only slightly after 15 years of age. The level of hookworm infection was low in pre-school children and then rose to remain above 30% for the older age-groups.

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# DENTAL CARIES IN MALAYSIAN CHILDREN WITH HEART DEFECTS

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## INTRODUCTION

THE FREQUENT OBSERVATION OF poor oral hygiene and numerous grossly carious teeth in patients attending The Children's Heart Clinic of the University Hospital, Kuala Lumpur is very worrying in terms of infective endocarditis risk, and stimulated the small survey of dental caries reported herein. The impression that gross dental caries were more prevalent amongst children with cardiac defects than amongst children with non-cardiac diseases was tested statistically.

## MATERIALS AND METHODS

233 children aged 2 to 12 years and suffering from either congenital (211) or rheumatic (22) heart disease were examined personally by one of the authors during a 6 months period in 1976 in the Children's Heart Clinic and Children's wards of University Hospital. Only obviously carious teeth seen on simple inspection with the aid of a torch and spatula were counted. It is very likely that small and hidden caries were missed. Filled, extracted or missing teeth were not counted, and more involved examinations (e.g. with x-rays) were not performed. Gingival sepsis was not quantitated. The findings reported therefore represent an underestimate of unfavourable oral hygiene.

A further 217 patients with non-cardiac diseases were similarly assessed for dental caries in the Children's Outpatient Clinics and Children's wards of University Hospital. This group had similar age, sex and ethnic composition to the group of children with cardiac defects. Chisquared test

(with Yates correction for  $2 \times 2$  tables) has been used in all comparisons.

## RESULTS

Patients having obvious dental caries were encountered with approximately equal frequency in both cardiac and non-cardiac groups (60% and 65% respectively). 63% of all patients examined (cardiac and non-cardiac combined) had dental caries.

Amongst cardiac patients there were an average 5.7 carious teeth per affected patient, compared with 4.6 for non-cardiac patients and 5.0 when all patients were combined. In both cardiac and non-cardiac groups sex differences were not significant, and within the group of cardiac patients no differences were attributable to presence or absence of cyanosis. Dental caries were significantly less prevalent amongst the Indian patients in the cardiac group but this was not so for Indians with non-cardiac diseases. The prevalence of dental caries reached a peak in the age range 5-7 years when 76% of patients (cardiac and non-cardiac combined) had dental caries, with an average of 5.6 carious teeth per affected person. Many of the children had obvious gingival sepsis, materia alba and calculus, also reflecting poor oral hygiene. With few exceptions, dental treatment had never been sought prior to examination for this survey.

## DISCUSSION

The prevalence of dental caries and poor oral hygiene is well documented in Malaysia and Singapore with overall dental caries prevalence of approximately 90% for school children (Dental Epidemiological Survey Committee 1972, Majid and Abbas 1972, Goh *et al.*, 1972). Prevalence rate of 75% for 5 year old preschool children in Singapore was reported by Goh and Lim (1971). Generally,

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Table I

Prevalence of obvious dental caries and mean numbers of carious teeth per affected patient, amongst 233 children with heart defects and 217 children with non-cardiac diseases

	Percentages of patients with obvious dental caries			Mean number of carious teeth per affected patient		
	Cardiac Patients	Non-Cardiac Patients	All Patients Combined	Cardiac Patients	Non-Cardiac Patients	All Patients Combined
	60	65	63	5.4	4.6	5.0
Male	63	67	65	5.7	4.5	5.2
Female	55	63	59	4.9	4.6	4.7
Chinese	64	75	68	5.5	4.9	5.3
Malay	63	57	59	6.2	4.8	5.4
Indian	29	56	49	3.3	3.9	3.8
Cyanosed	60	-	-	5.5	-	-
Not Cyanosed	60	-	-	4.9	-	-

Chinese children had the highest rates of caries and Indian children the lowest, as observed in this survey. Gingival inflammation was also extremely common with prevalence rates 60-74% amongst Malaysian school children (Dental Epidemiological Survey Committee 1972, Majid and Abbas 1972).

The relationship between poor oral hygiene and infective endocarditis in patients with congenital or chronic rheumatic heart disease has long been appreciated. The danger of infective endocarditis is increased by dental procedures (Eisenbud 1962, Johnson *et al.*, 1975) especially in the presence of frank oral sepsis such as pyorrhoea or apical abscess. The reason for this is believed to be the bacteraemia of oral cavity bacteria (especially *Streptococcus viridans*) which frequently follows dental procedures. Okell and Elliot (1935) demonstrated transient bacteraemia following tooth extractions in 34% of patients with healthy gums and in 75% of those who had pyorrhoea at the time of extraction. 10.9% of patients with pyorrhoea had bacteraemia before any dental procedure was undertaken. These important findings have been confirmed by others and transient bacteraemia following other forms of surgery (eg. tonsillectomy and urinary tract instrumentation) has also been reported.

Clearly doctors have a responsibility to advise good oral hygiene for their patients with heart disease and to warn them of the risks of infective endocarditis. Dentists, by questioning each patient about possible heart defects, murmurs and previous rheumatic fever, before dental treatment, can identify the majority of patients at risk and so take prophylactic action. These responsibilities are often ignored (McGowen and Tuohy 1968).

Believing that transient bacteraemia may cause infective endocarditis and that bacteraemia can be aborted by appropriate antibacterial agents used in conjunction with dental and other surgical procedures which carry the risk of bacterial dissemination, antibiotic "cover" is recommended for such procedures. In University Hospital the Children's Heart Clinic routinely suggests the following prophylaxis regimes, based on recommendations of the American Heart Association (1965).

(i) BEFORE

TREATMENT: IM Penicillin G 500,000 u  
Plus IM Procaine penicillin 500,000 u  
given ½ hour before.

OR

Oral Penicillin V 500 mg  
given 1 hour before.

AFTER TREATMENT: Oral Penicillin V 250 mg  
6th hourly for 10 doses.

(N.B. Half dosages for children younger than 5 years).

(ii) In cases of proven or suspected penicillin allergy, OR in cases where penicillin has been used within the preceding 1 month (such as, by patients with Rheumatic heart disease on penicillin prophylaxis):-

BEFORE TREATMENT: Oral Erythromycin 20 mg/  
Kg given 1½ hours before.

AFTER TREATMENT: Oral Erythromycin 10 mg/  
Kg 6th hourly for 10 doses.

As penicillin-resistant bacteria (including *Streptococcus viridans*) emerge within 24 hours of commencing penicillin therapy and persist for some weeks after cessation of penicillin (Editorial B.M.J. 1971) and as some patients are sensitive to penicillin, an alternative prophylactic regime is important. Tozer *et al.*, 1966 suggest cephaloridine, or cephaloridine followed by erythromycin as the most effective practical alternatives to penicillin.

In this community where dental caries and poor oral hygiene are so common, especially as corrective heart surgery is not yet available for many who need it, the morbidity suffered by patients with heart defects can be reduced by simple advice regarding dental hygiene, and appropriate precautions during dental procedures.

### SUMMARY

The prevalence of dental caries in a group of Malaysian children with congenital or rheumatic heart lesions was assessed and compared with a control group of children with non-cardiac diseases. Dental caries prevalence rates for the two groups were not significantly different. 63% of the total 450 children examined had carious teeth, with an average of 5 carious teeth per affected patient. The risk of infective endocarditis in relation to dental caries and poor oral hygiene in children with heart defects is emphasised.

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# MAXILLARY SINUS AND THE ORAL SURGEON

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## INTRODUCTION

PARANASAL SINUSES are cavities lined with respiratory mucosa and communicate through tiny apertures with the nasal cavity. The maxillary sinuses which are bilateral and situated within the body of the maxillae are in very close relationship with the maxillary posterior teeth and as a result of its position becomes the focus of attention in oral surgery. The bicuspid teeth and the first maxillary molar lie beneath the floor of even a small maxillary sinus while the remaining molar teeth may have a layer of bony tissue separating the roots from the lining (Figs. 1 & 2). In some patients it can be noted that the apex of the root is in contact with the mucosa of the antrum. In oral surgery it is not unusual to see patients with involvement of maxillary sinuses in conditions like extension of dental infections, complications of extraction of teeth, spread of tumors and in cases of trauma where middle third of the facial skeleton is fractured. In this article, by presenting some types of dental pathology involving maxillary sinuses an attempt is made to emphasize the close co-operation that exists among specialists of various disciplines of medicine like otolaryngologists, dental, oral surgeons and general surgeons.

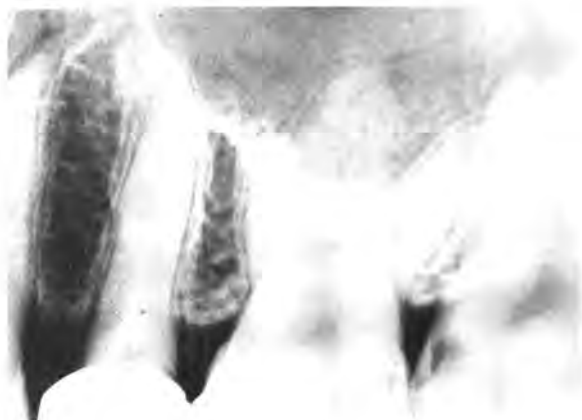
## PROBLEMS IN DIAGNOSIS

Patients with infections of maxillary sinus often present for the first time at the dental clinic. This can be appreciated when one realises that toothache is a very common symptom of an infected sinus. This is a result of the intimate relationship between the nerves supplying the maxillary teeth and the lining of the maxillary sinus. The superior alveolar

nerves supplying sensory fibres to the dental tissues run in the walls of the sinus and in the younger age



Fig. 1 Periapical radiograph showing antrum extending to premolar region.



**Fig. 2** Periapical radiograph showing close relationship between palatal root of 1st molar and sinus.

group are separated from the sinus by a thin plate of bone. With increase of age the inner walls of the canals resorb resulting in the separation of the sinus lining and the nerves by their connective tissue. During inflammation of this area, nerves supplying the dental tissues will be affected and the end result will be pain which resembles pulpitis. On clinical examination, it will be found that all teeth in the affected area are hypersensitive without pathology. In differential diagnosis of pain in the maxillary molar region one must consider conditions like trigeminal neuralgia too. Both acute and chronic form of sinusitis can appear as a result of dental infection. Normally a dental surgeon during clinical examination will be able to trace the cause of the infection to a diseased tooth or some surgical procedure connected with a tooth. In some studies it is observed that the dental causes of sinus infection were as high as 40%. Factors like state of health of the accessory sinuses should be considered in arriving at a diagnosis.

#### **DENTAL SURGICAL COMPLICATIONS**

Extraction of maxillary posterior teeth can in some patients give rise to complications such as creation of an oro-antral fistula or displacement of the whole tooth or root into the maxillary antrum (Figs. 3 & 4). This is usually a result of either the presence of a large air sinus or the absence of a correct technique for the removal of the tooth or root. History of previous antral involvement during surgery, or removal of isolated molar in relation to the sinus are indications for careful pre-operative evaluation and careful surgical removal of the tooth. Fracture of maxillary tuberosity during extraction is often due to the invasion of the tuberosity by the antrum and this can result in the creation of an oro-

antral fistula. A newly created oro-antral fistula is repaired by an oral surgeon by encouraging healing by organisation of blood clot. Usually this is achieved by providing a support in the way of immobilising a soft tissue flap and thereby preventing the entry of organisms into the sinus. At all times attempt is made to cover the defect with a mucoperiosteal flap. Additional support can be given by covering the area with an acrylic resin extension to a denture or other base plate. Patient is discharged with instruction not to blow the nose which may disturb the clot. Decongestant nasal drops and inhalations are of additional help to these patients.



**Fig. 3** Radiograph showing tooth in maxillary sinus.



**Fig. 4** Periapical x-ray showing fractured portion of root in the sinus.

## MALIGNANT DISEASE

It is possible that patients with malignant disease of maxilla may present at the dental clinic in the first instance particularly in rural hospitals. On clinical examination they may be seen to have signs and symptoms for which no obvious dental cause can be found. Common suspicious symptoms include pain in the upper jaw, bleeding from nose and in some patients there can be loosening of the maxillary teeth in relation to the sinus for which no local cause is demonstrable. Other useful hints include excessive bleeding after dental extractions and difficulty in healing of sockets following extraction with proliferation of soft tissue in some cases (Fig. 5). Detailed clinical examination together with x-ray investigation usually helps one to arrive at a definitive diagnosis and the chief responsibility of the dental/oral surgeon lies in promptly referring the patient to the E.N.T. (Otolaryngologist) specialist for management.

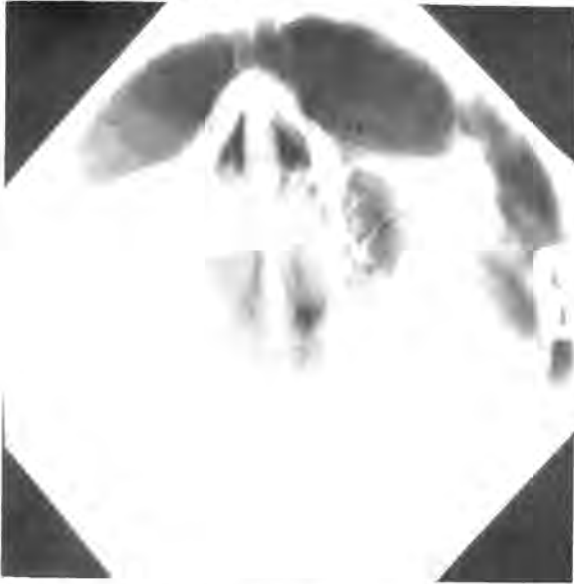


Fig. 5 Radiograph showing carcinoma of maxillary sinus.

## DENTAL CYSTS AND FRACTURES

Cysts may be seen in the maxilla in relation to the maxillary sinus and the commoner types include the dental and dentigerous variety. Cysts may also arise from the mucosa of the sinus. Cysts in the maxilla and the maxillary sinus may present very similar radiographic appearances and differentiation can be difficult at times. Comparison of similar radiographs of identical areas of the opposite sides of the skull will help in differentiation. Presence of vascular channels as radiolucent areas in x-ray of

the normal antrum together with the presence of Y sign of Ennis in the bicuspid region are helpful aids in definitive diagnosis. For further confirmation it is advisable to carry out procedures like aspiration of the contents of the lesion. Fractures of the middle third of facial skeleton often present with malocclusion, ophthalmic disturbances etc. as a result of comminution and displacement of the walls of the maxillary sinus (Fig. 6). It may become necessary for the surgeon to carry out open reduction in some cases of transverse facial fractures. In these cases very often it becomes necessary to remove haematoma and pieces of bone in the antrum via surgical exposure of the sinus. Correct reduction should be carried out to eliminate any displacement or step formation in the infra orbital ridge. A Caldwell-Luc procedure is the accepted technique for entry to the maxillary sinus if it becomes a necessity. It is also essential to carry out antrostomy in all infected cases to establish drainage.

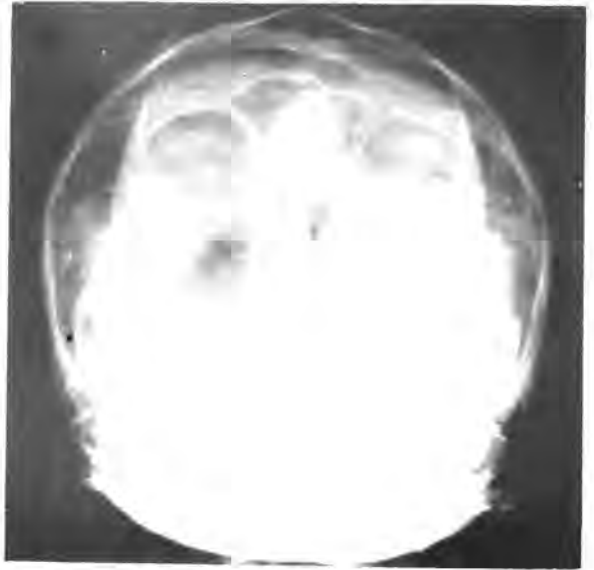


Fig. 6 Radiograph showing fracture of facial skeleton involving the sinus.

## CONCLUSION

Diseases of maxillary sinuses often present for the first time at various clinics in government hospitals and can be seen by variety of specialists like E.N.T. surgeons, dental, oral and general surgeons. Problems in diagnosis can arise in these patients by virtue of the fact that the dental tissues and the antrum are very closely related anatomically. By presenting some cases seen in oral surgery clinic an attempt is made to stress the need for increasing consultation among specialists in various disciplines of medicine and surgery.



# A PSYCHOSEXUAL STUDY OF ABORTION-SEEKING BEHAVIOUR

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## INTRODUCTION

MAN, through the ages from primitive, non-literate societies to advanced, industrialized and sophisticated societies, has attempted to control conception by a variety of largely crude methods, failing which he tried to interrupt pregnancy. Although abortion was and is widely practised, attitudes toward abortion have ranged over a wide spectrum, from approval, bordering on encouragement, to total prohibition and condemnation.

The term 'abortion' in both the legal and obstetric context is generally applied to the premature expulsion of the product of conception, that is, before twenty-eight weeks of pregnancy (the period after which the foetus is considered viable). The W.H.O. Scientific Group on Spontaneous and Induced Abortion (1969) defines 'induced abortions' as those initiated by deliberate action, undertaken with the intention of terminating pregnancy; all other abortions are considered as spontaneous even if an external cause is involved.

The current trend towards liberalization of abortion laws in many countries throughout the world has generated a wealth of data on the incidence of abortion and it is revealed that abortion has been the most widely practised method of fertility control in virtually every country, no matter what its culture, politics or religion.

## Induced Abortion in Malaysia

The laws regarding abortion in Malaysia are stringent within the context of the Penal Code, where sections 312-316 and 511 define induced

abortion as an act that is illegal and punishable. Thus, the Malaysian woman, who is intent on getting rid of an unwanted pregnancy will need to seek the services of back-street abortionists and *bomohs* in unhygienic surroundings, using various roots, herbs and twigs as abortifacient.

The West Malaysia Family Survey (1966) revealed that at least 1% of the women admitted to having one induced abortion during their reproductive life. The Report on Maternal Health and Early Pregnancy Wastage in Peninsular Malaysia (FFPA, 1977) shows that 18% of the induced abortions were performed with the help of medicine and herbs by non-doctors.

## Abortion-Seeking Behaviour

Psycho-social research in human fertility-regulating behaviour is gradually attracting the interest of a wide spectrum of behavioral scientists. Available information on the characteristics of abortion-seekers is fragmentary and studies are scanty. Another dimension of abortion, that is, sexual relationship, is even more neglected. If one wishes to place abortion within its psychosocial context, it emerges as one stage and one alternative strategy in a series of events, decisions and pathways that begin with sexual relationship.

In the context of current social demand and in the absence of any such studies, it seems at present relevant to study abortion in its psychosexual context. This study therefore attempts to get a 'feel' of the phenomenon, preliminary information and to form new hypothesis for future empirical investi-

gations. Thus, it is purely an exploratory study which attempts to describe the various socio-demographic, sexual and personality characteristics of women, seeking abortion at the University Hospital, Kuala Lumpur, Malaysia.

## METHOD

This study encompassed forty-two subjects picked randomly from those who came to seek termination of their pregnancies at the University Hospital during the period of July 1977 to October 1977. The data was obtained on two sets of questionnaires, a structured questionnaire containing items relating to (i) socio-demographic factors and (ii) sexual-relationship and the Eysenck Personality Inventory (E.P.I.), a standardized personality inventory. Interviews were conducted by the interviewers who were proficient in both the Chinese and Bahasa Malaysia dialects, besides English.

## RESULTS

### Socio-demographic Profile

#### *Ethnic Group :*

Women of all ethnic groups were recorded to have sought abortion to terminate their pregnancy. Table I shows that there were 17 (40%) Chinese,

15 (36%) Malays, 6 (14%) Indians and 4 (10%) Others.

#### *Age Distribution :*

The greatest proportion of women seeking abortion were in the 28-32 age group with a mean age of 29, which is slightly lower than the mean age of 31.1 years for all ever married females in the reproductive age in Peninsular Malaysia. The mean age for various ethnic groups is also shown in Table I.

#### *Marital Status :*

There were 37 (88%) married women, 2 (5%) were separated and 3 (7%) were single. Both the separated women and two of the single women were Malays, while the other single woman was a Chinese (Table I).

#### *Education :*

The majority of the women in the sample had some form of formal education. Twenty-three (55%) had gone to a secondary school, 3 (7%) had been to the University and only 2 (5%) were illiterate (Table I).

**Table I**  
**Distribution of Respondents by Mean Age, Marriage, Occupation and Education.**  
**(Socio-Demographic Variables)**

Item	Malay (N=15)	Chinese (N=17)	Indian (N=6)	Others (N=4)	Total (N=42)
(i) <i>Mean Age</i>	27	31	28	32	29
(ii) <i>Marital Status</i>					
Married	11	16	6	4	37
Separated	2	0	0	0	2
Single	2	1	0	0	3
(iii) <i>Occupation</i>					
Housewife	5	7	3	1	16
Working	10	10	3	3	26
(iv) <i>Education</i>					
None	1	1	0	0	2
Primary	5	4	1	0	10
Secondary	7	9	4	3	23
University	1	2	0	0	3
Other	1	1	1	1	4

### Occupation and Income :

Twenty-six (62%) of the women were employed and 16 (38%) were housewives (Table I). The largest number of subjects, that is, 17 (40%) came from the income group of \$150-\$350, 11 (26%) belonged to the bracket of \$351-\$500 and 8 (19%) came from the income group of above \$800. There were 4 (10%) subjects who came from the below \$150 income bracket.

### Religious Background :

All the subjects professed to belong to some religion, with one exception who called herself a free-thinker. Sixteen (38%) were Muslims, 11 (26%) were Buddhists, 9 (22%) were Christians and the remaining 5 (12%) were Hindus.

### Sexual Profile

The present study attempts to explore a few aspects of female sexual behaviour without formulating any hypothesis on the relationship, if any, between abortion and sexual behaviour as such. The results on sexual profile include data on the following aspects: pre-marital sex, forms and frequency of sexual intercourse, sexual satisfaction and orgasm, sexual frustrations and maladjustments and birth-control and sexual intercourse.

Table II  
Sexual Profile

Item	Yes	No	Total
Pre-marital sex	6	36	42
Orgasm experience	28	14	42
Enjoy sex	37	5	42
Husband ejaculates too quickly	20	22	42

### Pre-Marital Intercourse :

In the present sample, 6 (14%) subjects reported having experienced pre-marital intercourse and 36 (86%) denied ever having experienced pre-marital intercourse (Table II). There were no differences in terms of ethnic groups.

### Forms of Sexual Intercourse :

The most common position in this sample was the 'face-to-face' and more popularly known 'missionary' position. Sixteen (38%) practiced rear-entry position and oral-genital stimulation besides the common 'face-to-face' position.

### Duration and Frequency of Intercourse :

Six (14%) of the subjects reported the duration of intercourse to be less than five minutes, while 3 (7%) reported it to be more than half an hour. Twenty-one (50%) responded with the duration ranging from ten minutes to half an hour. Eleven (26%) reported the duration to be five minutes only.

Frequency of intercourse in itself does not tell very much on one's sexual responsiveness. However, the discrepancy between the actual and preferred frequency could be an important indicator. Twenty-one (50%) subjects reported the average frequency of intercourse per month to be 5-14 times, 13 (31%) had intercourse 1-4 times a month and 6 (14%) reported it to be 15-34 times per month. There was one woman who responded the frequency of intercourse to be 35 and above per month, and one subject who denied having any intercourse at all. There were no significant differences between the actual and preferred frequency of intercourse as reported by the subjects.

### Orgasm and Sexual Satisfaction :

In the present study, 28 (67%) women said that they had experienced orgasm sometime or other and 14 (33%) subjects denied ever experiencing an orgasm. There were 37 (88%) women who responded that they enjoyed sexual intercourse (Table II). However, there were only 15 (36%) women who achieved complete sexual satisfaction and 8 (20%) of the subjects had little or no satisfaction at all.

### Sexual Frustrations and Maladjustments :

This section includes items like - 'husband being too demanding', 'any unsatisfactory things in sexual-intercourse', 'desire for intercourse with other than husband', and 'sexual attraction towards own sex'. As shown in Table III, 16 (38%) subjects complained that their husbands were too demanding in bed. As for 'unsatisfactory things' in their sexual experience, 20 (47%) subjects said that their spouses ejaculate too quickly, 11 (25%) complained of too frequent intercourse, 8 (19%) objected to some of the practices during intercourse and 3 (6%) complained of difficulty in erection on the part of their spouses.

When asked whether they ever experience a desire for sexual intercourse with other than husband, 32 (76%) subjects said 'never,' 4 (10%) said that some times they had a desire for intercourse with other than their husbands and 6 (14%) reported this desire to be very rare.

As far as the attraction towards their own sex was concerned, 8 (19%) subjects admitted being sexually attracted to their own sex from 'sometimes' to 'frequently'. Among Malays, there were 7 (47%) women who said that they felt sexually attracted to women. None of the Indians or others experienced this attraction towards their own sex.

**Table III**  
**Sexual Frustrations and Maladjustments**

Item	No. of Responses
(i) <i>Husband too demanding</i>	
Yes	16
No	26
(ii) <i>Unsatisfactory things</i>	
Too little enthusiasm	2
Difficulty in erection	2
Ejaculated too quickly	17
Intercourse too often	9
Practices - objectionable	7
(iii) <i>Desire for intercourse other than husband</i>	
Frequently	0
Sometimes	4
Rarely	6
Never	32
(iv) <i>Sexually attracted to own sex</i>	
Frequently	2
Sometimes	6
Rarely	3
Never	31

*Birth-Control and Sexual Intercourse:*

Table IV shows that 33 (79%) subjects were practising some form of contraception and 9 (21%) did not use any method to avoid conception.

In spite of the fact that most of the women were using some form of contraception, 24 (55%) subjects felt unsafe during intercourse, 15 (34%) subjects said that it spoils the sexual pleasure and 19 (46%) subjects had definite fears of getting pregnant during intercourse.

Consistent and regular use of contraceptives is important for effective birth-control. Four (10%) subjects admitted that they frequently forget to take necessary precautions, 12 (28%) said 'sometimes' and 26 (62%) responded 'rarely' or 'never'.

Thirty-five (83%) subjects indicated a desire to have more children and only 7 (17%) subjects said that they do not wish to have any more children.

**Table IV**  
**Birth Control and Sexual Intercourse**

Item	No. of Responses
(i) <i>Methods Used</i>	
Pill	16
Condom	8
IUD	1
Withdrawal	3
Safe Period	4
Others	1
None	9
(ii) <i>Feel Unsafe</i>	
Yes	24
No	18
(iii) <i>Spoils Sexual Pleasure</i>	
Yes	15
No	27
(iv) <i>Fear of Pregnancy</i>	
Yes	19
No	23
(v) <i>Forget to take necessary precautions</i>	
Frequently	4
Sometimes	12
Rarely	15
Never	11

**Personality Profile**

The Eysenck Personality Inventory (Form A), was used to study the personality profile which measures the personality dimensions of Extraversion and Neuroticism as defined within Eysenck's personality theory.

Table V presents the mean scores for all the ethnic groups on the N (Neuroticism), E (Extraversion) and L (Lie) Scales - which show high standard deviations for all the groups.

On the N Scale, the Chinese scored the highest mean score of 13.29 which is higher than the mean score of 12.86 for the total group; though not statistically significant.

On the E Scale, the Malays scored the highest mean score of 14.31 which is higher than the mean E score of 11.37 for the total group. This difference was found to be statistically significant ( $p < .05$ ). Indians scored the lowest mean score of 9.37 and when compared with the mean score for Malays, the difference is statistically significant ( $p < .05$ ).

With the exception of Malays, the rest of the ethnic groups had higher mean score on the N than the E Scale and the mean N score for the total group was found to be higher than the mean score on the

**Table V**  
**Mean Scores and Standard Deviations of Various Ethnic Groups (N=42) on**  
**Eysenck Personality Inventory (Form A)**

	Malay		Chinese		Indian		Others		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Neuroticism (N)	12.81	4.92	13.29	3.18	12.17	3.79	12.25	6.06	12.86	4.31
Extraversion (E)	14.31	3.99	9.65	3.37	9.33	4.82	10.0	1.22	11.37	4.36
Lie Score (L)	4.56	1.97	4.06	1.86	4.00	1.15	3.75	1.09	4.21	1.79

E Scale, though these differences are not statistically significant.

The mean L score for the total group was within the range required for the validity and reliability of the responses.

## DISCUSSION

### Socio-demographic Characteristics

Though the size of the sample was relatively small due to the legality of the issue and the nature of the study, the findings on the socio-demographic variables are comparable to the ones made by FFPA (1976). There is a higher proportion of Chinese and Indians when compared to the community group distribution, though the trend is not unexpected as the respondents were from urban areas where there is a greater concentration of Chinese and Indians. The majority of the women went through some form of education and were working women who came from lower income groups. Age and marital status is an important characteristic, as most of the women were married with an average age of twenty-nine and had children, which is contrary to their American counterparts as reported by Tietze and Lewit (1973) in their findings in "The Joint Program for the Study of Abortion" (JPSA) where the typical patient was young in her early twenties, single and pregnant for the first time. This nullifies the fallacy that only young, unmarried women seek abortion and abortion law reforms may encourage immorality. Though the majority of the women belonged to some religious group, the degree to which they practiced their religion was not assessed. Religion was found to be related to the rate of abortion in the FFPA Survey (1976) where those who actively practiced their religion had lower induced abortion rates.

### Sexual Profile

With the now ready availability of controlling conception by a multitude of techniques and devices as well as the concern over the need to control population, there are broad changes in human values

regarding sexual activity and freedom. Sex is not considered to be restricted for procreation alone. However, the question of female sexuality has rarely been explored and thus far there is no published work on the nature of female sexual behaviour in Malaysia. Being purely an exploratory study, an attempt has also been made to study few characteristic patterns of female sexuality in the present study.

Most of the women were frank and readily discussed the intimate aspects of their sexual experience. Many of them admitted pre-marital sex and experiencing sexual attraction towards their own sex in spite of the strong social and moral convictions. The women in the present sample are found to be quite active in their sexual life, and there is a fair amount of sexual experimentation. There is ample evidence that all cultures experiment with coital positions. Apart from providing variety, experimentation with coital positions helps make intercourse a more deliberate and purposeful event, instead of a mechanical act leading to procreation alone.

If orgasm is chosen as a unit to quantify human sexual behaviour, then almost one-third of the respondents had never experienced orgasm which is somewhat close to the Kinsey's findings where about 30% either never achieve orgasm or do so occasionally (Kinsey *et al.*, 1953), while Shere Hite (1977) in her nation-wide study of female sexuality found that for over 70% of the women, intercourse did not regularly lead to orgasm. However, it must be added at this point that sexual responsiveness and orgasm-capacity need to be considered separately. While the majority of the respondents enjoyed sexual intercourse, a considerable number of them were unable to achieve complete sexual satisfaction.

In the light of evidence mustered by Masters and Johnson (1966) that the physiological processes involved in the female orgasm are analogous to



those in the male orgasm, the fact remains that women have more orgasm difficulty and less sexual satisfaction. Beside the stringent sexual controls to which women have been subjected to from early childhood, it also appears from the study that sexual frustration is evoked by the poor performance of their partners, where almost half of the respondents complained that their partners ejaculate too quickly.

Another factor that makes the sexual act a serious menace, is the risk of impregnation. There are frequent assertions in the literature that fear of pregnancy inhibits women and prevents them from experiencing sexual stimulation positively (Landis *et al.*, 1950; Terman, 1938; Rainwater, 1965; Farber *et al.*, 1966). In spite of the fact that most women were using some form of contraception, a large number of them felt unsafe during intercourse and consequently found that it spoils their sexual pleasure.

Though the respondents were seeking the termination of their pregnancy, the majority of them showed a desire to have more children in the future and therefore abortion was found necessary only because of contraceptive failures.

#### **Personality Profile:**

The subjects were assessed on the personality dimensions of Extraversion and Neuroticism. Neuroticism (N) is defined as the "general emotional liability of a person, his over-responsiveness and his liability to neurotic breakdown under stress." Extraversion (E) refers to the "outgoing, uninhibited social proclivities of a person." (Eysenck, 1959).

The E.P.I. also incorporates a lie scale by the use of which the subjects showing "desirability response set" may be eliminated. However, such subjects in this study, though few, were retained since the tendency to have a high L score may in itself be an interesting trait (Eysenck & Eysenck, 1963).

The results on the personality inventory show the total sample to be more introverted and slightly more neurotic than the Eysenck standard group. These findings are comparable with those in the study by Olley (1971) who measured 370 women on Cattell's 16 PF test at Aberdeen and found that the personality pattern of women who sought abortion was found to be more "neurotic" than the general population. However, it would be premature to come to such a conclusion in the present study in the absence of a control group.

There were significant differences within the various ethnic groups on the two personality dimensions. Malays were found to be more extroverted

than others and they also scored a higher mean lie score indicating a tendency to respond in a more desirable manner. Chinese showed a higher mean N score indicative of an overall unstable, neurotic traits compared to the rest of the group.

#### **CONCLUSION**

In the absence of precedent studies on the subject, it is difficult to compare the personality profile of the abortion-seekers in this sample except to merely state the characteristics that were found to be significant in this study. Far from pretending to be a complete study in itself, this effort will hopefully provide a basis for further research into the subject. It is pertinent to note that some of the characteristics of abortion-seekers that were revealed in this study may have definite implications in terms of existing legislation on abortion in Malaysia. For instance, the significant percentage of married women who sought abortion despite wanting to have children in the future, may warrant a case for a limited legalization of abortion in this country. The high incidence of patients coming with incomplete and septic abortions further substantiates the need for such law reform.

A final point and amongst most significant which must be considered, is the fate of children born to women who have been refused an abortion. Psychiatric literature abounds with research and case-histories documenting the immediate and long-term effects of unwantedness upon the child, if not directly, it is communicated inevitably, though unconsciously, in his mother's behaviour and response.

#### **SUMMARY**

Forty-two women who sought to terminate the unwanted pregnancy were interviewed to assess their socio-demographic characteristics, sexual profile and personality profile. They were found to be from all the major ethnic groups, majority of whom were married, working women with secondary education and an average age of twenty-nine years. Though a large percentage of them professed to enjoy sexual intercourse with their husbands, many of them had not experienced orgasm, failed to derive complete sexual satisfaction and enumerated among some of the unsatisfactory things in their sexual experience like 'husband ejaculates too quickly.' Some of them acknowledged being sexually attracted to their own sex, most of them being Malays. Though the majority of the respondents used some form of contraceptives, many of them felt unsafe during intercourse and found it to be interfering with their sexual experience. On the personality test, they were found to have traits of 'Introversion' and 'Neuroticism' with an exception of Malays who were more extroverted than the rest of the sample.

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# VARIATION IN SERUM IMMUNOGLOBULIN G, A AND M LEVELS IN MALAYSIAN BLOOD DONORS

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## INTRODUCTION

GAMMA-GLOBULINS consist of 5 major class of immunoglobulins (Ig) which are distinguished from each other by their Heavy chain immune specificity. In serum, the IgG makes up about 70 percent, IgA about 1-20 percent and IgM about 1-10 percent of the total gamma-globulins; IgD and IgE are present in trace amounts. The physio-chemical characteristics and the biological properties of these immunoglobulins are now fairly well understood and have been discussed in several reviews (Cohen & Milstein, 1967; Tomasi & Bienstock, 1968; Franklin & Frangiore, 1970; Bennich & Johansson, 1970).

There is a trend to study the levels of the immunoglobulins in various populations in order to gain a better understanding of the biological role of the immunoglobulins and also to derive the normal limits of the serum immunoglobulin levels. It is widely reported, chiefly as a consequence of results derived from work on ethnic Africans, that hyper-gamma-globulinemia is a common feature of populations in the developing countries of the tropics (Turner & Voller, 1966; Michaux, 1966; McFarlane & Voller, 1966; Rowe *et al.*, 1968; Samuel *et al.*, 1970; Higashi & Chowdury, 1971; McFarlane, 1973; Zegers *et al.*, 1973). Implicit in these observations is the suggestion that elevated immunoglobulin levels in the tropical populations is due to the prevalence of viral and bacterial infections and other parasitic infestation. A comparison of serum immunoglobulin levels in health (Claman & Merrill, 1964; Fahey & McKelvey, 1965; Lichtman *et al.*, 1967; Allansmith *et al.*, 1968; Rowe *et al.*, 1968)

and disease (Ngu *et al.*, 1966; Steihm & Fudenberg, 1966; Palma-Carlos *et al.*, 1971; Blaese *et al.*, 1971; Scott & Rasbridge, 1972; Lai & Van Furth, 1974; Dasgupta, 1974) for the same populations show that the immunoglobulin concentrations are raised in certain infections and diseases.

Apart from the reports on Africans, there has been little interest in the level of serum immunoglobulins in populations living in the tropics. Indeed, this blood parameter had not been investigated in normal Malaysians prior to our preliminary studies (Yadav & Shah, 1973, 1977; Shah & Yadav, 1973) although the population, especially in the rural areas, is subject to various endemic tropical diseases and parasitic infestations. Thus, the aim of this study was to determine the normal serum levels of IgG, IgA and IgM of Malaysians from the urban region (Chinese, Indian and Malays) and compare the data with that from the Orang Asli (Malaysian aborigines) who live mainly in the forest and are of a different socio-economic milieu.

## MATERIALS AND METHODS

### Blood Samples

Blood from normal young adults aged 11 to 20 years was obtained from male and female students at two schools in Petaling Jaya. One ml of blood was drawn by antecubital venepuncture into a 2 ml disposable syringe and allowed to clot overnight at 4°C in the syringe. Next morning, the serum was separated from the clot by centrifugation. Sera from adults aged 21 to 50 years were obtained from healthy blood donors through the courtesy of the Blood Bank at the University Hospital, Petaling

Jaya. The serum samples from Orang Asli were obtained via courtesy of the Gombak Orang Asli Hospital, Selangor. The sera were from non-patients who normally accompany the sick member of the family to the hospital. The 1846 sera used in this study were kept frozen at  $-20^{\circ}\text{C}$  until required.

### Preparation of immunoglobulins

The rabbit H-chain specific antisera to IgG, IgA and IgM were prepared in our laboratories following previously described techniques (Vaerman *et al.*, 1963; Fahey and McLaughlin, 1963). Briefly, the IgG was obtained as follows. The precipitate obtained at 40 percent Ammonium sulphate saturation of human serum was dialysed against 0.01 M phosphate buffer (pH 8.0) overnight at  $4^{\circ}\text{C}$ . A 10 ml aliquot of the dialysate protein was applied to a fractionation column ( $2.6 \times 30$  cm) containing DEAE-cellulose which had been equilibrated with 0.01 M phosphate buffer (pH 8.0) at  $4^{\circ}\text{C}$ . The same buffer was applied to the column at a flow rate of 15 ml per hour and the eluants collected in 4 ml fractions (LKB Ultra Rac Fraction Collector No. 7000A). The IgG, the purity of which was attested by Ouchterlony's (1968) double diffusion and immunoelectrophoresis (Scheidegger, 1955), was eluted from the column as a single peak at optical density 280 nm with 0.01 M phosphate buffer. The fractions containing the IgG were pooled, then concentrated to a final volume of 4 ml by negative pressure ultrafiltration using visking cellulose tubing ( $8/32''$  pore diameter less than 10,000 daltons) and stored at  $-20^{\circ}\text{C}$  in aliquots of 1 ml.

For preparation of IgA, 30 mls of pooled human serum was diluted nine times its volume with 0.02 M phosphate buffer (pH 6.0) and dialysed at room temperature against 2 litres of the same buffer which was continuously stirred. At the end of 2 hours, the buffer was renewed and dialysis continued for another 4 hours. The fine precipitate formed in the tube was removed by centrifugation and saved for isolation of IgM. The supernatant was concentrated to 30 mls by negative pressure ultrafiltration. Then an equal volume of 0.1 M  $\text{ZnSO}_4$  was added with continuous stirring, and precipitation was induced by raising the pH to 6.85 by dropwise addition of 1M  $\text{Na}_2\text{CO}_3$  at room temperature. The precipitate was removed by centrifugation, and the supernatant was concentrated to 4 mls at  $4^{\circ}\text{C}$  by negative pressure ultrafiltration. The solution was freed from zinc by addition of 1 percent (w/v) trisodium EDTA salt and dialysed overnight against 0.01M phosphate buffer (pH 8.0) at  $4^{\circ}\text{C}$ . Then a 2 ml sample of the solution was applied to a DEAE-cellulose column ( $1.6 \times 23$  cm) which had been

equilibrated with 0.01M phosphate buffer (pH 8.0). The column was eluted by gradient elution, made up of 200 ml of initial buffer (0.01M, pH 8.0) stirred by magnetic stirrer in a beaker connected by a siphon to another vessel containing 125 ml final phosphate buffer (0.3M, pH 8.0). A flow rate of 15 mls per hour was maintained through the column and 3.4 ml fractions effluents were collected with the aid of a fraction collector. The protein concentration was estimated by measuring the optical density at 280 nm in a Beckman Spectrophotometer. Two protein peaks were obtained and the fractions under the first peak were pooled and concentrated to a final volume of 10 ml. The precipitate obtained by 40% ammonium sulphate saturation of the solution was dissolved in 2 ml saline. Further IgG contaminants were removed by treatment with 0.5 mg of rabbit anti-IgG immunoabsorbent (Avrameas & Ternynck, 1969). The IgA, purity of which was checked by immunodiffusion tests, was dialysed against saline at  $4^{\circ}\text{C}$  and kept at  $-20^{\circ}\text{C}$  in aliquots of 1 ml.

The euglobulin precipitate obtained from the preparation of IgA was dissolved in 10 ml saline, and dialysed against 0.1M Tris-HCl buffer (pH 8.0) at  $4^{\circ}\text{C}$  overnight. Precipitate formed during the dialysis was discarded by centrifugation and the supernatant used for the purification of IgM. The protein sample was applied to a Sephadex G-200 column ( $2.6 \times 190$  cm) which was equilibrated with 0.1M Tris-HCl buffer (pH 8.0). Eluates were collected at a flow rate of 15 ml/hr. in 5 ml fractions and the protein concentration estimated by reading the optical density at 280 nm. The fractions under the first peak were pooled and concentrated to 10 mls by negative pressure ultrafiltration. The proteins precipitated with 40% ammonium sulphate were dissolved in 2 ml saline and dialysed against 0.01M phosphate buffer at  $4^{\circ}\text{C}$  overnight. The 2 ml sample was then applied to a DEAE-cellulose column ( $1.6 \times 24$  cm) which was equilibrated with 0.01M phosphate buffer (pH 8.0). The column was eluted by gradient elution with 160 ml, 0.01M phosphate buffer (pH 8.0) as initial buffer and 80 ml 0.3 M phosphate (pH 8.0) as final buffer. Three ml fractions were collected at a flow rate of 15 ml/hr and the protein concentration was estimated at optical density at 280 nm. The fractions under the second peak were pooled and concentrated to 7 mls by ultrafiltration. Then, Potassium bromide crystals were added (24 gm/100 ml) to give a density of 1.2. The solution was centrifuged at 105,000 g for 24 hours in a Ultracentrifuge (Beckman Spinco Model L, Rotor Type 40). The lipoproteins contaminants which formed a top layer were pipetted off and the remaining solution dialysed against saline. The



purity of IgM was attested by immunodiffusion and aliquots of 1 ml kept at  $-20^{\circ}\text{C}$ .

### Preparation of antisera

The antisera was made in New Zealand white rabbits (2–3 kg) obtained from Central Animal House of the University Hospital. The rabbits were maintained on animal feed pellets and water *ad libitum* and green vegetables provided twice weekly.

An emulsion made with 0.5 mg of purified immunoglobulin in 1 ml saline was mixed with equal volume of complete Freund's Adjuvant (Difco Co., Detroit, U.S.A.) was injected subcutaneously at 6 to 8 sites on the dorsum and flanks of the rabbit. Subsequent multisite injections were routinely done weekly, in incomplete Freund's Adjuvant. After the 7th injection the rabbits were bled regularly from the marginal vein of the ear and the serum prepared from the blood was stored at  $-20^{\circ}\text{C}$  in 5 ml aliquots.

Anti-IgG sera specific to the heavy chain was prepared as follows. To a 50 ml aliquot of anti-IgG rabbit serum was added 1 ml of pooled Sephadex G-200 Fractions of peak I (chiefly IgM and some IgA) and precipitate formed after 30 minutes at room temperature and overnight at  $4^{\circ}\text{C}$  were removed by centrifugation. The procedure to remove light chain cross-reactivity was repeated, usually two to three times, until no further precipitate occurred. The anti-IgG so obtained did not cross-react with IgM and IgA and was used in the Mancini's (1965) quantitation procedure.

Anti-IgA and anti-IgM were made specific for the heavy chain by the addition of cord serum immunoabsorbents (Avrameas & Ternynck, 1969). One gram of the insoluble immunoabsorbent was added to 10 ml each of anti-IgA and anti-IgM rabbit serum. The mixture was gently stirred and incubated at room temperature for 1 hour and at  $4^{\circ}\text{C}$  overnight. The procedure had to be repeated once or twice, with a fresh batch of immunoabsorbent to make the antisera H-chain specific.

### Quantitative Determination of Immunoglobulins

The sera was assayed for immunoglobulin G, A and M by the single radial immunodiffusion method using agar diffusion plates incorporating immunoglobulin H-chain specific rabbit antisera (Mancini *et al.*, 1965). To 100 ml of barbiturate buffer (pH 8.6, ionic strength 0.1) was added 0.5 gm sodium azide to prevent bacterial growth, 6 gms polyethylene glycol to stabilise the agar and enhance

precipitation, and 3 gms of agarose (Sigma Chemical Co., St. Louis, U.S.A.). The agar was heated with constant stirring and upon going in solution it was distributed into 20 ml McCartney bottles and stored at  $4^{\circ}\text{C}$ . The required amount of solidified agar was melted in a boiling waterbath and then cooled to  $55^{\circ}\text{C}$ . The antiserum after appropriate dilution with barbiturate buffer (1:6 for anti-IgG, 1:4 for anti-IgA and anti-IgM sera) was brought to  $55^{\circ}\text{C}$  in a water bath. Equal volumes of the agar and anti-serum were mixed and quickly poured using preheated pipettes into special moulds consisting of two glass plates ( $7 \times 10$  cm) held 1.8 mm apart; the moulds were placed in the vertical position until the agar solidified. Circular wells were punched in the gel using a gel-cutter of 3 mm bore. In each agar plate, 10  $\mu\text{l}$  of appropriate standards (obtained from World Health Organisation), control and test sera were placed in the wells and allowed to diffuse 3 days in anti-IgG and anti-IgA agar plates and 5 days in anti-IgM agar plates. The average reading of the diameters of the precipitation rings were taken at  $90^{\circ}$  with each other. Observations for standard immunoglobulin were plotted on semi-logarithmic scale and the concentration of the immunoglobulin in test serum was determined from the standard curve and expressed in mg/100 ml and also in International Units (I.U.) per ml.

Estimate of the reproducibility of the technique for the quantitative determination of immunoglobulins in our laboratory was obtained from the values observed on one control serum included in each antibody-agar plate prepared on different days using different batches of antisera. The coefficient of variation found was 3.5 percent for IgG, 6 percent for IgA and 6.8 percent for IgM. Thus, the variation was small and comparable to those reported by others (Kalf, 1970; Maddison *et al.*, 1975).

## RESULTS

### Immunoglobulin G levels in serum

*Normal levels and distribution:* The mean serum IgG levels of 445 Chinese, 409 Indians, 635 Malays and 217 Orang Asli of various ages is summarised in Table 1. The mean serum IgG concentration of females is not significantly different from that of the males for each of the age groups tabulated except that of the 11 to 15 years age group. In Chinese, Indian and Malays the mean IgG level of females is significantly higher ( $P < 0.01$ ,  $P < 0.05$ ,  $P < 0.01$ , respectively) than the mean IgG level of the males; in the Orang Asli there is no difference in the serum IgG levels in the sexes of this age group.



Table I: Serum IgG levels in Malaysians of four racial origins

Race & Sex	Age (years)	Young adults							Adults				Total
		11-15	16-20	21-25	26-30	31-35	36-40	41-50	11-50				
CHINESE	Males	1084 ± 322† (24)	1286 ± 554 (147)	1340 ± 382 (84)	1361 ± 326 (68)	1216 ± 408 (52)	1106 ± 265 (22)	1394 ± 479 (7)	1280 ± 449 (404)				
	Females	1340 ± 581** (13)	1146 ± 196 (10)	1365 ± 295 (11)	1367 ± 201 (3)	1228 ± 239 (4)	-	-	1291 ± 385 (41)				
INDIAN	Males & Females	1174 ± 435 (37)	1277 ± 540 (157)	1343 ± 373 (95)	1361 ± 321 (71)	1218 ± 396 (56)	1106 ± 265 (22)	1394 ± 479 (7)	1281 ± 443 (445)				
	Males	1079 ± 436† (24)	1336 ± 360 (75)	1363 ± 384 (104)	1271 ± 286 (80)	1271 ± 457 (64)	1176 ± 340 (16)	1126 ± 321 (16)	1287 ± 382 (379)				
MALAY	Females	1323 ± 194* (13)	1229 ± 180 (6)	1233 ± 111 (6)	1167 ± 120 (3)	1115 ± 235 (2)	-	-	1257 ± 186 (30)				
	Males & Females	1165 ± 387 (37)	1328 ± 351 (81)	1357 ± 376 (110)	1267 ± 282 (83)	1265 ± 452 (66)	1176 ± 340 (16)	1126 ± 321 (16)	1284 ± 316 (409)				
ORANG ASLI	Males	1236 ± 279† (7)	1362 ± 282 (203)	1297 ± 471 (196)	1318 ± 292 (92)	1243 ± 316 (50)	1525 ± 314 (26)	1625 ± 305 (4)	1330 ± 284 (378)				
	Females	1587 ± 192** (12)	1280 ± 172 (20)	1211 ± 215 (15)	1342 ± 157 (6)	1250 ± 36 (4)	-	-	1332 ± 228 (57)				
ORANG ASLI	Males & Females	1458 ± 284 (19)	1355 ± 275 (223)	1291 ± 384 (211)	1320 ± 285 (98)	1243 ± 304 (54)	1525 ± 314 (26)	1625 ± 305 (4)	1331 ± 280 (635)				
	Males	1720 ± 480† (5)	1759 ± 440 (33)	1836 ± 898 (78)	1911 ± 234 (7)	1872 ± 323 (6)	2042 ± 850 (7)	1717 ± 413 (15)	1818 ± 727 (151)				
ORANG ASLI	Females	1583 ± 768 (6)	1818 ± 472 (20)	1770 ± 740 (12)	1825 ± 159 (8)	2111 ± 224 (6)	1816 ± 450 (9)	1470 ± 248 (5)	1788 ± 484 (66)				
	Males & Females	1646 ± 674 (11)	1781 ± 453 (53)	1827 ± 859 (90)	1865 ± 201 (15)	1991 ± 320 (12)	1914 ± 665 (16)	1656 ± 393 (20)	1809 ± 662 (217)				

† Mean ± standard deviation in mg per 100 ml; multiply by 0.12 to convert to I.U./ml. Parenthesis indicates number of observations.

Significant difference between males and females of each group \* P < 0.05, \*\* P < 0.01

The frequency distribution profiles of the serum IgG levels for Chinese (Fig. 1), Indian (Fig. 2) and Malays (Fig. 3) aged 11 to 50 years show a similar range (700 to 2350 mg/100 ml) and mode (1151 to 1300 mg/100 ml). In the Orang Asli (Fig. 4) the IgG levels are more broadly distributed, with a wider range (851 to 3250 mg/100 ml) and the mode is widely spread (1451 to 1900 mg/100 ml). About 13 percent of the Orang Asli have IgG levels greater than the highest level observed in the other 3 races (Fig. 4).

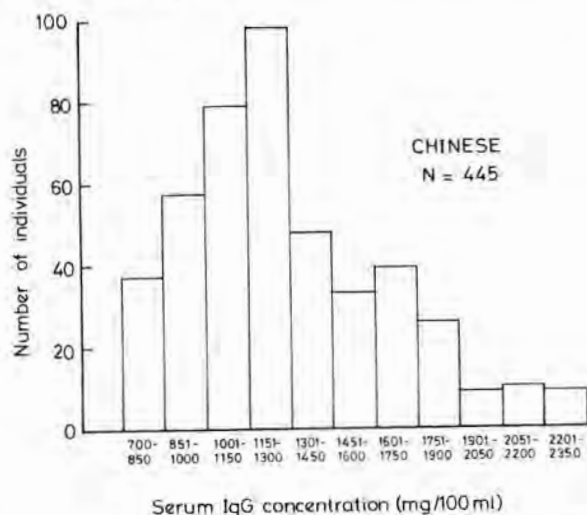


Figure 1: Frequency histogram profile of the serum IgG levels in the Chinese.

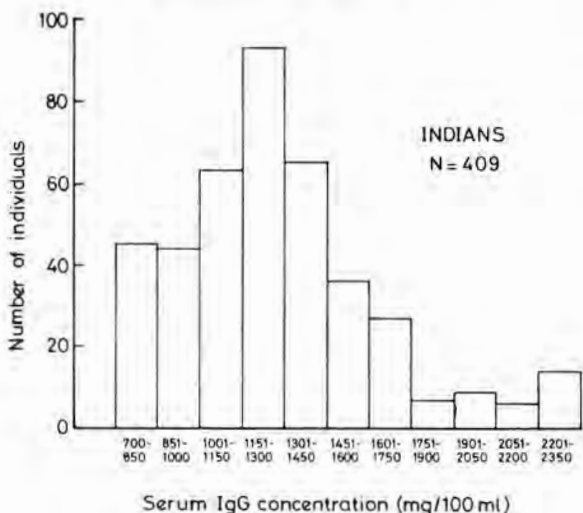


Figure 2: Frequency histogram profile of the serum IgG levels in the Indians.

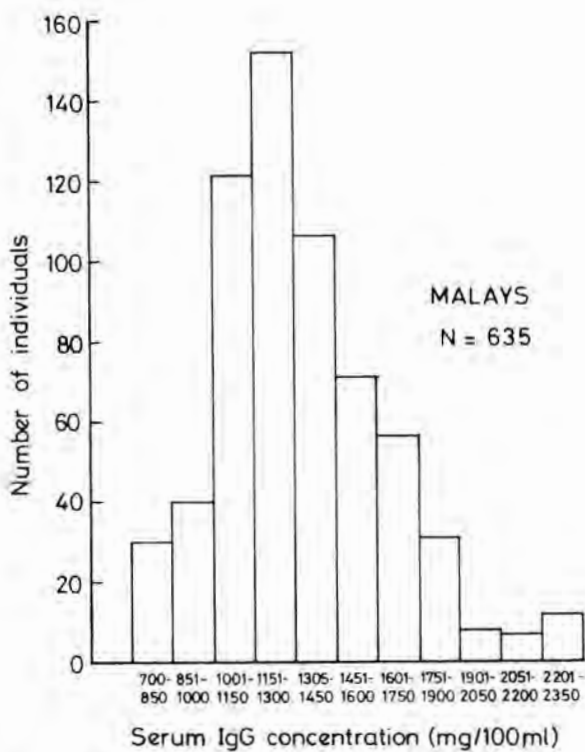


Figure 3: Frequency histogram profile of the serum IgG levels in the Malays.

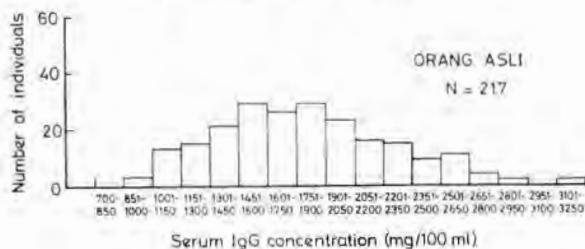
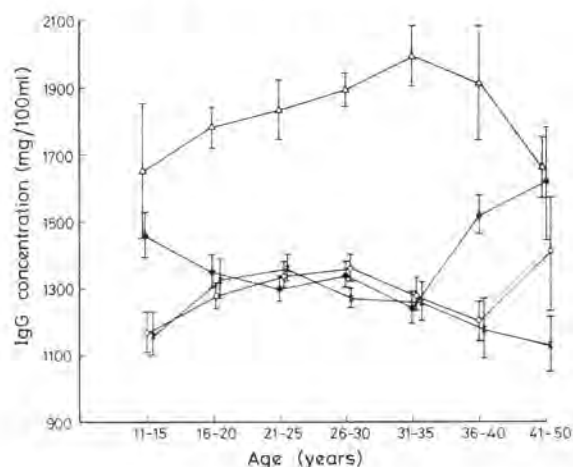


Figure 4: Frequency histogram profile of the serum IgG levels in the Orang Asli.

*Age variations:* In the age groups between 16 to 35 years there is little difference in the serum IgG levels of the 3 urban races, Malays, Chinese and Indians (Fig. 5). The mean IgG levels of the Malays aged 11 to 15 years is higher than the Chinese and Indians of the same age group. Among people aged 35 years and older, the Malays have higher mean IgG level than the Indians and Chinese. In contrast to the urban races, the Orang Asli have the highest IgG levels at all ages between 16 to 40 years; in the 11 to 15 years and 41 to 50 years age groups, the IgG levels of the Orang Asli are of equal magnitude to those of Malays of the same age

group but these levels are significantly higher ( $P < 0.05$ ) when compared to the levels in Chinese or Indians of the same age group.



**Figure 5:** Changes in serum IgG levels with age in Chinese (○), Indians (x), Malays (△) and Orang Asli (●). Bars indicate standard error of the mean.

The mean serum IgG levels of young adults (11 to 20 years) is not significantly ( $P < 0.05$ ) different from the mean levels of adults (21 to 50 years) in Chinese, Indian and Orang Asli. However, in Malays, the mean serum IgG concentration of young adults is significantly higher ( $P < 0.01$ ) than those of adults (Table II).

**Table II**

**Mean Serum IgG levels in Chinese, Indians, Malays and Orang Asli**

Age (years)	Young adults (11-20 years)	Adults (21-50 years)	Total (11-50 years)
Chinese	1257 ± 523† (194)	1301 ± 369 (251)	1282 ± 443 (445)
Indian	1277 ± 373 (118)	1287 ± 290 (291)	1284 ± 316 (409)
Malay	1363 ± 277* (242)	1311 ± 323 (393)	1331 ± 280 (635)
Orang Asli	1758 ± 496 (64)	1830 ± 719 (153)	1809 ± 662 (217)

† Mean ± standard deviation in mg per 100 ml. Parenthesis indicates number of observations.

\* Significant difference ( $P < 0.01$ ) between young adults and adults of each race.

**Racial differences:** Analysis of variance of the total mean serum IgG level for the four races shows that there is a significant difference ( $P < 0.01$ ) between the IgG concentration of the Orang Asli and the IgG concentration of the 3 urban races. The total mean serum IgG levels do not differ significantly ( $P < 0.01$ ) between the Malays, Chinese and Indians, but the total mean serum IgG of the Malays is significantly higher compared to the Chinese at the 5 percent probability level. There is no significant difference in the mean serum IgG levels of the Malays and Chinese adults but a significant difference ( $P < 0.01$ ) exists between the mean serum IgG levels of the Chinese and Malay young adults. Thus, the significant difference, observed in the total mean serum IgG levels of Malays and Chinese is due to the variance of the mean serum IgG concentrations in young adults.

### Immunoglobulin A levels in serum

**Normal levels and distribution:** In the Indians and the Orang Asli the mean serum IgA level is not significantly different in males and females of the age groups studied. In Chinese and Malays the females have significantly higher ( $P < 0.01$ ) serum IgA levels than males when all age groups are considered; in Chinese this sex difference is mainly due to the age group 16-20 years and in Malays it is due to the age group 11 to 15 years (Table III). The frequency distribution profiles of the serum IgA for the three urban races of the age 11 to 50 show the range between 80 to 440 mg/100 ml; the mode is at 161-200 mg/100 ml for Chinese and Indians and at 121-160 mg/100 ml for Malays (Figs. 6, 7, 8). In the Orang Asli, the IgA levels are broadly distributed with a range of 161 to 680 mg/100 ml and a mode of 321-360 mg/100 ml. In 18 percent of the Orang Asli the serum IgA levels are greater than the highest level observed for the 3 urban races (Fig. 9).

**Age variations:** The mean serum IgA level in the Orang Asli is higher than the levels observed in the three urban races for all age groups investigated (Fig. 10). The mean IgA levels of the Indians aged 16 to 35 years is higher than the IgA levels of the Chinese and Malays of the same age group. Of the four races, only in Malay and Chinese young adults have a significantly higher ( $P < 0.01$ ) mean IgA level than the levels of adults of each race; the mean IgA levels in young and old adults are of equal magnitude in Indians and Orang Asli (Table IV).

**Racial differences:** Analysis of variance of the data shows that a significant difference ( $P < 0.01$ ) exists between the serum IgA levels of the Orang Asli on one hand and the serum IgA levels in Chinese,

Table III: Serum IgA levels in Malaysians of four racial origins

Race & Sex	Young adults							Total	
	Age (years)	11-15	16-20	21-25	26-30	31-35	36-40		41-50
CHINESE	Males	218 ± 59† (25)	190 ± 63 (103)	180 ± 70 (138)	177 ± 70 (68)	192 ± 74 (50)	187 ± 76 (24)	189 ± 87 (16)	187 ± 72 (424)
	Females	257 ± 83 (16)	260 ± 65*** (9)	206 ± 65 (17)	-	-	-	-	237 ± 77** (42)
	Males & Females	233 ± 72 (41)	196 ± 66 (112)	183 ± 69 (155)	177 ± 70 (69)	192 ± 74 (50)	187 ± 76 (24)	189 ± 87 (16)	191 ± 72 (466)
	Males	232 ± 66† (27)	217 ± 79 (60)	228 ± 80 (130)	222 ± 71 (66)	222 ± 102 (40)	203 ± 52 (12)	199 ± 71 (22)	222 ± 79 (357)
INDIAN	Females	247 ± 57 (12)	206 ± 65 (11)	190 ± 57 (10)	-	-	-	-	216 ± 62 (33)
	Males & Females	237 ± 64 (39)	215 ± 77 (71)	225 ± 79 (140)	222 ± 71 (66)	222 ± 102 (40)	203 ± 53 (12)	199 ± 71 (22)	222 ± 78 (390)
MALAY	Males	200 ± 61† (36)	189 ± 59 (60)	187 ± 91 (100)	174 ± 68 (60)	169 ± 70 (22)	168 ± 36 (4)	170 ± 38 (12)	184 ± 74 (294)
	Females	257 ± 72* (13)	222 ± 77 (7)	183 ± 94 (12)	-	-	-	-	221 ± 88* (32)
	Males & Females	215 ± 69 (49)	192 ± 62 (67)	187 ± 92 (112)	174 ± 68 (60)	169 ± 70 (22)	168 ± 36 (4)	170 ± 38 (12)	188 ± 77 (326)
ORANG ASLI	Males	396 ± 104† (17)	388 ± 94 (24)	393 ± 116 (79)	417 ± 88 (7)	394 ± 18 (4)	407 ± 95 (4)	413 ± 98 (17)	396 ± 107 (152)
	Females	350 ± 101 (13)	392 ± 98 (14)	390 ± 125 (16)	486 ± 93 (8)	415 ± 35 (4)	361 ± 84 (6)	356 ± 98 (6)	390 ± 109 (67)
	Males & Females	376 ± 105 (30)	389 ± 96 (38)	392 ± 118 (95)	454 ± 97 (15)	404 ± 37 (8)	379 ± 90 (10)	388 ± 101 (23)	394 ± 107 (219)

† Mean ± standard deviation in mg per 100 ml; multiply by 0.66 to convert to I.U./ml. Parenthesis indicates number of observations.

\* Significant difference between males and females of each group \* P < 0.05, \*\* P < 0.01

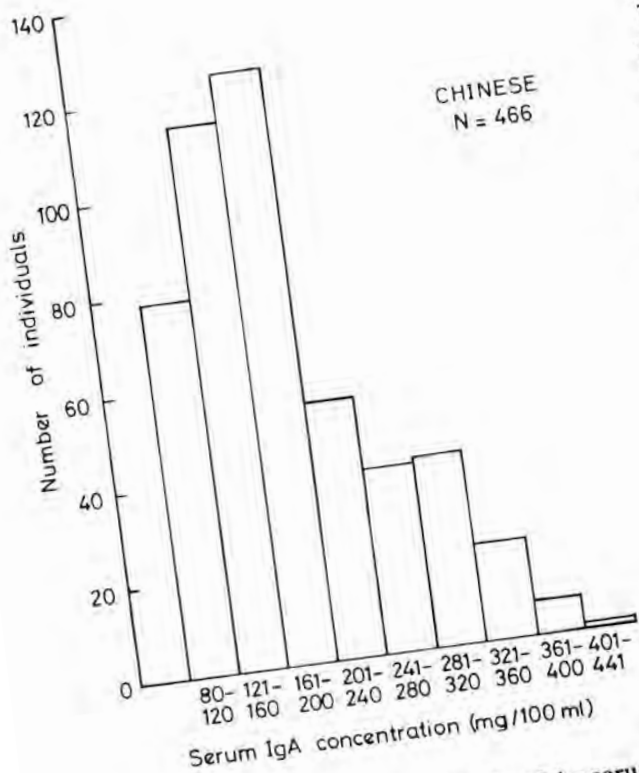


Figure 6: Frequency histogram profile of the serum IgA levels in the Chinese.

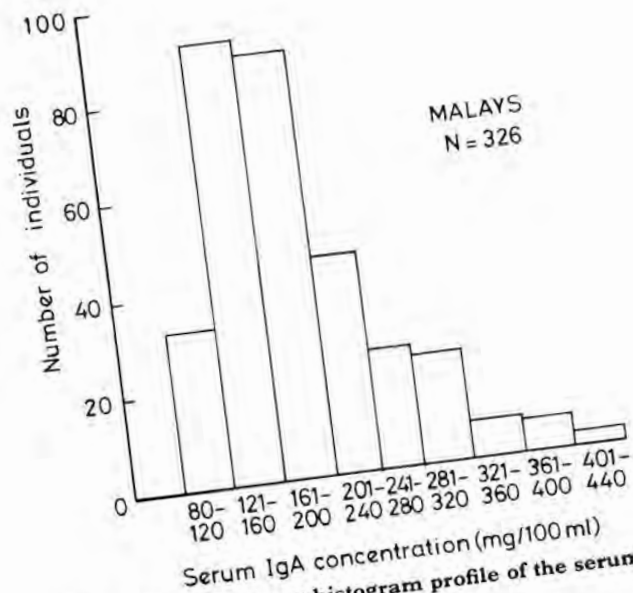


Figure 8: Frequency histogram profile of the serum IgA levels in the Malays.

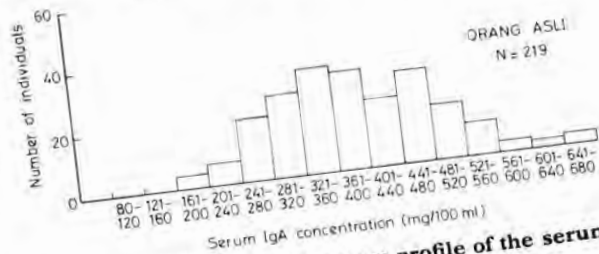


Figure 9: Frequency histogram profile of the serum IgA levels in the Orang Asli.

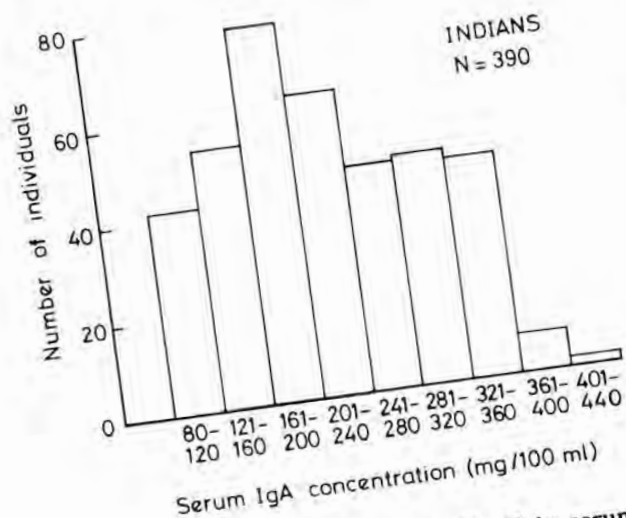


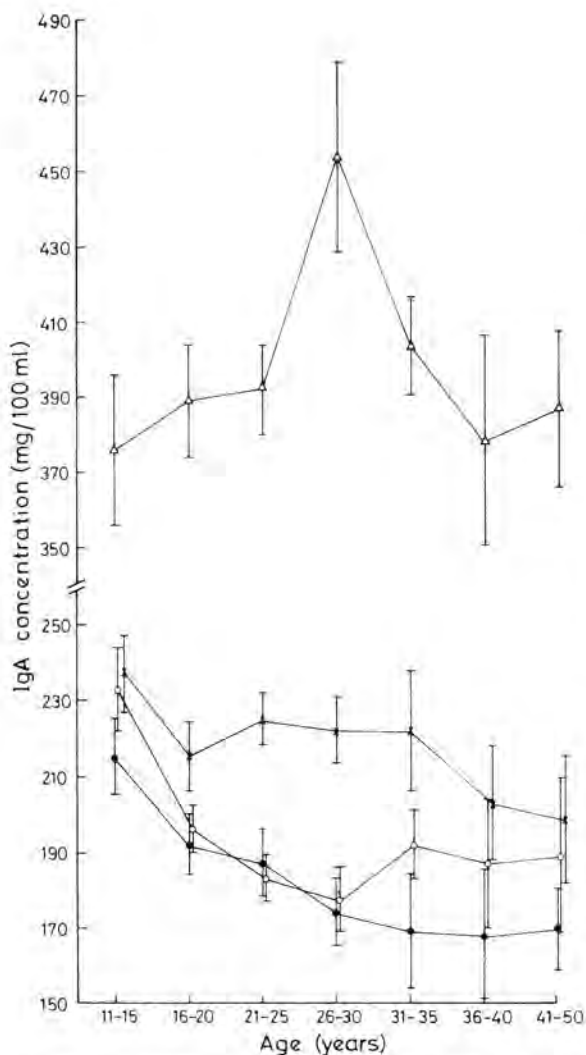
Figure 7: Frequency histogram profile of the serum IgA levels in the Indians.

Table IV  
Mean serum IgA levels in Chinese, Indians, Malays and Orang Asli

Age (years)	Young adults (11-20 years)	Adults (21-50 years)	Total (11-50 years)
Race			
Chinese	206 ± 70†** (153)	184 ± 72 (313)	191 ± 72 (466)
Indian	223 ± 74 (110)	221 ± 80 (280)	222 ± 78 (390)
Malay	201 ± 67** (116)	180 ± 80 (210)	188 ± 77 (326)
Orang Asli	384 ± 100 (68)	401 ± 101 (151)	396 ± 101 (219)

† Mean ± standard deviation in mg per 100 ml.  
 Parenthesis indicates number of observations.  
 \*\* Significant difference ( $P < 0.01$ ) between young adults and adults of each race.





**Figure 10:** Changes in serum IgA levels with age in Chinese (○), Malays (●), Indians (x) and Orang Asli (△). Bars indicate standard error of mean.

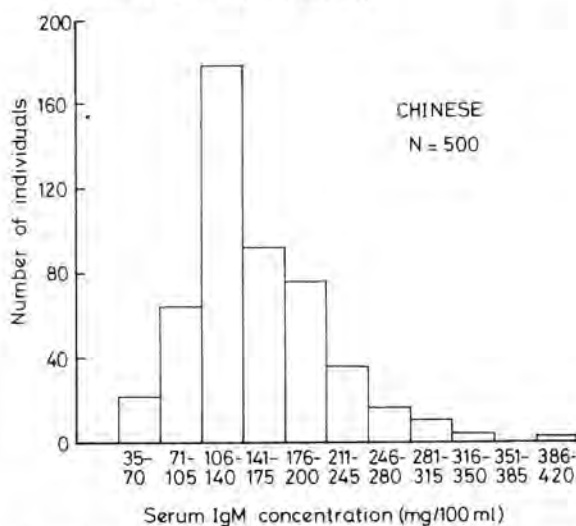
Indians and Malays, respectively, on the other hand. The higher mean serum IgA level of the Indians differ significantly ( $P < 0.01$ ) from the mean serum IgA levels of Chinese and Malays, but there is no significant difference ( $P < 0.05$ ) between the mean IgA levels of the Chinese and Malays.

### Immunoglobulin M levels in serum

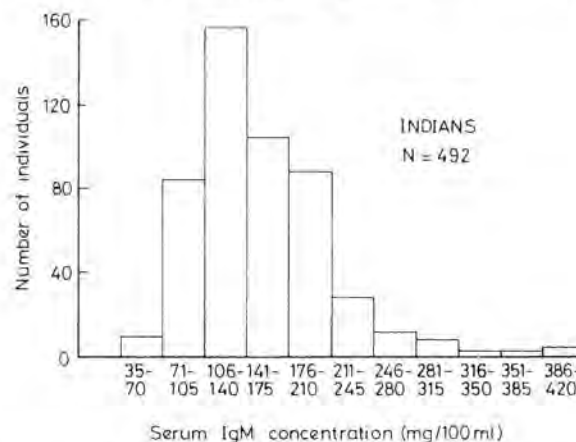
**Normal levels and distribution:** In the Chinese, Indians and Malays, the females have significantly higher ( $P < 0.01$ ) serum IgM levels than males, in all the age groups studied. In contrast, the mean

serum IgM level of 201 Orang Asli studied, no statistical difference was observed between the values for females and males in each of the age groups listed and the total for all age groups (Table V).

The distribution profiles for serum IgM concentration in Chinese, Indians and Malays show that for the three races, the levels range from 35 to 420 mg/100 ml with the mode at 106 to 140 mg/100 ml. The serum IgM levels for Orang Asli ranges from 71 to 490 mg/100 ml with the mode at 211 to 245 mg/100 ml. In 3 percent of the Orang Asli the serum IgM level is greater than 420 mg/100 ml which is the highest level observed for the urban races (Figs. 11, 12, 13, 14).



**Figure 11:** Frequency histogram profile of the serum IgM levels in the Chinese.



**Figure 12:** Frequency histogram profile of the serum IgM levels in the Indians.

Table V: Serum IgM levels in Malaysians of four racial origins

Race & Sex	Young adults							Total	
	Age (years)	11-15	16-20	21-25	26-30	31-35	36-40		41-50
CHINESE	Males	165 ± 39† (20)	147 ± 54 (132)	150 ± 50 (132)	131 ± 42 (62)	130 ± 35 (38)	120 ± 30 (18)	146 ± 48 (28)	143 ± 49 (204)
	Females	218 ± 79** (28)	212 ± 67** (28)	182 ± 43** (6)	178 ± 50** (8)	-	-	-	208 ± 71** (70)
	Males & Females	195 ± 71 (48)	159 ± 62 (160)	148 ± 50 (138)	136 ± 45 (70)	130 ± 35 (38)	120 ± 30 (18)	146 ± 48 (28)	152 ± 57 (500)
	Males	166 ± 34† (30)	148 ± 46 (92)	143 ± 45 (130)	131 ± 41 (66)	143 ± 37 (60)	133 ± 41 (25)	130 ± 30 (32)	142 ± 43 (436)
INDIAN	Females	220 ± 72** (24)	290 ± 111** (6)	245 ± 83** (12)	199 ± 48** (14)	-	-	-	224 ± 77** (56)
	Males & Females	190 ± 61 (54)	155 ± 59 (98)	151 ± 57 (142)	142 ± 50 (80)	143 ± 37 (60)	133 ± 41 (26)	130 ± 30 (32)	152 ± 55 (492)
MALAY	Males	144 ± 34† (14)	153 ± 37 (48)	154 ± 59 (132)	134 ± 38 (84)	141 ± 46 (40)	160 ± 100 (14)	146 ± 47 (10)	147 ± 53 (342)
	Females	228 ± 94** (16)	194 ± 67** (8)	201 ± 74** (16)	249 ± 55* (12)	-	-	-	219 ± 79** (52)
ORANG ASLI	Males & Females	189 ± 84 (30)	159 ± 45 (56)	159 ± 63 (148)	148 ± 58 (96)	141 ± 46 (40)	160 ± 100 (14)	146 ± 47 (10)	157 ± 62 (394)
	Males	212 ± 88† (17)	229 ± 55 (21)	256 ± 82 (74)	235 ± 65 (7)	259 ± 62 (4)	218 ± 49 (4)	205 ± 50 (12)	240 ± 78 (139)
	Females	250 ± 39 (7)	249 ± 72 (15)	264 ± 55 (15)	265 ± 42 (8)	297 ± 76 (5)	284 ± 89 (5)	234 ± 90 (7)	260 ± 72 (62)
	Males & Females	223 ± 86 (24)	237 ± 63 (36)	257 ± 78 (89)	252 ± 55 (15)	280 ± 73 (9)	255 ± 81 (9)	215 ± 69 (19)	246 ± 77 (201)

† Mean ± standard deviation in mg per 100 ml; multiply by 1.43 to convert to I.U./ml. Parenthesis indicates number of observations.

Significant difference between males and females of each group \* P < 0.05, \*\* P < 0.01

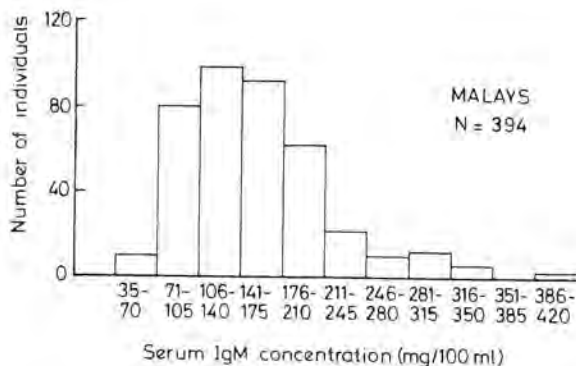


Figure 13: Frequency histogram profile of the serum IgM levels in the Malays.

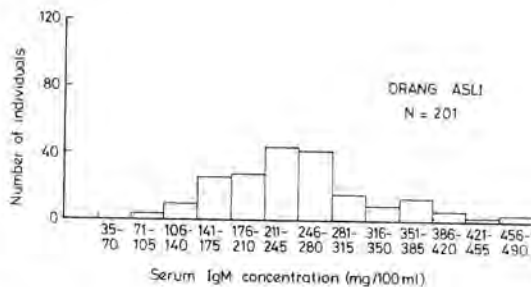


Figure 14: Frequency histogram profile of the serum IgM levels in the Orang Asli.

**Age variations:** The Chinese, Indians and Malays have almost similar serum levels of IgM for the various age groups studied, but the mean IgM level of the Orang Asli is significantly higher ( $P < 0.01$ ) than those recorded for the urban races. The mean serum IgM levels drop from about 180–200 mg/100 ml in the three urban races at 11–15 years of age to about 140 mg/100 ml at 41–50 years of age (Fig. 15). The young adults of Chinese, Indian and Malay have serum IgM levels which are significantly higher ( $P < 0.01$ ) than those of the adults. In the Orang Asli, the young and old adults have serum IgM levels of similar magnitude (Table VI).

**Racial differences:** Analysis of variance for the total mean IgM level of the four races shows that although there is no significant difference ( $P < 0.01$ ) between the total mean IgM levels of the Chinese, Indians and Malays, the total mean of each of these races is significantly lower ( $P < 0.01$ ) than that of the total mean of serum IgM levels of the Orang Asli.

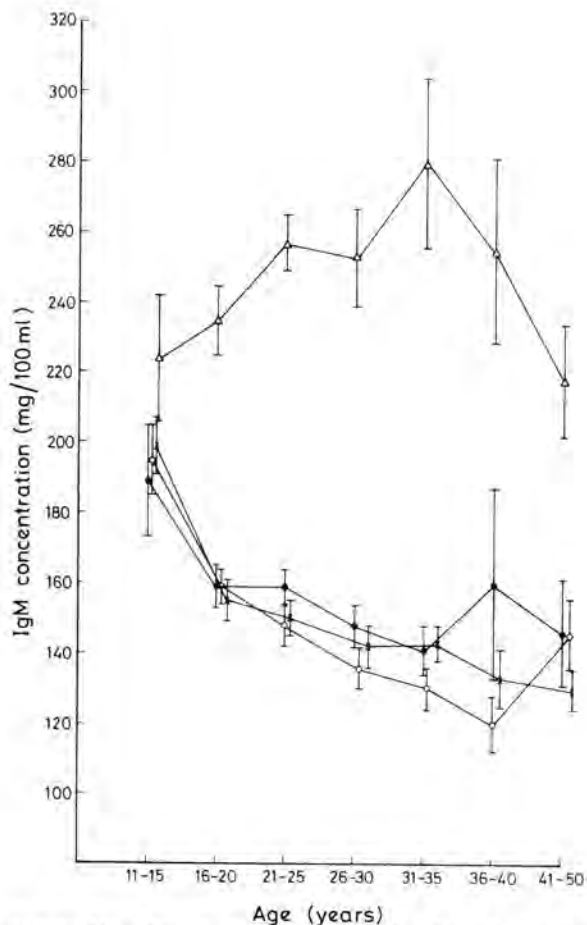


Figure 15: Changes in serum IgM levels with age in the Chinese (○), Indians (x), Malays (●) and Orang Asli (△). Bars indicate standard error of mean.

Table VI  
Mean serum IgM levels in Chinese, Indians, Malays and Orang Asli

Age (years)	Young adults (11–20 years)	Adults (21–50 years)	Total (11–50 years)
Chinese	167 ± 66†** (208)	147 ± 47 (292)	152 ± 57 (500)
Indian	168 ± 62†** (152)	145 ± 50 (340)	152 ± 55 (492)
Malay	170 ± 63†** (86)	154 ± 61 (308)	157 ± 62 (394)
Orang Asli	232 ± 74 (60)	252 ± 77 (141)	246 ± 77 (201)

† Mean ± standard deviation in mg per 100 ml. Parenthesis indicates number of observations.

\*\* Significant difference ( $P < 0.01$ ) between young adults and adults of each race.

## DISCUSSION

In adults a correlation between age and serum IgG levels has not been demonstrated in Caucasian Americans (Steihm & Fudenberg, 1966; Lichtman, 1967; Allansmith *et al.*, 1968), and Africans (Rowe *et al.*, 1968a). This lack of correlation between age and immunoglobulin was also noted for IgA and IgM (Lichtman, 1967a; Rowe *et al.*, 1968; Kalff, 1970). Similarly, in the four Malaysian races, each of the three serum immunoglobulins were not correlated with age, for the age group 11 to 40 years. There was no difference in the serum levels of IgG in the young adults (11–20 yrs) and adults (21–50 yrs) in the Chinese, Indians and Orang Asli, but in Malays the young adults had higher levels of serum IgG than adults. In the Orang Asli, there was no difference in the serum IgM and IgA levels of young adults and adults indicating that serum immunoglobulin levels varied little between the age of 10 to 50 years. In the Chinese, the Indians and the Malays, there was a decline of serum IgM and IgA levels in adults but in the Indians the serum IgA levels did not show any variation between the ages 10 to 50 years. Adult serum IgG levels are attained in Caucasian Americans at age 11 to 20 years (Steihm & Fudenberg, 1966; Allansmith *et al.*, 1968) but similar work for Malaysians has not been reported (Yadav & Iyngkaran, in preparation). However, from the foregoing it is clear that adult serum immunoglobulin levels are attained at 11–20 years or earlier.

Females in many populations have been reported to have significantly higher serum IgM levels than males (Butterworth *et al.*, 1967; Grundbacher, 1972; Rowe *et al.*, 1968; Rhodes *et al.*, 1969; Maddison *et al.*, 1975; Allansmith *et al.*, 1969; Kalff, 1970) and this difference becomes apparent in most instances after six years of age (Butterworth *et al.*, 1967; Allansmith *et al.*, 1969). A sex difference in the level of serum IgA or IgG has not been generally observed. In Malaysian females of Chinese, Indian and Malay origin, the serum IgM levels were significantly higher than in males but in the Orang Asli a sex difference in the serum IgM levels was not present. Grundbacher (1972) has suggested that the X-chromosome of man carries genes with an effect on serum IgM concentration but the observations do not exclude the effect of hormones (Washburn *et al.*, 1965) or other factors associated with the sexes (Yadav and Shah, 1977). The lack of difference in serum IgM levels of males and females in Orang Asli and occasionally in other races (Norberg, 1967; Alarcon-Segovia and Fishbein, 1970; Buckley & Dorsey, 1971) has been attributed to high serum IgM levels which masks the difference (Fahley & McKelvey, 1965; Veys & Claessen, 1968)

and these high levels may develop as a consequence of regular antigenic exposure to recurrent parasitic infections or other antigenic exposure. The Orang Asli had significantly higher serum IgM levels than the other three urban-residing races.

The urban-living Malaysians, in contrast to other populations living in the tropics, like Liberians (Capucinelli *et al.*, 1972), Nigerians (McFarlane *et al.*, 1970) Bantu and Pygmies from Congo (Simbeye, 1970) and the Africans of Senegal (Lamy, 1966), Tanzanians (Nantulya & Lindquist, 1973) and the Watut and non-Watut aborigines of Papua New Guinea (Wells, 1968), have significantly lower immunoglobulin levels, especially that of IgG and IgM. Indeed, the urban Malaysians possessed immunoglobulin levels comparable to those reported for populations of the temperate region, for example, the British (Rowe *et al.*, 1966), Americans (Fahey & McKelvey, 1965), Belgians (Veys & Claessens, 1968) and resident of Lisbon (Palma-Carlos & Palma-Carlos, 1971). Although Malaysians in general are subject to various tropical diseases, the relatively lower serum immunoglobulins in Malaysians may be attributed to the better hygienic conditions of the urban group studied.

The serum immunoglobulin levels of the Orang Asli are comparable to the levels of the Watut and non-Watut aborigines, the Liberians and Tanzanians, and higher than the levels of the Indian population (Schgal & Aikat, 1970; Samuel *et al.*, 1970; Dasgupta, 1974) and the Caucasians of the temperate regions (Fahey & McKelvey, 1965; Steihm & Fudenberg, 1966; Veys & Claessens, 1968; Palma-Carlos & Palma-Carlos, 1971). It is apparent that tropical populations, especially those living in unsanitary conditions and lacking regular medical care would be subject to high rate of parasitic infections and their serum immunoglobulin levels are likely to be elevated.

The jungle-dwelling Orang Asli, compared to the urban-living Malaysians, have significantly high levels of serum IgG, IgA and IgM. These elevated serum immunoglobulins in the Orang Asli have been attributed to prevalence of parasite infections among this community (Yadav & Shah, 1977) but direct evidence is not available. Consolidated results of surveys conducted in the Orang Asli show the presence of 22 helminth and protozoal parasites (Dunn, 1972). The main parasites in terms of potential pathogenicity and prevalence (percent in parenthesis) are *Entamoeba histolytica* (3.2%), *Giardia lamblia* (11.1%), *Ascaris* (38.1%), *Trichuris trichuria* (55.4%), hookworm (72.8%) and others (32.2%). In addition, filariasis (Ramachandran *et al.*, 1964), Malaria (Bolton, 1972) and leprosy (Bolton, 1968)

are common in the community. In African races, elevation of serum immunoglobulin G, A and M levels is associated with malaria (Abele *et al.*, 1965; Tobie *et al.*, 1966; Targett, 1970), with filariasis (Michaux, 1966), with amoebiasis (Abioeye *et al.*, 1972) and with tuberculosis (Malomo *et al.*, 1970; Fahey, 1965). Studies on the changes in the levels of serum immunoglobulins before, during and after infection by human and simian malaria showed a direct correlation between the rise of malaria antibody production with increased serum IgM, IgG and IgA levels (Abele *et al.*, 1965; Tobie *et al.*, 1966). At present there is a need for similar investigations in the Malaysians.

It has been clearly established in animal experiments (McDevitt & Benacerraf, 1969; Benacerraf & Katz, 1975) and there is some evidence from man that genetic factors play an important role in the development and dynamic maintenance of serum immunoglobulin levels. For instance, a higher serum IgG, IgA and IgM levels have been observed in negroes in contrast to white Caucasians living in similar socio-economic environments (Lichtman *et al.*, 1967; Karayalcin *et al.*, 1973; Maddison *et al.*, 1975).

Our studies show that Malays (Yadav *et al.*, 1977) and Orang Asli (Yadav & Shah, 1977, and this communication) living in the rural areas have high serum immunoglobulins because of the prevalence of parasites in their environment but Malays with better hygienic conditions in urban areas have low normal serum immunoglobulin levels. We have no information from Orang Asli who have moved to urban areas but hospitalised pregnant females have lower serum immunoglobulin levels than non-hospitalised females (Shah, 1975; Shah & Yadav, 1977). These observations suggest that in Malaysians, environmental factors are chiefly responsible for the high serum immunoglobulins found in rural Malaysians.

### SUMMARY

The serum immunoglobulin levels of urban-residing Chinese, Malays and Indians were compared to those of the forest-dwelling Orang Asli of the age group 11 to 50 years. The serum IgG, IgA and IgM mean levels in the Chinese are  $1281 \pm 443$ ,  $191 \pm 72$ ,  $152 \pm 57$  mg/100 ml; Indians are  $1284 \pm 316$ ,  $222 \pm 78$ ,  $152 \pm 55$  mg/100 ml; Malays are  $1331 \pm 280$ ,  $188 \pm 77$ ,  $157 \pm 62$  mg/100 ml and Orang Asli are  $1809 \pm 662$ ,  $394 \pm 107$ ,  $246 \pm 77$  mg/100 ml, respectively. In contrast to the urban-residing group, all these serum immunoglobulin levels were significantly raised in the Orang Asli. The serum IgM levels in the Chinese, Indians

and Malays were of equal magnitude for all age groups but the serum IgG levels were raised ( $P < 0.05$ ) in the Malays and the serum IgA levels were raised ( $P < 0.001$ ) in the Indians. For the age groups studied an association between the mean immunoglobulin level and increasing age was not noted. Females had higher serum IgM levels than males in Chinese, Indians and Malays but in the Orang Asli there was no sex difference in the serum IgM level. There was no difference in serum IgA and IgG levels between the sexes in all four races.

In general, the serum IgG, IgA and IgM total mean levels of urban-residing Malaysians are comparable to the levels reported for Caucasians residing in countries of the temperate regions. However, in the Orang Asli, the three serum immunoglobulins were higher than those observed for populations of the temperate regions and the serum levels of immunoglobulin are comparable to those reported for populations normally living in the tropical regions.

### ACKNOWLEDGEMENTS

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# COMPARATIVE STUDY OF THE BIOAVAILABILITY AND DISSOLUTION BEHAVIOR OF FIVE BRANDS OF TETRACYCLINE CAPSULES

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## INTRODUCTION

STABILITY AND SAFETY are some of the qualities that define a good drug product. Equally important and frequently ignored is the efficiency by which the product delivers the drug. The availability of drug defines the efficiency of drug products and clearly then a reduction in drug availability can be considered equivalent to a reduction in dosage. Studies made on blood and/or urine levels or other body fluids following the administration of a drug product in order to ascertain a significant concentration in these fluids where its presence is understood to be effective is termed biological availability or bioavailability.

Barr *et al.* (1972) studied three commercial tetracycline preparations and found them to be significantly different in bioavailability. Lovering *et al.* (1975) undertook study involving nine brands of tetracycline preparations available in Canada and found there were significant differences in bioavailability. Both studies showed the validity of either measuring the blood level or urine level for studies of tetracycline bioavailability, confirming earlier work of Chulski *et al.* (1961). Present work involved the comparative study of five brands of commercial tetracycline capsule available in Malaysia (some manufactured locally) and correlations were made between bioavailability and dissolution rates. Bioavailability was obtained from cumulative

urine concentration following its oral administration. This is considered as justified as the rate of excretion of tetracycline correlates extremely well with area under the curve (AUC) of blood level, hence a good indication of bioavailability (Barr *et al.*, 1972; Lovering *et al.*, 1975).

## MATERIALS AND METHOD

Samples from one Lot of the commercial product of each of the five brands of tetracycline capsules were obtained from a retail pharmacy. Each claimed to contain 250 mg tetracycline base per capsule. Each brand of the tetracycline HCl had been designated as brand A, B, C, D and E respectively. Five capsules from each brand were analysed to ascertain the amount of tetracycline present by comparison to the reference standard curve prepared using standard tetracycline HCl powder obtained from Sigma Chemical Co.

*In-vitro* dissolution rates of all the five brands of tetracycline capsules were performed according to the method described in USP XVIII (1970) at 37°C and the rotating basket kept at 50 r.p.m. for a period of 30 min. Simulated gastric fluid was as the dissolution medium and samples were analysed spectrophotometrically at 270 nm for tetracycline by the method of Kohn (1961) on five capsules for each brand. Mean values were taken and dissolution profiles were plotted by plotting percentage of tetracycline dissolved against time.

*In-vivo* studies: Ten healthy volunteers (aged 21–25 yrs.) with no history of allergy to drugs, and no evidence of kidney and liver diseases were chosen

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for the study. The ten volunteers were divided into two groups of 5. One group underwent single dose study while the other group followed the multiple dose study. Volunteers received no drugs affecting liver enzyme activity in 30 days period before the trial and no drug of any kind or alcohol, in the 48 hr prior to or during the test period. Each volunteer whether following single dose study or multiple dose study received each brand of tetracycline capsule(s) at weekly intervals according to the scheme shown in Table 1.

**Dosing scheme for 5 different brands of tetracycline given to volunteers for both single and multiple dose study**

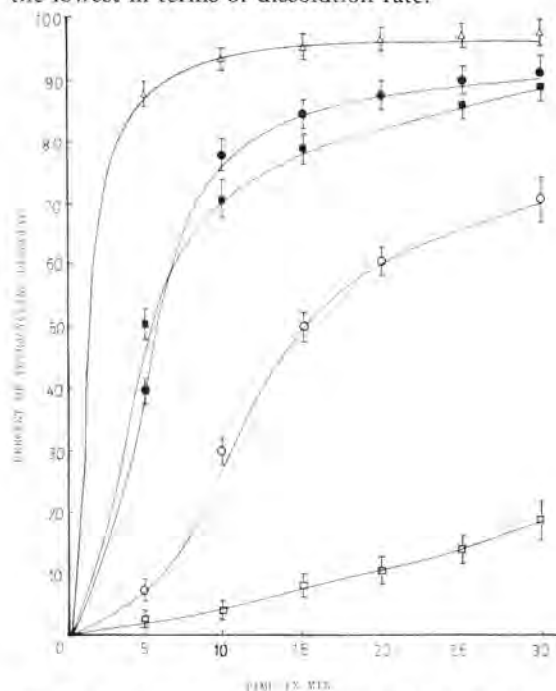
Subject	Test periods				
	Week 1	Week 2	Week 3	Week 4	Week 5
1	A	B	C	D	E
2	B	C	D	E	A
3	C	D	E	A	B
4	D	E	A	B	C
5	E	A	B	C	D

Each volunteer fasted for at least 8 hr prior to receiving the capsule (first capsule for multiple dose study). Tetracycline 250 mg capsule was administered orally at 7.00 a.m. in the fasting state accompanied by 50 ml water. Food was withheld for the next 4 hr after tetracycline administration, but 50 ml of water was given every two hours after administration of tetracycline until the volunteers went to bed at night. This was to ensure an adequate urine flow. For the next day, volunteers were asked to drink 50 ml water every three hours until they went to bed. Urine samples were collected at 0 (at time of administration), 3, 6, 9, 12, 24 and 48 hr. The urinary volume measured and samples frozen for the assay of tetracycline concentration.

For multiple dose study a total of 3 tetracycline capsules were taken by each volunteer. The capsule was taken at an interval of 8 hr. There is no change in protocol as that in single dose study except collection of urine sample was made at 3, 6, 9, 12, 15, 18, 24, 32 and 48 hr after oral administration of first capsule. No attempt was made to collect urine sample longer than 48 hr for it had been shown previously that 48 hr is more than adequate for tetracycline administered orally to be cleared into the urine (Barr *et al.*, 1972).

## RESULTS

The dissolution behaviour of the 5 brands of tetracycline was shown in Figure 1. The values obtained were the mean  $\pm$  standard error of six capsules from each brand. Brand E possessed the fastest dissolution rate. This was followed by brands B and D (comparable in dissolution rate) which in turn followed by brand A. Brand C ranked the lowest in terms of dissolution rate.



**Figure 1.** Dissolution behaviour of 5 brands of tetracycline. Value obtained are mean  $\pm$  S.E. of 6 capsules for A ( $\circ$ ), B ( $\bullet$ ), C ( $\square$ ), D ( $\blacksquare$ ), and E ( $\triangle$ ).

The cumulative urinary concentrations of tetracycline in 48 hr period were plotted in Figure 2 for single dose study and Figure 3 for multiple dose study. In both studies, brand C ranked the lowest in terms of bioavailability as reflected from the cumulative urinary concentration of tetracycline. In both studies again, brand E appeared to be most available, although in multiple dose study (Figure 3), the availability of brand E was only marginally above that of brands B, D and A. While the availabilities of brands B, D and A appeared to be comparable and insignificantly difference, there were definite differences in bioavailability between brands E and C. Brand E being very much more bioavailable than brand C. Good correlations were seen between single dose and multiple dose study for the cumulative urinary concentration of tetracycline measured during the 48 hr period for the 5 brands under study.

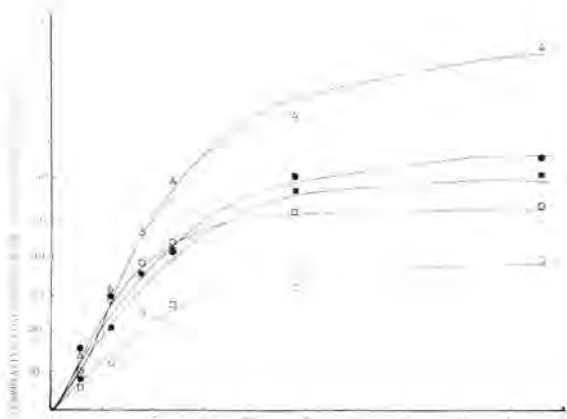


Figure 2. Cumulative concentration of tetracycline in urine for single dose study for 48 hr. A (○), B (●), C (□), D (■), and E (△). For simplicity the standard error bars had been omitted.

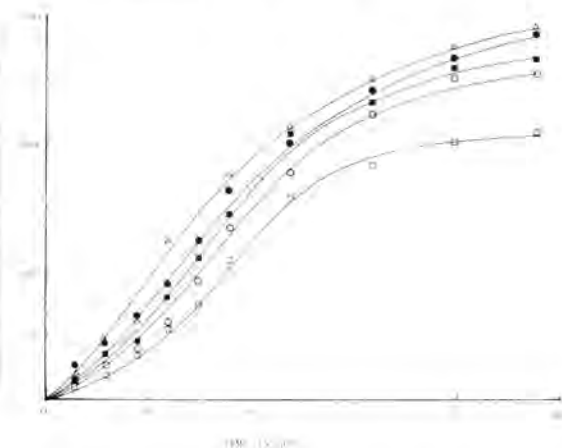


Figure 3. Cumulative concentration of tetracycline in urine for multiple dose study for 48 hr. period. A (○), B (●), C (□), D (■), and E (△). For simplicity the Standard errors bars had been omitted.

## DISCUSSION

There were differences in bioavailability in the 5 brands of tetracycline both in single dose and in multiple dose studies. In single dose study urinary data showed that brand E was most bioavailable. Brand B appeared to be comparable in bioavailability to brands D and A. Brand C was the least bioavailable. Good correlation was observed between differences in bioavailability seen in single dose and in multiple dose studies. This inferred that single

dose study can be used to predict the bioavailability of tetracycline for volunteers that followed multiple dose regimen confirming earlier observation (Barr *et al.*, 1972).

The order of dissolution rate carried out in *in-vitro* on the 5 brands of tetracycline was in good agreement with the bioavailability data both for single and for multiple dose study. Thus dissolution rate of the tablets could be wholly if not mainly responsible for the differences in bioavailability seen in the 5 brands under study.

So far no study had been undertaken on the failure of tetracycline therapy in Malaysia. From data provided it is possible that decrease in absorption from the gastro-intestinal tract due to the low availability could be responsible for some of the therapeutic failure for this widely used drug, in particular brand C whose availability proved to be relatively low. Moreover, it is common knowledge that antacids containing polyvalent cations (e.g. magnesium hydroxide) decrease tetracycline absorption (Harcourt & Hamburger, 1957; Kunin, 1961). Iron tablets taken together with tetracycline and dairy product like milk and cheese (that contain the di or polyvalent cations) can reduce the absorption of tetracycline. Decrease in absorption of tetracycline will not only decrease the amount of tetracycline which reach the systemic circulation and hence the site of infection, but also will increase the amount of drug remaining in the gastrointestinal tract. If more tetracycline remains in the gastrointestinal tract as a consequence of decrease absorption this will increase the possibility of nausea, mucosal irritation and alteration of normal flora at gastrointestinal tract which are all common untoward effects of tetracycline.

Finally it must be mentioned that these studies were made on normal healthy individuals and what effect an infection had (under which tetracycline is indicated) on the absorption of tetracycline is not known. Moreover only one lot of each brand was studied, they should not be taken as identical to others of the same brand.

## SUMMARY

Comparative study was made on the bioavailability and dissolution behaviour of five commonly used brands of tetracycline capsules available in Malaysia. Significant differences were detected both in bioavailability and in dissolution behaviour amongst the five brands. *In-vitro* dissolution rate correlated well with both single dose and multiple dose bioavailability *in-vivo* involving healthy volunteers.



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# THE INFLUENCE OF HOST STAGE AND SEX UPON THE SIZE AND COMPOSITION OF THE THELASTOMATIDS PARASITIC IN THE HINDGUT OF *PERIPLANETA AMERICANA* L. AND *NEOSTYLOPYGA RHOMBIFOLIA* (STOLL)

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## INTRODUCTION

THE COCKROACHES are an ancient and highly successful form of insect life. They have been in existence since Pennsylvanian times and the fossil record indicates that in general body form they have remained a very stable group (Moore *et al.*, in Cochran *et al.*, 1975). About 3500 named species of living cockroaches have been catalogued (Princis, in Cochran *et al.*, 1975; Rehn in Roth and Willis, 1960) but additional species are being found and named continually, so that the final number probably will far exceed the number of 4000 suggested by James and Harwood (in Cochran *et al.*, 1975).

Rehn (1945) has pointed out that the majority of cockroach species are not domiciliary pests. In fact, the pest species constitute less than 1% of all cockroaches.

The medical importance of cockroaches is much greater than generally realised as they have been shown to harbour pathogenic bacteria, serve as intermediate hosts for pathogenic helminthes and to carry helminth eggs, viruses, protozoa and fungi affecting man and other vertebrate animals (Roth and Willis, 1957; Roth and Willis, 1960); Tarshis, Cornwell, James and Harwood, Rueger and Olson, Pulner and Sarchenko, in Cochran *et al.*, 1975). Sixteen species of cockroaches are considered vectors of pathogenic organisms affecting man (Roth and Willis, 1975a). It has been identified that cockroaches harbour about 80 species of Aschelminthes, 5 species of Acanthocephala (Guthrie and Tindall, 1968). Cockroaches have been shown to be natural intermediate hosts for 12 species of

Helminthes and intermediate hosts experimentally for 11 other species (Cornwell, 1968). Acholomu and Finn (in Cochran, 1975), Khairul Anuar (1976) and Schaefer (1970) have also shown that *Periplaneta americana* is a natural intermediate host of *Moniliformis moniliformis* in Puerto Rico, Penang and Honolulu respectively.

Parasites of cockroaches have been reported from throughout the world (Chitwood, 1932; Macadow, Semans, Armen, Mac Kinnon, Hoyte, Jenkins in Yuan and Kevin Cahill, 1970 and Guthrie and Tindall, 1968). There have been no studies of the parasites, particularly nematodes of the cockroach, *Neostylopyga rhombifolia* (Stoll) but there have been a few studies on the common american cockroach *Periplaneta americana* L. in Penang (Khairul Anuar, A. and Paran, T. P., 1976, 1977). Thus, the study is of importance especially in Asia and other neighbouring countries where people work, eat and sleep with cockroaches. Their habit of feeding on both human faeces and human food is an example of their potential health hazard to man. The importance of this point becomes clearer when it is realised that cockroaches move freely from building to building or from sewer or privy to human habitations. The present study is devoted mainly to find the frequency occurrence of the parasites belonging to the family Thelastomatidae, super family Oxyuroidea (Chitwood, 1932) and also the worm load of those parasites in *Periplaneta americana* and *Neostylopyga rhombifolia*. These nematodes, the oxyurids, are parasites in the hindgut of cockroaches (Welch and Jarry in Poinar, 1975; Hominick and Davey 1972; Basir 1956;

Chitwood, 1932). The influence of host stage and sex upon the size and composition of the worms are also discussed.

Parasites encountered in the study are *Hammer-schmidtella diesingi* (Hammerschmidt, 1838), *Thelastoma malaysiense* (Khairul Anuar, 1977), *Leidynema appendiculata* (Leidy, 1850) and *Severianoia severianoii* (Schwenke, 1926; Travassos, 1929). Under present study *Severianoia severianoii* was only found in *Neostylopyga rhombifolia*. *Thelastoma malaysiense* is a new species (Khairul Anuar, 1977) and was shown to be harboured by the common american cockroach, *Periplaneta americana*, in Penang. *Hammer-schmidtella diesingi* and *Leidynema appendiculata* were also shown to be harboured by *Periplaneta americana*. They were previously shown by Khairul Anuar (1977), Hominick and Davey (1972).

### Relationship between Oxyurids, Cockroaches and Vertebrates

Parasites of the family Thelastomatidae live in the hind gut of cockroaches, the lining of which is lost at ecdysis. They not only survive the hazard but take advantage of the fact that the exuviae can be contaminated with eggs and may be eaten (Crofton, 1966). Nematodes are capable of developing forms which can survive the hazard imposed by repeated moultings. Peregrine (1974), had indicated that the parasite *Thelastoma attenuatum* can respond to unfavourable conditions within the host by producing its resistant stage, in this case the egg. This would suggest a fairly high degree of host-parasite specificity.

Galeb (in Cochran *et al.*, 1975) had shown experimentally that oxyurids eat the same food as the host insect and that if one starves them by withholding food from the host, the oxyurids die and disappear, these worms are not parasites but commensals. Experiments also showed that *Thelastoma* appears to feed indiscriminately on host hindgut contents and it is also capable of digesting its own food, hence not relying on the host for predigested material (Lee, 1958). Poinar (1975) suggested that the parasites of this family are found in those insects having a slow rate of food movement and a well developed microbial flora. It has not been determined if their nourishment consists of partially digested food or microbial agents in the host's gut or both. None have been cultured as artificial media and their association with the host appears to be an obligate one. Although generally considered as parasites their feeding habits also qualify them as commensals. Dobrovolny and Ackert (1934) stated that "all observations seemed to indicate that the health fertility and activity of the heavily infected cockroaches were comparable with those of non-

parasitised specimens". Thus, they are innocuous to their hosts and only Rostom and Taylor (in Poinar, 1975) described instances where pinworms apparently damaged the peritrophic membrane and gut wall of their hosts.

Nutritional studies show that entomogenous nematodes have several methods of absorbing nutrients in the hosts body cavity. These include normal oral uptake, absorption through the cuticle which may or may not be aided by microvillarlike processes and uptake by phagocytosis.

There is no indisputable report of an obligate insect parasitic nematodes obtaining nourishment from vertebrates or plants. There are reports of mermithid nematodes occurring in man and six such cases have been reviewed by Foster (in Poinar, 1975). Entomogenous nematodes could enter vertebrates in drinking water or in food containing parasitised insects, however, in such cases they probably would be killed and expelled through the rectum. Up to present study, entomogenous nematodes present no serious threat to plants or animals.

### MATERIALS AND METHODS

The host, *Periplaneta americana* L. was caught in large numbers at night using a special trap (PAT.P. Japan, Type DS. 12) (Khairul Anuar and Paran, 1976, 1977). The other host, *Neostylopyga rhombifolia* (Stoll), was caught by hand since it was rarely found in large numbers. The cockroaches, adults and nymphs collected from all parts of campus were identified into stages and sexes. The numbers of cockroaches caught are shown below:-

Sex and stage	<i>Periplaneta americana</i> L.	<i>Neostylopyga rhombifolia</i> (Stoll)
Female adult	50	20
Female nymph	50	20
Male adult	50	20
Male nymph	50	20

The host were anaesthetized with ether and dissected immediately for parasites in saline (6.9%) to avoid rupturing the nematodes. The gut was removed and transferred into a cavity block of saline. The gut was then teased open in saline with fine needles and was examined under a dissecting microscope with transmitted light. The female nematodes were picked with fine pipettes and they were classi-

ficd to different species with aid of the compound microscope. The number belonging to each species was also noted. Measurements were also made. Drawings were made with the use of slide projection.

The number of adult females of nematodes was used as an index of population of the three species in a particular hindgut. This was because of the extreme variation in numbers of juvenile nematodes (Hominick and Davey, 1972).

## RESULT

### *Periplaneta americana* L.

The overall infection rate of nematode infection among male and female adults and nymphs is given in Table I. The percentage of adult female hosts infected by nematodes was the highest (96%). This was followed by adult male hosts, 94% and 86% in the case of both male and female nymph hosts. The adults were more highly infected compared to the nymphs and the overall infection was found to be 90.5%.

Three species of nematodes were found to be associated with 100 *Periplaneta americana* dissected. They were *Hammerschmidtella diesingi*, *Leidynema appendiculata*, and *Thelastoma malaysiense*. The infection by *Hammerschmidtella diesingi* was found to be highest in adult females (60%). When stages and sexes of roaches were ignored, the percentage parasitism by *Hammerschmidtella diesingi* was 56%. There was no significant difference in the degree of infection among male and female and among adult and nymph roaches. The degree of parasitism by *Leidynema appendiculata* was found to be highest in immature roaches (32%) but there was no significant difference in the degree of infection among adults and nymphs of *Periplaneta americana*. Adult female and immature roaches were highly infected by *Hammerschmidtella diesingi* and *Thelastoma malaysiense* and least infected by *Leidynema appendiculata*. This is shown in Table II.

However, the host carried more than one species of nematodes. In the case of female adult roaches, the percentage of infection by only *Hammerschmidtella diesingi*, *Leidynema appendiculata* and *Thelastoma malaysiense* were found to be 16%, 12%, 22% respectively; in male adults, 14%, 10%, 28% respectively; and in female and male nymphs 10%, 8% respectively. Single infection by *Hammerschmidtella diesingi* was found to be highest in female adults (16%) and the single infection by *Thelastoma malaysiense* was found to be highest in male adults (28%). There was almost the same degree of infection by *Leidynema appendiculata* in all hosts. All these are tabulated in Table III. There was no difference in the degree of single infection by the 3 worms in all nymphs of both sexes but there was some small difference in both adult and nymph hosts.

Double infection by nematodes was quite common. The infection by both *Hammerschmidtella diesingi* with *Thelastoma malaysiense* was found to be the highest and that by *Hammerschmidtella diesingi* with *Leidynema appendiculata* showed little variation. Double infection was found to be much higher in the nymphs.

Triple infection was shown to occur only in adult hosts, 8% in female adults and 6% in male adults. This forms a low infection.

Table IV gives the frequency distribution of number of species of nematodes. For adults of both sexes, 1 species per host was the commonest whereas in nymphs of both sexes, 2 species per host was the commonest. Three species per host did occur in the adults but never in the nymphs.

### *Neostylopyga rhombifolia* (Stoll)

Table V gives an overall infection rate of nematode infection among adults and nymphs of *Neostylopyga rhombifolia*. It is clearly shown that the adults were more highly infected compared to the nymphs.

Table I

The overall infection rate of nematode infection among male adults, female adults and nymphs of *Periplaneta americana* L.

	Examined			Positive			% Infected		
	Male	Female	Total	Male	Female	Total	Male	Female	Average
Adult	50	50	100	47	48	95	94	96	95
Nymph	50	50	100	43	43	86	86	86	86

The infection rate in adult female and adult male and immature roaches did not differ significantly. ( $P \leq 0.050$  by Chi-square test)

**Table II**  
**Nematodes in 200 *Periplaneta americana* L.**

	Adult male roaches			Adult female roaches			Immature roaches			Total	
	Total no. Examined	No. with Parasite	% with Parasite	Total no. Examined	No. with Parasite	% with Parasite	Total no. Examined	No. with Parasite	% with Parasite	No. with Parasite	% with Parasite
<i>H. diesingi</i> *	50	26	52	50	30	60	100	56	56	112	56
<i>T. malaysiense</i> *	50	33	66	50	30	60	100	58	58	121	60.5
<i>L. appendiculata</i> **	50	12	24	50	15	30	100	32	32	59	29.5

\* The infection rate in adult male and female, and immature roaches did not differ significantly. ( $P \leq 0.05$ , by Chi-square test).

\*\* The infection rate in adult male and female and immature roaches differed significantly. ( $P \leq 0.95$ , by Chi-square test).



Table III

Percentage *Periplaneta americana* L. with single infection, double infection and triple infection of adult female nematodes

	No. of Host Examined	only H	only L	only T	H + L	H + T	T + L	H + L + T
Female adult	50	16	12	22	8	28	2	8
Male Adult	50	14	10	28	4	28	4	6
Female nymph	50	10	8	8	10	36	14	0
Male nymph	50	10	8	8	10	36	14	0
Adult	100	30	22	50	12	56	6	14
Nymph	100	20	16	16	20	72	28	0

Table IV

Frequency distribution of number of species of nematodes

No. of species per host	Female		Male		Adult	Nymph
	Adult	Nymph	Adult	Nymph		
0	2	7	3	7	5	14
1	25	13	26	13	51	26
2	19	30	18	30	37	60
3	4	0	3	0	7	0

Table V

The overall infection rate of nematode infection among male adults, female adults and nymphs of *Noestylomyia rhombifolia* (Stoll).

	Examined			Positive			% Infected i		
	Male	Female	Total	Male	Female	Total	Male	Female	Average
Adult	20	20	40	18	19	37	90	95	92.5
Nymph	20	20	40	6	8	14	30	40	35.0

The infection rate in adult females and adult males did not differ significantly but differed significantly in nymph females and nymph males. ( $P < 0.005$ , by Chi-square test).

The infection rate in adults and nymphs differed significantly ( $P < 0.025$ , by Chi-square test).

*Leidynema appendiculata* was the most predominant nematode in all stages and sexes of the hosts. The percentage of parasitism in both male and female adults was found to be 60% and 20% in the case of immature ones. The second degree of infection was that by *Thelastoma malaysiense* in adults of both sexes and *Hammerschmidtella diesingi* in immature roaches. *Severianoia severianoii* was uncommon in the adults of both sexes but it was found to parasitise immature roaches (12.5%). The overall infection was highest by *Leidynema appendiculata* (40%).

The infection by *Thelastoma malaysiense* and *Leidynema appendiculata* were found to be high in adults and low in nymphs but that by *Severianoia severianoii* was found to be the reverse.

Single infection was found to be highest by *Leidynema appendiculata* in all stages and sexes of the roaches. For double infection, adults were more highly infected by *Hammerschmidtella diesingi* with *Leidynema appendiculata* and *Thelastoma malaysiense* with *Leidynema appendiculata*, whereas, for

nymphs by *Hammerschmidtella diesingi* with *Leidy-nema appendiculata*.

Table VIII gives the frequency distribution of the number of species of nematodes present. Most adults had a species per host whilst most nymphs had 0 species per host. Triple infection only occurred in adult females and 4 species per host was uncommon in any of the hosts dissected.

### DISCUSSION

The results point out clearly that the parasites that were harboured by the two hosts were the same, the exception being in the case of *Severianoia severiano* which was only found in *Neostylopyga rhombifolia*. Thus, we can say that the worms form the common parasites of local (Penang) cockroaches.

Males and females are not equally susceptible to parasites (Hominick and Davey, 1972). It is clearly shown that females were more highly infected

than males. Dobrovolsky and Ackert (1934), Bozeman (1942) and Gordon (1970) working with various Thelatomatids and cockroaches also reported that the level of infestation was highest in adult female hosts. This is different from many known facts that males are more highly infected with parasites. Berry (1962) studied trematodes *Cercaria ubiquitousoides* of marine snails, *Littorina saxatilis*. There seemed to be greater numbers of infected female than infected male hosts. The reason given was that higher mortality occurred in the male and more males die young while more females survive longer. This explains greater accumulation of trematodes in females. The same argument can be applied to that of cockroaches under study. But, the longevity of both male and female of cockroaches is not studied, presumably female longer.

Hominick and Davey (1972) suggested that host nutrition may play an important part in the differences in parasitism of males and females. Though all stages of the hosts may take food from the same source, quantitative and even qualitative differences

Table VII

Percentage *Neostylopyga rhombifolia* (Stoll) with single infection, double infection and triple infection of adult female nematodes.

	No. of host Examined	% infected with								
		only H	only L	only T	only S	H + L	H + T	T + L	L + S	H + L + T
Female adult	20	10	30	20	0	10	5	15	0	5
Male adult	20	15	20	15	0	15	0	25	0	0
Female nymph	20	5	10	5	5	10	0	0	5	0
Male nymph	20	0	10	0	15	5	0	0	0	0
Adult	40	25	50	35	0	25	5	40	0	5
Nymph	40	5	20	5	20	15	0	0	5	0

Table VIII

Frequency distribution of number of species of nematodes

No. of species per host	Female		Adult		Adult	
	Adult	Nymph	Adult	Nymph	Adult	Nymph
0	1	12	2	14	3	26
1	12	5	10	5	22	10
2	6	3	8	1	14	4
3	1	0	0	0	1	0
4	0	0	0	0	0	0

Note: Although the percentage of parasitism often gives a rough estimate of the incidence of parasitism, it can be erroneous

Table VI  
Nematodes in 80 *Neostylopyga rhombifolia* (Stoll)

	Adult male roaches		Adult female roaches		Immature roaches		Total		
	Total no. Examined	No. with Parasite	% with Parasite	Total no. Examined	No. with Parasite	% with Parasite	Total no. Examined	No. with Parasite	% with Parasite
<i>H. diesingi</i> *	20	6	30	20	6	30	40	4	10
<i>T. malaysiense</i> **	20	8	40	20	9	45	40	1	2.5
<i>L. appendiculata</i> **	20	12	60	20	12	60	40	8	20
<i>S. severiano?</i> ***	20	0	0	20	0	0	40	5	12.5

\* The infection rate in adult male and female and immature roaches did not differ significantly ( $P > 0.05$ , by Chi-square test).

\*\* The infection rate in adult male and female did not differ significantly but differed significantly in adults and nymphs ( $P < 0.05$ , by Chi-square test).

\*\*\* The infection rate in adults and nymphs differed significantly ( $P < 0.05$ , by Chi-square test).

in food intake may exist. Wharten *et al.* (1965) suggested that adult female cockroaches have a greater preference for cellulose than do nymphs or adult males. This availability of cellulose may play a crucial role in determining the numbers of worms.

There was comparatively higher infection rate in adults than in nymphs. This is probably due to the fact that most of the worms that had infected the hosts can withstand the molting events in cockroaches except *Leidynema appendiculata* in *Periplaneta americana*. Besides that, it is a well known fact that molt leaves at least a part, if not all, of the parasite burden intact (Leibersperger, in Jarry, 1964). Jarry (1964) used this evidence to explain the cumulative infestation that allows the worms to attain high numbers in adult cockroaches. Also, it is probably that most of the worms are able to survive osmotic stress that may occur in the hindgut of molting cockroaches.

Some nematodes have been shown to produce their own neurosecretory factor(s), others are able to utilise an exogenous source of insect hormones in controlling their developmental processes. Nadakal and Nayar (1968) suggested that the corpus allatum hormone of *Periplaneta americana* may affect the fecundity of three species of oxyurid nematodes but their evidence is inconclusive. *Hammerschmidtella diesingi* depends upon a supply of neurosecretory material from the median neurosecretory cells (M.N.C.) of *Blatta orientalis* for maximum development (Gordon, 1968). Gordon (1969) had also suggested that it is the host's M.N.C. - corpora cardiaca complex which is essential to the nematode for successful parasitism. Thus, we can conclude that the lack of host neurosecretory material ('activation hormone') directly or indirectly caused either a partial destruction and/or elimination of adult nematodes from the insect or prevented the parasite larvae from developing into adult nematodes. This explains the lower number of worms found in nymphs.

In *Neostylopyga rhombifolia*, there was a significant difference in the degree of infection of *Leidynema appendiculata* among the adults and nymphs.

In *Neostylopyga rhombifolia*, there was a significant difference in the degree of infection of *Leidynema appendiculata* among the adults and nymphs. More occurred in adult roaches. This is probably because most juveniles of this Thelastomatid do not survive the complex series of events involved in molting of the host. Lee (1960) and Khairul Anuar (1977), Hominick and Davey (1972) also observed that *Leidynema appendiculata* survived the molt in *Blatta orientalis* and *Periplaneta americana*

respectively. Comparing between the adult and nymphal stages of *Periplaneta americana*, *Leidynema appendiculata* was more common in the immature ones but there was no significant difference. This contradicts with the well known fact that the number of *Leidynema appendiculata* are low in nymphs (Hominick and Davey, 1972). This is probably due to some worms which take advantage of the fact that the exuviae can be contaminated with eggs and may be eaten during early instars, when they do not go far to search for food. This could also be due to accidental result of small samples. It is a well known fact that many nematodes belonging to the family Thelastomatidae lay their eggs in strings or in clumps of two or three (Basir, 1956). As a result of this cockroach ingests more than one egg at one time, but neither the laid eggs, nor eggs removed from the uterus of *Hammerschmidtella diesingi* and *Leidynema appendiculata* possess a sticky coat (Lee, 1960). In the rectum of cockroach, the eggs of *Leidynema* are usually at the multi-celled stage. Hominick (1974), observed that under some circumstances, the eggs of *Leidynema appendiculata* may undergo precocious development to the infective stage in the uterus of the mother. Hence, there is possibility of autoinfection. If this infection takes place during the host's nymphal stage, more worms will be present. The potential significance of the above fact is difficult to explain because there is no information on how frequently cockroaches with infective nematode eggs in their hindguts occur in the population under study and how frequently it occurs during the nymphal stage of the cockroaches.

Single infection by *Leidynema appendiculata* was found to be higher in adults than in the nymphs of both species of hosts and single infection formed the highest percentage compared to its double and triple infections. Besides the fact that it cannot withstand moulting, it can only survive well when it does not occur with any other species of worms, that is, when there is competition for food, space, etc. In *Periplaneta americana* slight variation was found in its nymphal stage. Hominick and Davey (1972) had also pointed out that *Leidynema appendiculata* is not able to withstand competition. The number of *Leidynema appendiculata* is low in nymphs and high in adults because in its nymphal stage, it is faced with competition with *Hammerschmidtella diesingi* which is predominant.

In *Neostylopyga rhombifolia*, *Thelastoma malay-siense* had the same fate as that of *Leidynema appendiculata*. The infection rate in adult males and adult females did not differ significantly, but it differed significantly in adults and nymphs. In *Periplaneta americana*, there was no significant difference in the degree of infection among adult

males and adult females and immature roaches. This is probably due to the fact that *Thelastoma malaysiense* is unable to survive the complex series of events that are occurring during moulting.

There was no significant difference in the degree of infection by *Hammerschmidtella diesingi* among adults and nymphs of both hosts. The results show that it can withstand competition with *Leidynema appendiculata* which is predominant in the adults. This is in contrast to a fact given by Hominick and Davey (1972) that *Hammerschmidtella diesingi* is unable to withstand competition with *Leidynema appendiculata*. Hominick and Davey (1972) had shown that *Hammerschmidtella diesingi* infested nymphs cumulatively and its numbers decrease in adults, possibly, because the juveniles and even adults are not able to withstand competition. Galeb (in Hominick and Davey, 1972) stated that *Hammerschmidtella diesingi* by its shape and enormous fecundity annihilates *Leidynema appendiculata*, so that the former increases in number and the latter becomes more and more rare.

Results also show that adult females were more highly infected by *Hammerschmidtella diesingi* than the adult males. This is probably due to reasons given earlier as why females were more highly infected than males. There was no significant difference in the degree of infection among male and female roaches.

*Severianoia severiano* is a rare species and was found to harbour by only *Neostylopyga rhombifolia*. It was never occurred in the adults and the degree of parasitism was only 12.5%. This is probably due to the fact that it has a very low fecundity, that it reaches its sexual maturity very early such that it is never survived until hosts' adult stage. The other possible reason is that the worms might have a short life-cycle, too short to compare with hosts' life-cycle or longevity. As stated earlier the nutrients taken by adults and nymphs might be slightly different. If these worms depend on certain food taken by the nymphs but not eaten by the adults, the worms will not survive in the latter. Other than that, a very low tolerance to osmotic changes that occur during moultings can be used to explain this fact. The observation that it was never found in *Periplaneta americana* is interesting. This forms the difference in the suitability of hosts for *Severianoia severiano*.

#### SUMMARY

*Periplaneta americana* L. was shown to harbour a maximum of three species of Thelastomatidae, namely, *Thelastoma malaysiense*, *Leidynema appendi-*

*culata* and *Hammerschmidtella diesingi*. Besides these three worms, *Neostylopyga rhombifolia* (Stoll) was found to harbour *Severianoia severiano*. The infection by *Leidynema appendiculata* was generally more prevalent in the adult hosts (especially *Neostylopyga rhombifolia*) whereas the infection by *Hammerschmidtella diesingi* was more or less of the same degree either in adult or in nymph hosts. This is probably due to the inability of *Leidynema appendiculata* juveniles to survive the moulting of the hosts while *Hammerschmidtella diesingi* can successfully do so. The infection by *Thelastoma malaysiense* was found to be high in the adult hosts of both species. This shows that its juveniles are also unable to survive the moulting of the hosts. *Severianoia severiano* was found to occur only in *Neostylopyga rhombifolia* (Stoll) and it only infected the nymphal stage of the host. There was no significant difference in the degree of infection among the adult male and adult female hosts (both species). The infection rate in adults and nymphs differed significantly in *Neostylopyga rhombifolia*.

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# FIELD GUIDE FOR THE STUDY, COLLECTION AND PRESERVATION OF MEDICINAL PLANTS

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## INTRODUCTION

MANY DRUGS listed in the pharmacopeia have been derived from plants which in turn have been recognized and used by traditional medical systems from various parts of the world. Examples include morphia, rauwolfia, digitalis, quinine, and chaulmoogra oil. The ancient Chinese pharmacopeia includes at least 60 ancient Chinese remedies identical in botanical or biological origin as drugs used today. More recent work has added several hundred new drugs derived from traditional Chinese medicine to the modern pharmacopeia used in China (Keys, 1976).

Elsewhere in the world similar work is being carried out. A complete analysis of medicinal plants is being carried out in Mexico by the Mexican Institute of Medicinal Plants (IMEPLAM) with priority being given to plants with effects on the cardiovascular system, and with anti-diabetic and anti-parasitic properties (Lozoya, 1977). In Africa, the newly established Centre for Scientific Research into Plant Medicine in Ghana (Ampofo, 1977) reports that tapping the knowledge of the traditional healer has been rewarding, and that many of the herbal preparations produce a satisfactory response in 75% of their patients. Work on medicinal plants is also being conducted in Ethiopia (Kloos, 1977), Papua New Guinea (Sterly, 1975), Fiji (Thaman, 1977) and elsewhere.

Mahler (1977), the Director-General of the World Health Organization, notes that:

*"The age-old arts of the herbalists too must be tapped. Many of the plants familiar to the 'wise-woman' or the 'witch-doctor' really do have the healing*

*powers that tradition attaches to them; the pharmacopeia of modern medicine would be poorer if one removed from it all the preparations, chemicals and compounds whose origins lie in herbs, funguses, flowers, fruits and roots."*

*"Let us not be in any doubt: modern medicine has a great deal still to learn from the collector of herbs. And already a number of Ministries of Health, in the developing countries especially, are carefully analysing the potions and decoctions used by traditional healers to determine whether their active ingredients have healing powers that 'science' has overlooked. Whatever the outcome of such scientific testing, there is no doubt that the judicious use of such herbs, flowers and other plants for palliative purposes in primary health care can make a major contribution towards reducing a developing country's drug bill."*

A renewed interest in the medicinal plants used by traditional herbalists has meant that many of these herbs are now being collected for identification and analysis. However the unsystematic collection of bits of bark, stems, and other plant parts do not provide sufficient material for a proper taxonomic identification to be made. Further, poor ethnological documentation and erroneous or incomplete collection of local vernacular names, often leads to confusion and frustration. The following guidelines are being published to assist would-be collectors in the systematic study, collection, preservation and identification of promising medicinal plants.

## TRADITIONAL MEDICINE

The surface of the earth is covered with numerous plants only some of which are of medicinal value. It is therefore essential to begin by tapping

the knowledge of traditional medicine. Ampofo (1977), of the Centre for Scientific Research into Plant Medicine in Ghana, notes that many plant screening programmes have not yielded any fruitful results because traditional healers have not been involved in these trials and that with the advice of the good healers he has had at least a 50/50 change of success. The first step in research into medicinal plants would thus involve the tapping of traditional medical knowledge concerning the value of plants.

In addition to information available as oral traditions, old texts on traditional medicine may exist and can also serve as useful points to start from. However many are written in an archaic language and care must be taken in the translation of terminology relating to pathology, disease names, symptomatology and signs as well as to the local vernacular names of plants. In particular care must be exercised in the translation of plant names and in their identification by informants. Verification from more than one source will be necessary in most cases to ensure accuracy in the translation of such texts.

In the case of oral information obtained from informants, detailed field notes are essential and a tape-recorder may prove invaluable. Information regarding the disease states for which a herb is advocated, the manner in which the herb is prepared, the dosage, and the local vernacular name of the medicinal plant should always be recorded. Particular care must be exercised regarding the local vernacular names of the medicinal plants identified by informants as it is not unusual for an informant to fabricate a name if the real one is not known to him. Verification from more than one source is invaluable.

Care should also be exercised regarding local vernacular medical terms. It is always essential to have these explained and elaborated so that the precise meaning of each term can be compared with modern medical terminology particularly in relation to disease names, pathology, symptomatology and physical signs. Field notes should always be made of the meaning of these local vernacular terms.

## COLLECTION OF MEDICINAL PLANTS

Once a number of "promising" medicinal plants have been "identified" either from old traditional medical texts or from informants, such as traditional medicine-men, the next task is to locate a flowering specimen of the plant, collect adequate specimens, and preserve these for taxonomic identification and classification.

## Herbarium Specimens

A herbarium is a collection of dried plants that have been systematically arranged to facilitate taxonomic identification and classification, and are most usually maintained by departments of botany in universities, museums, botanical gardens and departments of forests or agriculture, and is the most likely place where promising medicinal plants can be systematically identified. In order to identify a specimen, the botanical taxonomist will need a herbarium specimen, that is a whole plant or a portion of it not exceeding 43 cm × 28 cm showing all its essential characteristics, such as leaves, flowers and fruits, correctly pressed flat and preserved. A herbarium specimen should always bear an identification tag with the name of the collector and a serial number corresponding to the serial number of the collector's field notes. A label bearing the salient field notes, to be described, should also be attached.

The herbarium specimen should consist of all the essential parts of the plant including its leaves, flowers, and fruits. The more complete the specimen, the easier will be the task of identification.

## Field Notes

Complete data recorded with a dark soft lead pencil relating to the specimen should be kept in a prepared field note book that has a stiff cover. It is essential not to record data in washable inks which may become indecipherable from rain. The following data should always be included. Name of collector, serial number of collection, date, geographical locality including name of district and sub-district, habitat, form of plant, its height, bole, and its characteristic features (which might be lost as a consequence of preservation) particularly in relation to its roots, leaves, flowers, fruit, bark and wood, and the local vernacular names by which it is known. These should be systematically noted for every specimen collected.

The initials and *name* of the collector and the collection *serial number* are essentially to label the specimen. It is therefore most important that the collection serial numbers are never duplicated and that each specimen is individually numbered. To avoid confusion, it is advisable to number specimens serially from 001 onwards. The *date* of collection should be recorded in the conventional order of day, month and year.

The geographical *locality* should include the name of the district and sub-district as well as the approximate altitude above sea level. To assist in the identification, a brief description of the *habitat* in which the plant is growing should be noted.

The type of soil, topography, nature of vegetation and relative position of the plant to other vegetation should be included.

The *form* of the plant should be indicated e.g. tree, shrub, herb, or creeper (Fig. 1). For trees, the *height* and *bole*, the length of trunk from ground to the first major limb, should be estimated. The diameter at breast high (d.b.h.) should also be measured.

It is particularly necessary to record those characteristic features of the plant that will be lost as a consequence of preservation. The *texture*, *colour*, *smell* and *arrangement of parts* are of particular importance. As a guide the basic types of *roots* are shown in Fig. 1, whilst the basic features of the different parts of a *leaf*, the different types of leaf arrangements, the degrees of lobing of leaves, the different types of leaf venation and the different shapes of leaf that are commonly encountered are shown in Figs. 2, 3 and 4. It should be noted that compound leaves can be distinguished from simple leaves by looking at the base of the leaf stalk. A true leaf stalk or petiole is usually swollen at its point of attachment to the twig and has within its axil a vegetative bud, the axillary bud. A petiole of a compound leaf does not have an axillary bud (Fig. 2).

The position of the *flowering shoot* as well as the type of *inflorescence* should be described (Fig. 5). Observations regarding features of the *stem*, *bark* and nature of *wood* should be noted (Fig. 6). Characteristics such as colour, texture, thickness and hardness, particularly those that may be lost as a consequence of preservation should be noted. The size, colour and texture of the *fruits* should also be recorded.

The *local vernacular name* should always be recorded. However care should be taken to verify that the name is correct and that it has been correctly spelt. The language or dialect used should also be recorded.

### Collecting the Specimens

The specimen may consist of a whole plant including the roots or a part of the plant, showing all its essential features, but measuring no more than 43 cm by 28 cm. If necessary several parts are collected but each is identified by a tag, a small watchmaker tag is ideal, bearing the initials and name of the collector and a collection number corresponding to the serial number of the field notes. To avoid confusion specimens from the same plant should bear the same collection number while

specimens of the same type of plant collected from another site should bear a new collection number. Each specimen bearing a different collection number should be placed in a different specimen folder, each of which is labelled with the corresponding collection number. A specimen folder consists of several folded sheets of newspaper of 44 cm. by 29 cm. between the sheets of which related specimens are placed (Fig. 7). Specimens should always be pressed in a specimen folder the day it is collected and in any case before it wilts.

In addition to an identification tag, each specimen should also bear a label summarising the salient field notes mentioned previously. This is to assist the taxonomist identify the specimen.

### PRESERVATION OF SPECIMENS

There are basically two ways of preserving specimens so that they are not attacked by mildew and destroyed. The principal way, used for all specimens intended as permanent herbarium specimens and as specimens for phytochemical analysis, is by drying, either atmospheric drying or heat drying. The second method is by chemical treatment.

#### Atmospheric Drying

In the tropics, atmospheric drying is usually unsatisfactory for the larger succulent specimens, and will not be considered here. Heat drying is much more satisfactory and is accomplished by heating prepared specimens over kerosene pressure lamps or over electrical incandescent lamps (Fig. 8). Specimens should first be placed between newspaper folds of about 44 cm. by 29 cm. (Fig. 7). Loose flowers and fruits should be placed in a packet bearing a corresponding collection number. If necessary extra folds and pieces of newspaper are added to ensure that the specimen will be properly pressed flat. Each specimen folder is then separated by a sheet of similar sized corrugated board with its corrugations running at right angles to the long axis of the folder. If possible, this is then separated from the next specimen folder and corrugated board by a corrugated sheet of aluminium to facilitate the passage of warm air and the process of drying (Fig. 8). The whole is then bound tightly between two end boards by two strong straps. This drying press is then placed on its side over the drier containing the heating lamps. To direct all the heat through the press, vents and gaps in the top of the drier should be blocked. After 12 hours the straps should be tightened. Drying takes from 24 to 36 hours. The press should be opened and each specimen individually examined. All dried specimens should be removed to prevent excessive drying and brittleness.

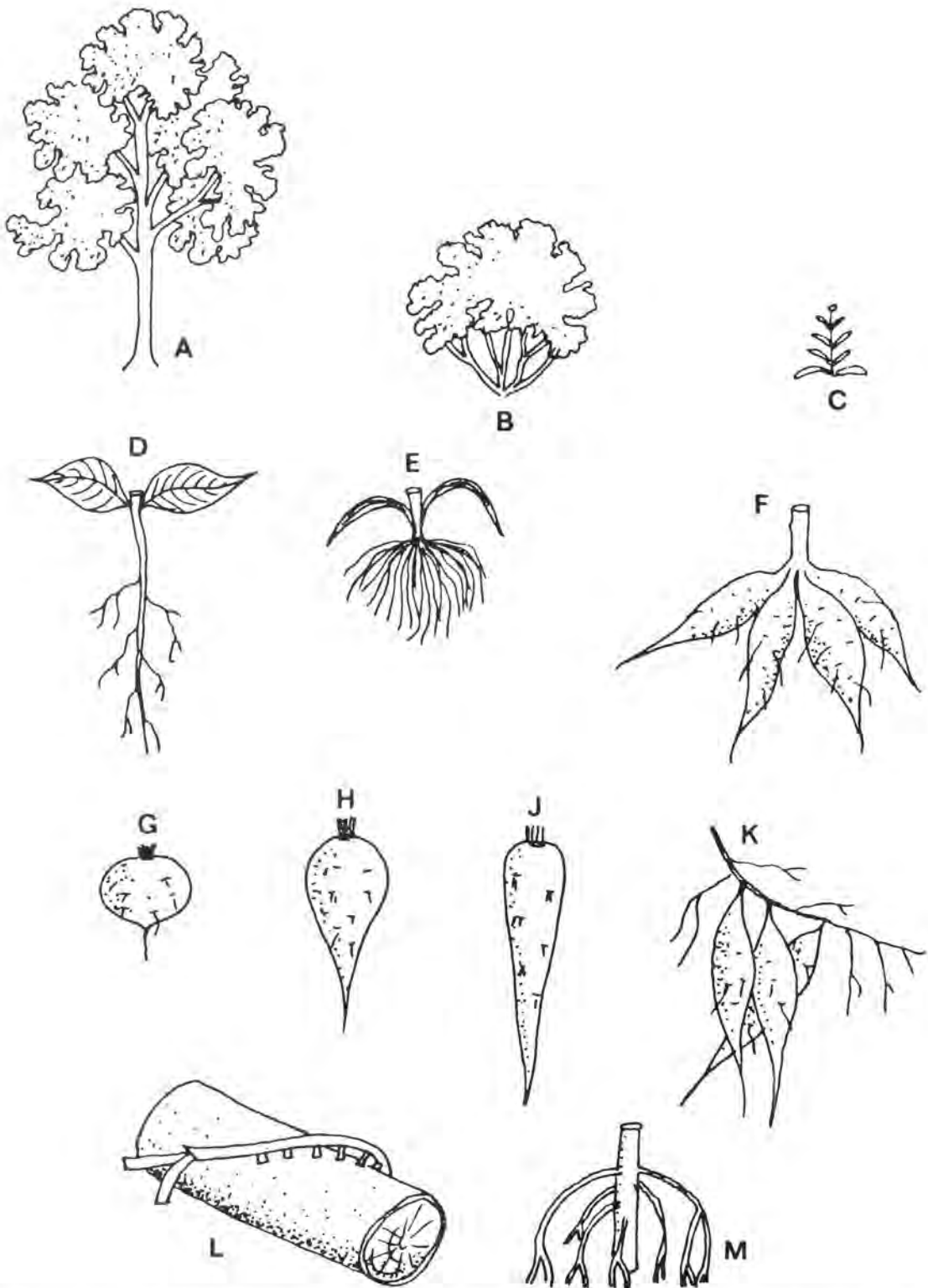


Fig. 1 Diagrammatic representation of: A - tree, B - shrub, C - herb, and of common types of roots: D - taproot, E - fibrous roots, F - fascicled roots, G - spheroidal, H - turbinated, J - obconical, K - fusiform, L - adventitious and M - prop roots.



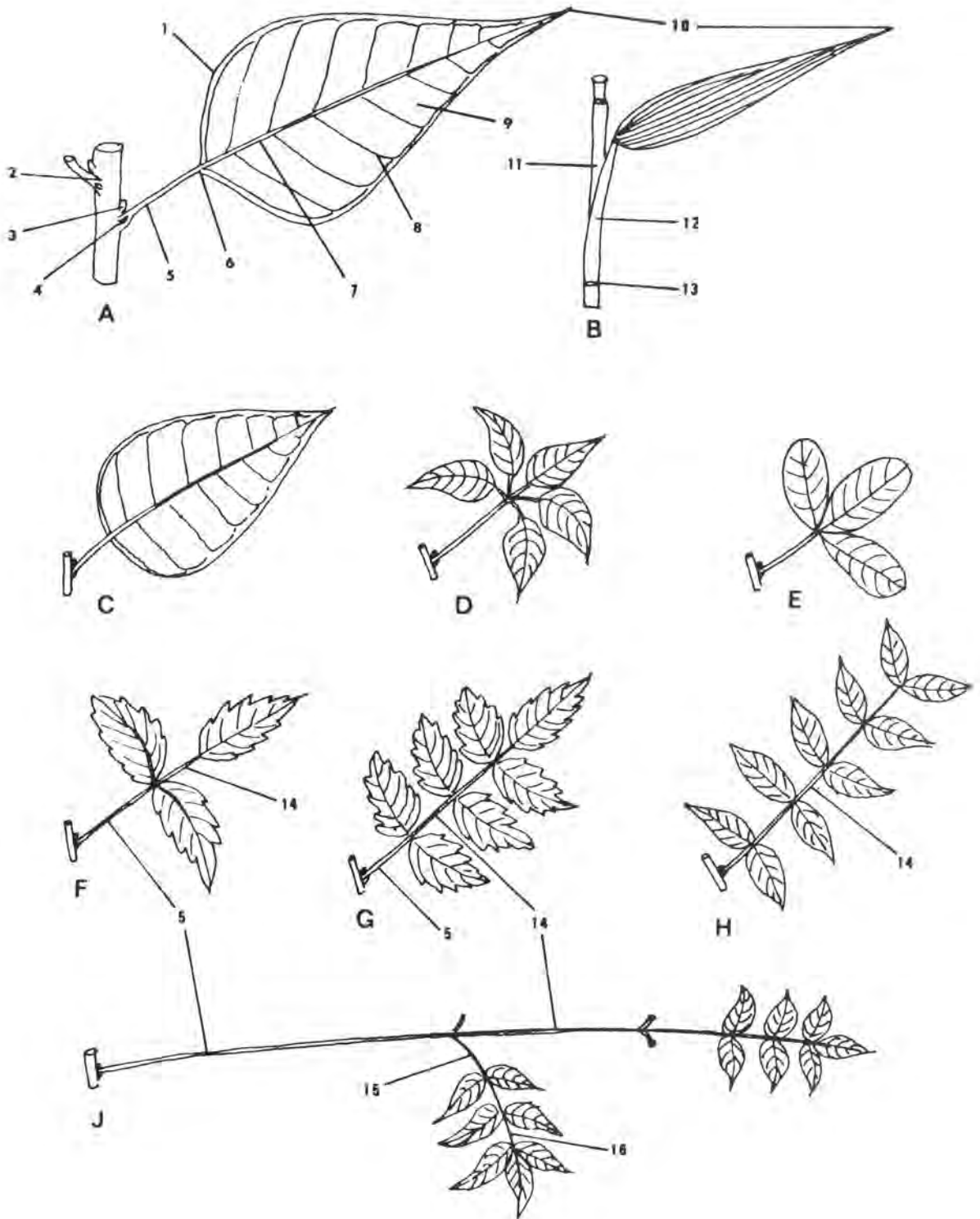
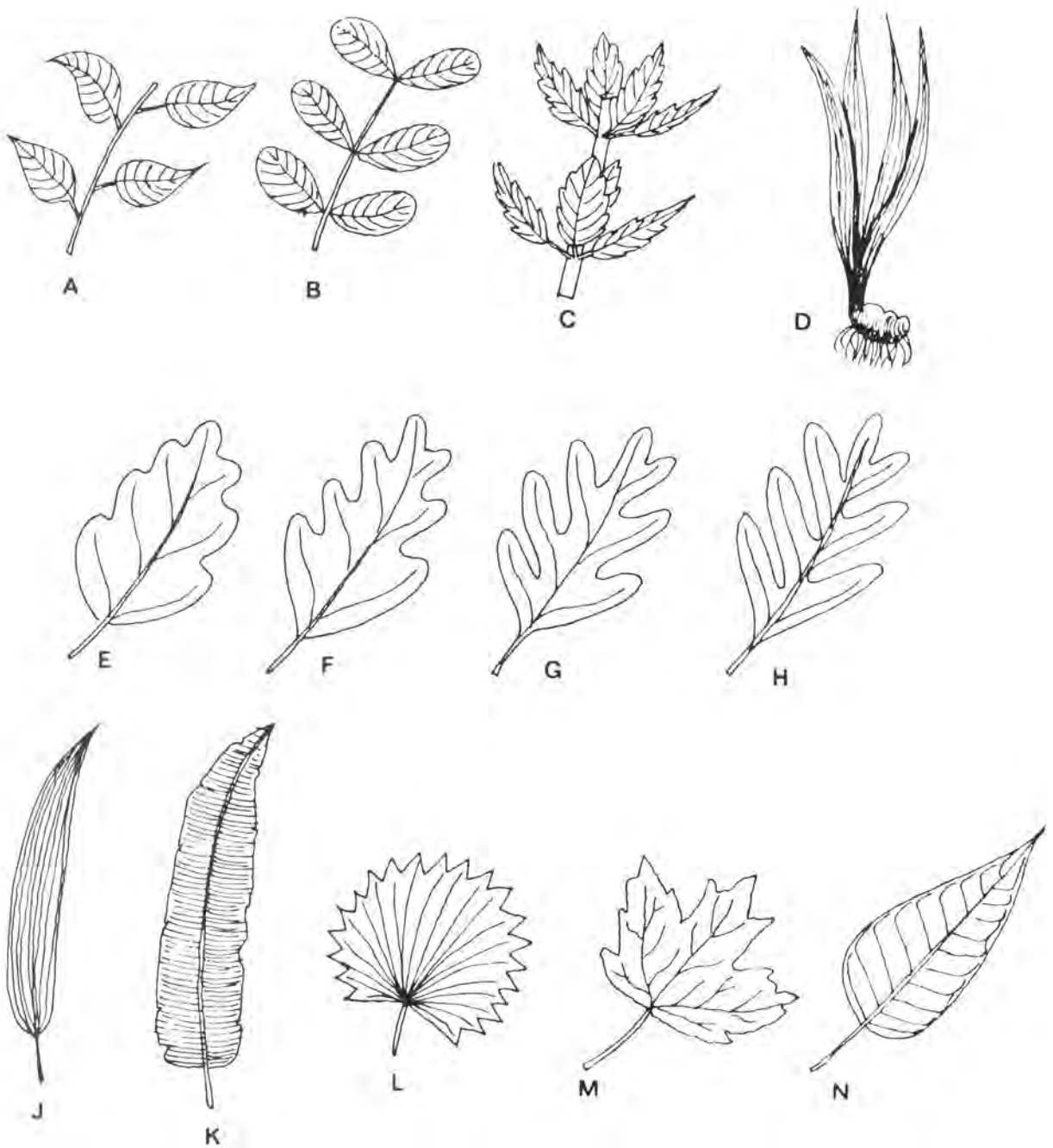


Fig. 2. Parts of a leaf (A and B): 1 - margin, 2 - axil, 3 - axillary bud, 4 - stipule, 5 - petiole, 6 - base, 7 - midrib vein, 8 - lateral vein, 9 - blade, 10 - apex, 11 - internode, 12 - sheath, 13 - node, 14 - rachis, 15 - petiole and 16 - rachilla. Leaf arrangements: C - simple leaf, D - palmately compound, E - palmately trifoliolate compound, F - pinnately trifoliolate compound, G - odd pinnately compound, H - even pinnately compound and J - bipinnately compound.



**Fig. 3** Leaf arrangements: A - alternate, B - opposite, C - whorled and D - equitant. Degrees of lobing of leaves: E -lobed, F-cleft, G- parted and H -divided. Leaf venation: J -parallel (nerved), K - parallel (pinnate), L - radiate, M - palmately reticulated and N - pinnately reticulated.

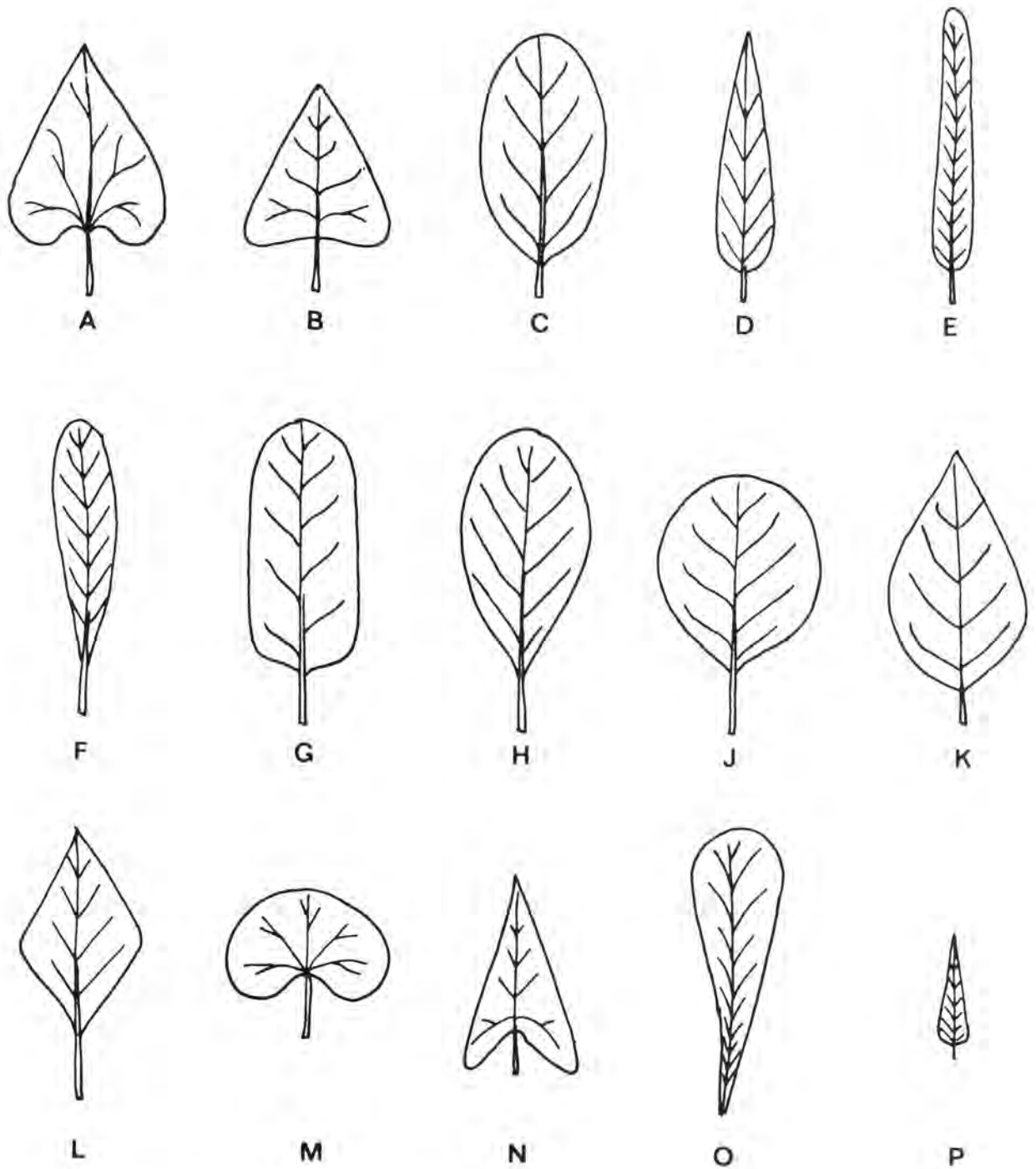


Fig. 4 Shape of leaf blades: A - cordate, B - deltoid, C - elliptical, D - lanceolate, E - linear, F - oblanceolate, G - oblong, H - obovate, J - orbiculate, K - ovate, L - rhombic, M - reniform, N - sagittate, O - spathulate and P - subulate.

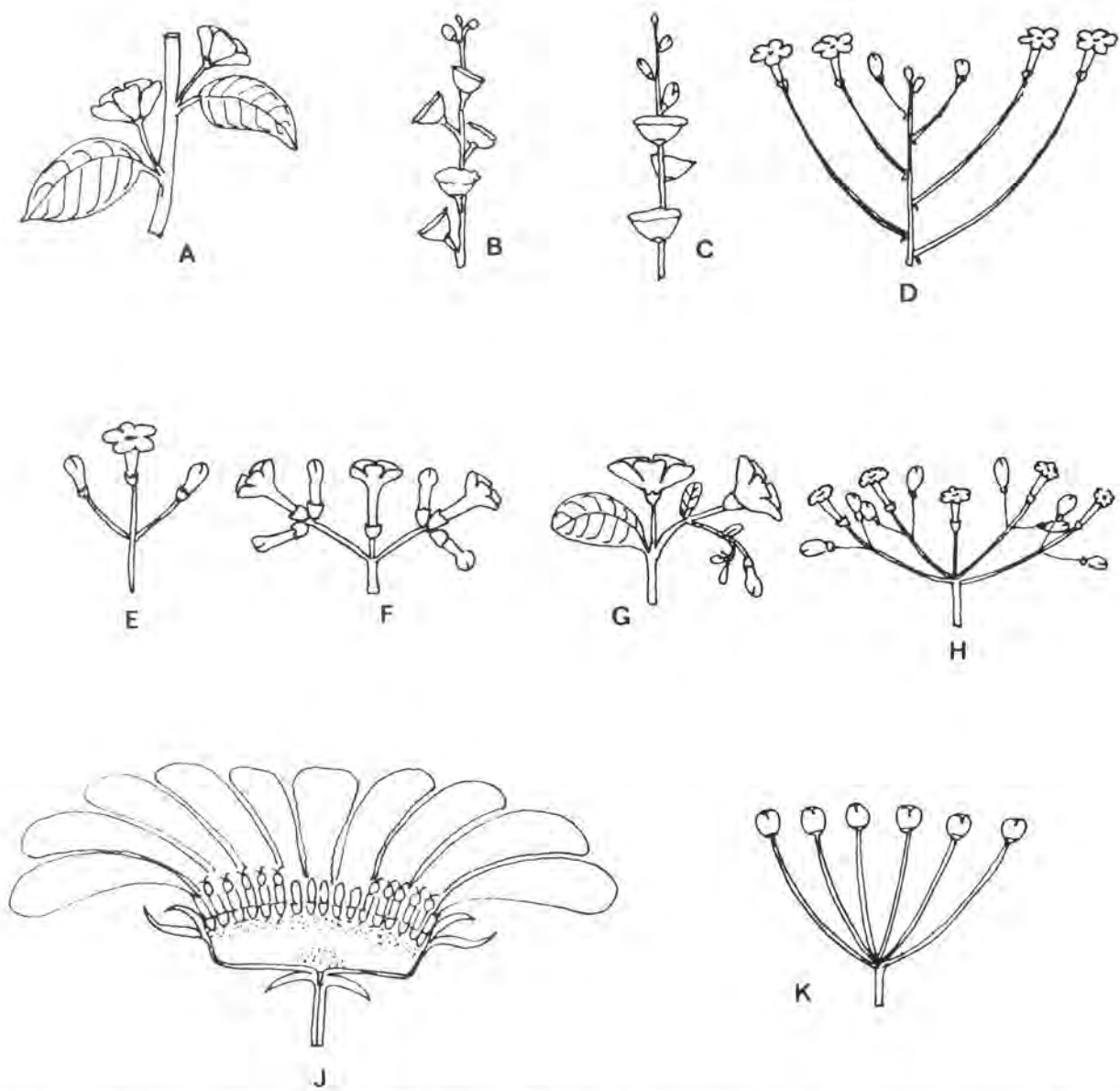
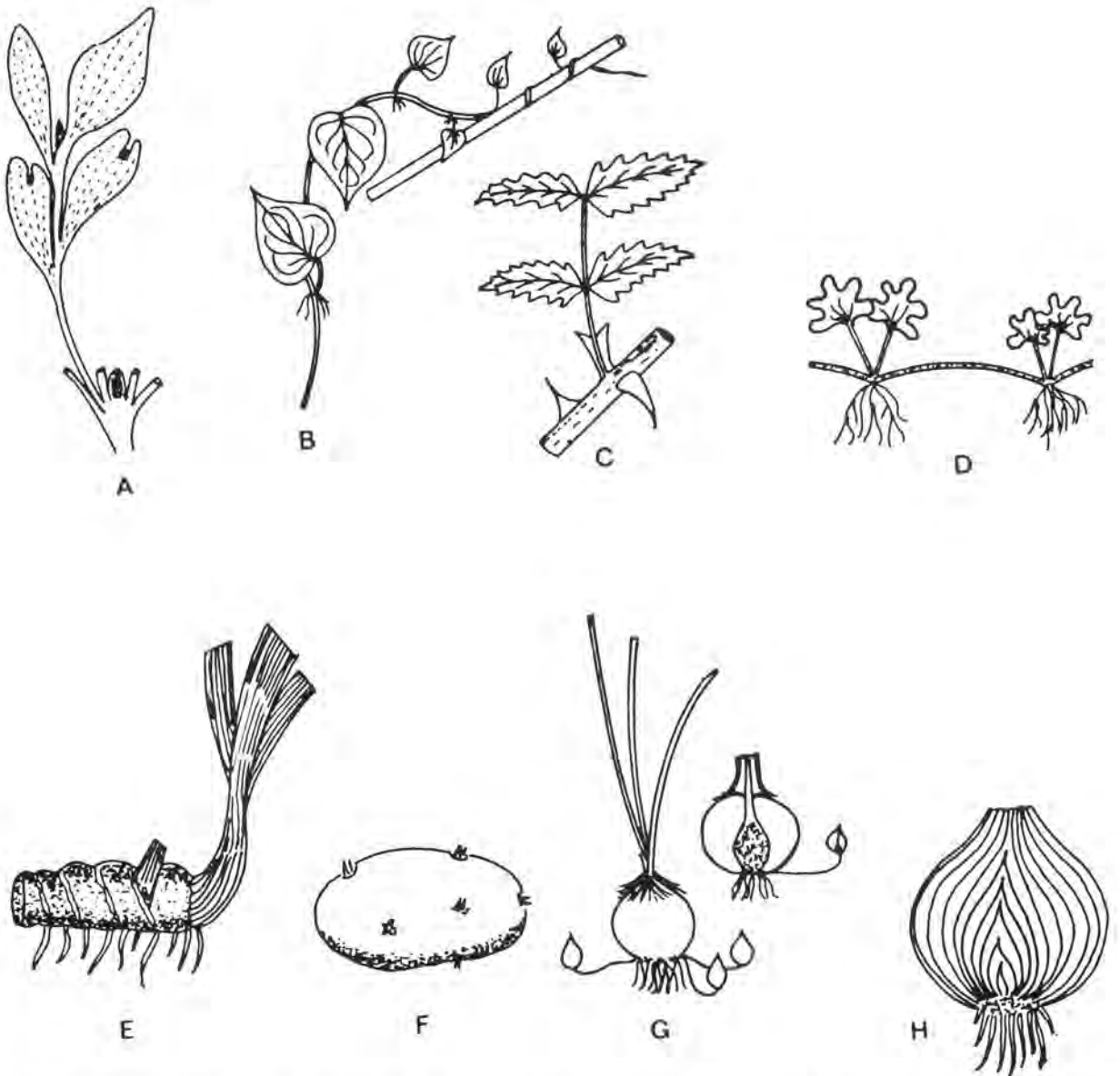


Fig. 5 Inflorescence types: A - axillary flower. Racemose (centripetal) types: B - raceme, C - spike and D - corymb. Cymose (centrifugal) types: E - simple dichasium, F - compound dichasium, G - helicoid cyme, H - pleiochasium. Racemose or cymose: J - capitulum, K - umbel.



**Fig. 6** Modified aerial stems: A - phylloclade, B - stem tendril, C - thorns or spines, D - stolon or runner. Modified subterranean stems: E - rhizome, F - tuber, G - corm, H - bulb.



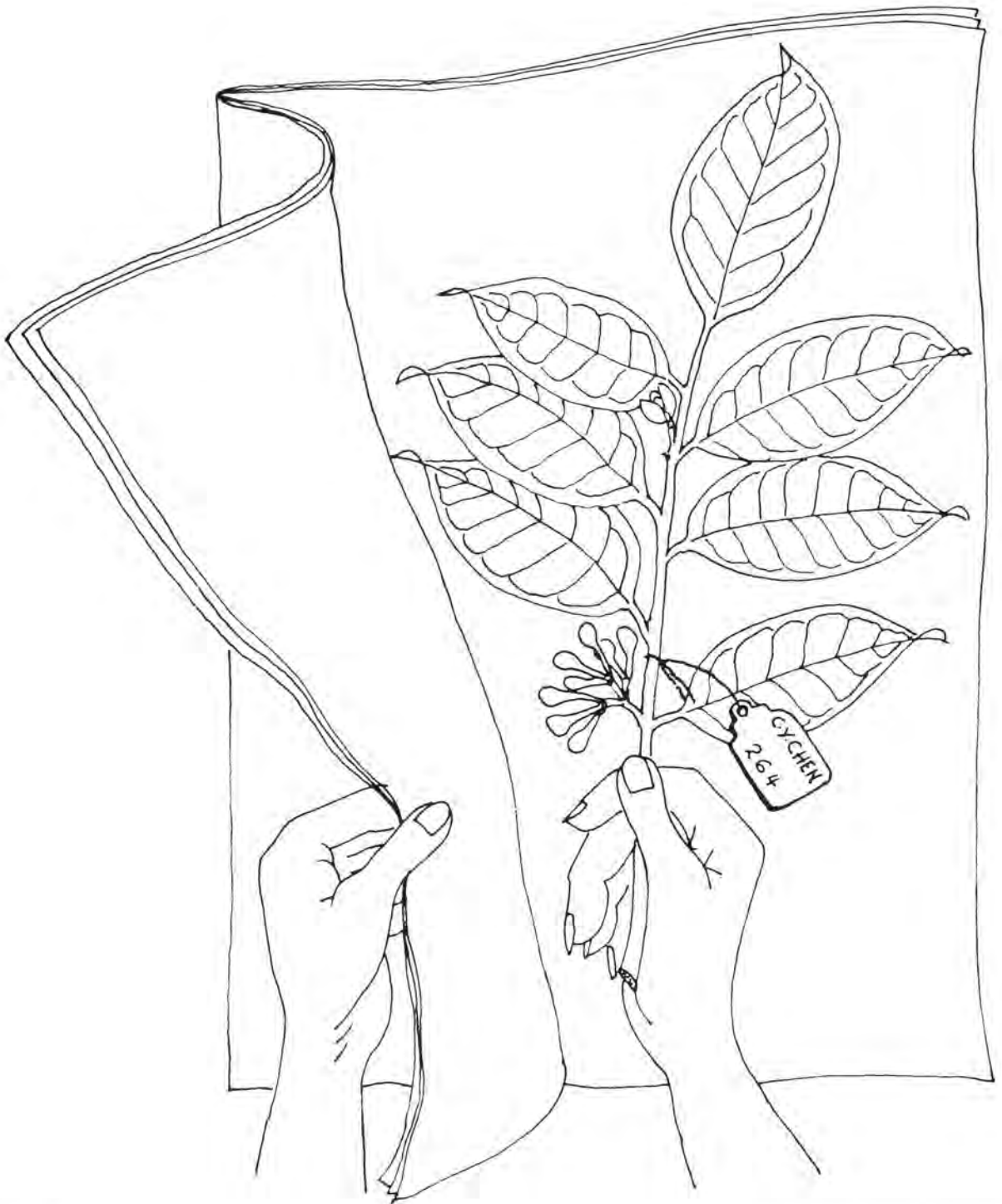


Fig. 7 A specimen complete with flowers and fruits has been tagged and numbered and is being placed between sheets of folded newspapers, measuring 44 cm by 29 cm, ready for pressing.

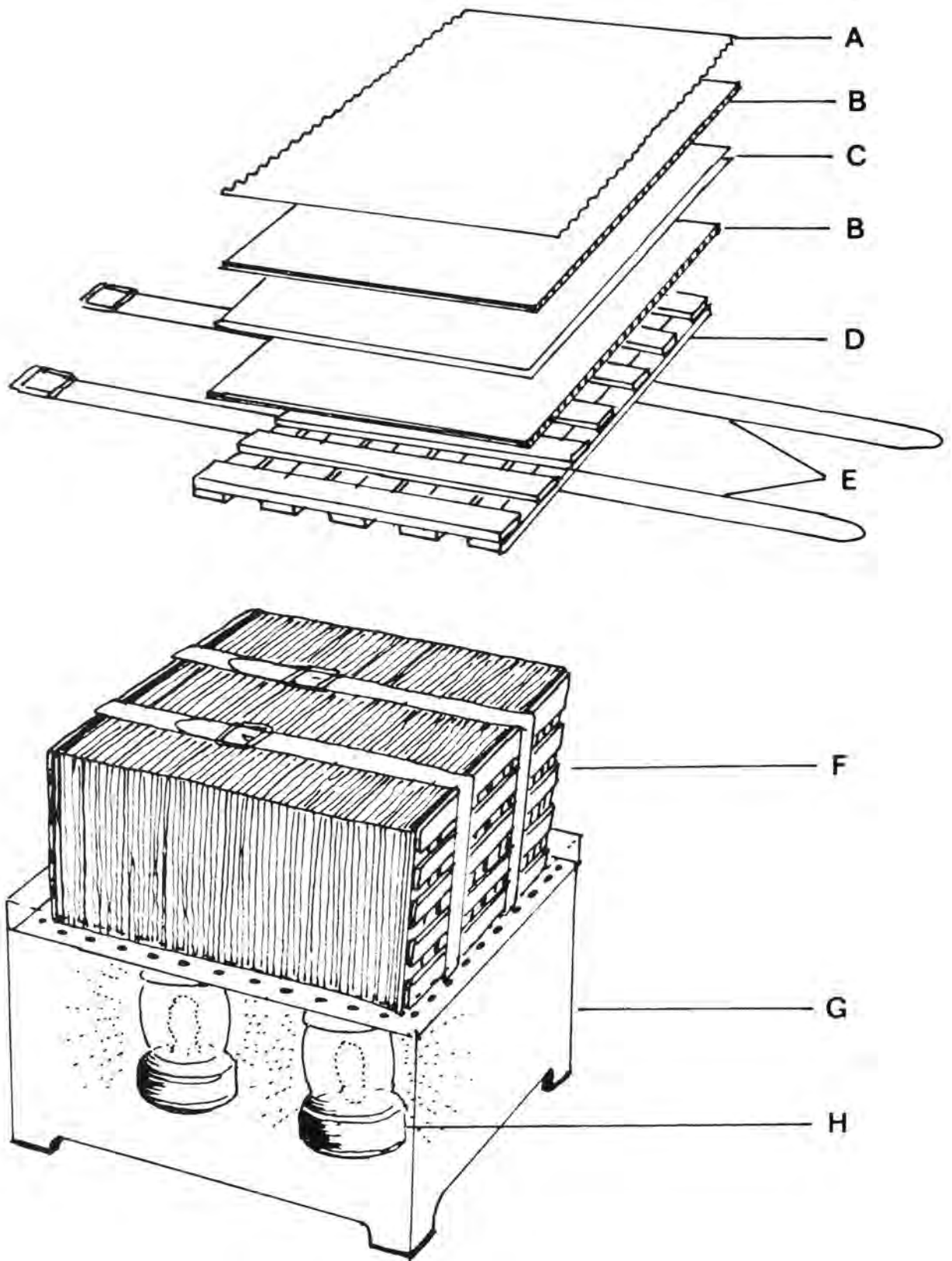


Fig. 8 Construction of a drying press with its component parts shown: A - aluminium corrugate, B - corrugated board, C - specimen folder, D - end board and E - straps to bind the press. The completed drying press (F) is shown in position on its side on top of the drier (G) heated with kerosene pressure lamps (H).

### Chemical Treatment

Specimens may also be preserved chemically with either a solution of 4-6% formaldehyde or methylated spirits. As in the case of specimens to be preserved by drying, specimens for chemical treatment are normally placed in between sheets of folded newspapers and pressed for about 12 hours, after which the press is opened and the specimens removed. If necessary the newspaper sheets are replaced. The specimen folders are then neatly inserted into a polythene bag and about 3 cupfuls of methylated spirits or 4-6% formaldehyde spread evenly across the open ends of the bundle of folders. The bag is then sealed and is ready to be sent to the herbarium. Bulky and fleshy fruits can be preserved in a bottle containing methylated spirits or formaldehyde. However it should be borne in mind that chemically treated specimens are only useful for taxonomic identification and cannot be used for phytochemical analysis.

### PHYTOCHEMICAL AND PHARMACOLOGICAL TESTS

Once "promising" medicinal plants have been identified sufficient quantities will need to be collected

for phytochemical analysis and, eventually, for pharmacological tests. The techniques for these are well established and will not be described in this field guide.

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## CORRESPONDENCE

### Gangrene of the foot

Dear Sir,

These are photographs of the successful treatment of diabetic gangrene of the foot of an Indian Estate Conductor, aged 49, who was given daily for six months Vit. E (Esai) 1,000 units, and Vit. C (Takeru), 1,500 mgm.

The gangrenous toes fell off six months later and the ulcers healed. His diabetes was treated



Fig. 1 Gangrenous foot of a diabetic Indian Estate Conductor aged 49 years.

with insulin and diabenese. His happiness at being rescued from amputation of his foot was shared by all who treated him.

Yours etc.,

D.R. Tweedie,  
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Fig. 2 The healed foot of the Indian six months later after he had received daily Vit. E 1,000 units and Vit C 1,500 mgm.

The Hon. Editor,

Dear Sir,

In their article entitled *Oral Manifestations of Microbial Diseases* which appeared in volume 32, pages 232-235 in 1978, G. Singh and K. Subramaniam stated that infectious mononucleosis can produce a false positive serological test for syphilis. King, A. and Nicol, C. (1975), however, state that "Glandular Fever has been thought to produce this type of reaction, but this has not been confirmed by recent surveys." Further, Dunlop, E.M.C. of the London Hospital, and Wilkinson, A.E. of Venereal Disease Research Laboratory, London (personal communication, 1977) in their studies

found that sero-positivity in infectious mononucleosis is not in any way significantly higher than in the normal population.

I am, etc.,

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### REFERENCE

King, A. and Nicol, C. (1975) *Venereal Diseases*, 3rd Ed., Balliere Tindall, London, p. 131.

## BOOK REVIEWS

McGaghie, W.C., Miller, G.E., Sajid, A.W. and Telder, T.V. (1978) **Competency-based Curriculum Development in Medical Education: An Introduction**, Public Health Papers No. 68, World Health Organization, 91 pp. Sw. fr. 9.

Medical education has become of increasing interest to the medical profession and no longer a closely guarded domain of medical schools. Medical educationists and the profession have expressed concern over the discrepancies that existed between the medical curriculum and the functional requirements of medical practice and, in the past two decades, the undergraduate curriculum has been critically reviewed by all medical schools and many of them have made significant changes. In addition, the new schools that have been established have radically departed from the traditional curriculum and adopted a curriculum in which a high degree of integration has been brought about in both the vertical and horizontal dimensions.

This publication from the World Health Organization edited by eminent medical educationists has made a critical review of the various curricula models and expressed the need for medical schools to continually evaluate teaching. The authors have carefully reviewed and identified some of the inadequacies of a subject-centred curriculum and expressed the view that such a curriculum prepares health workers according to disciplinary rather than community expectation. A truly integrated undergraduate curriculum, on the other hand despite its favourable feature, is often difficult to implement effectively. Apart from the teachers' earlier resistance to changes, faculties which are departmentally structured find difficulty in integration across disciplines. The authors have, however, highlighted its advantages. In support of the Competency-Based Curriculum the authors have identified its advantages and emphasised the need for new skills on the part of teaching staff. The authors have presented an indepth study

on curriculum development based on competency and have carefully analysed the element of competence required of doctors and emphasised that a good physician in one setting may be totally incompetent in another depending on the health needs of the population. Detailed analyses on physician activities required to identify the level of competence are carefully explained to support the main theme of the thesis. Arising from this, they have suggested possible curriculum content required in the undergraduate curriculum. The remainder of the book deals with the programme organization in general terms with reference to the general training of doctors and recommended methods of identifying various curricula modules and instructional units.

Examinations are usually equated with assessments in the training programme and authors have critically reviewed this and emphasised the need for frequent assessments of learning rather than having examinations as methods of certifying that the students have learned an acceptable amount of what has been taught.

The last chapter deals with details of preparation of teachers, students and institutions to accept new ideas in curriculum and educational concepts.

I recommend this monogram published by the World Health Organization as a useful document for all medical educationists and am confident that it will stimulate a new approach in curriculum development. The authors have clearly outlined the value of a competency-based curriculum and methods of developing such a curriculum. A central component of the competency-based system is the need for students to accept responsibility for learning and for the teachers to continually examine its efficiency and effectiveness, its costs and its benefits.

K. Somasundaram