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MALARIOGENIC STRATIFICATION OF INDIA USING ANOPHELES CULICIFACIES SIBLING SPECIES PREVALENCE

Malaria continues to be a serious problem in many parts of the world including in India. Global experience in malaria control over the past several decades suggests that control of malaria is a complex phenomenon and is dependent on several factors such as vector and parasite species prevalence, susceptibility/response of vectors to the control measures in operation, antimalarial drug choice, drug policy, susceptibility of parasites to drugs, management of environmental conditions that influence vector and parasite prevalence, budgetary provision, and finally the governmental policies in the implementation of available control measures. After the resurgence of malaria in the 1970s (6.4 million cases in 1976), in the 80s and 90s reported cases varied between 1.5 to 2.0 million annually with the implementation of the modified plan of operation since 1977. In the late 90s several epidemics have occurred in many parts of the country and the incidence increased to around 3.0 million cases in 1995-96 with about 40% of *Plasmodium falciparum* cases and deaths also being reported during the epidemics. However, by 1998 the total cases of malaria had come down to 2 million annually.

Due to the development of resistance to insecticides in disease vectors and increased awareness of environmental pollution there is a need to reduce insecticidal use. The global strategy recommended by WHO also suggested the judicious use of insecticides and situation specific control measures with emphasis on environmental management methods[1]. Thus, there is a need for alternative, innovative, sustainable and cost effective methods for malaria control. Stratification of areas to identify suitable control measures is an accepted strategy. This article reports on the stratification of India based on the prevalence of *Anopheles culicifacies* sibling species.

Anopheles Species, Malaria Vectors and Species Complexes

There are about 450 *Anopheles* species, of which 70 are considered important in the transmission of human malaria. Indian anopheline fauna comprise 58 species with 9 of them acting as vectors of malaria[2]. *An. culicifacies, An. dirus, An. fluviatilis, An. minimus, An. stephensi* and *An. sundaicus* are the important vectors and because of their biological characteristics and ecological adaptation, the whole country, except a few high altitude and coastal areas on the mainland, comes under the influence of these species and experiences malaria. Except *An. stephensi*, all the other vectors are species complexes *ie* each taxon comprises a number of morphologically indistinguishable biological species, commonly known as sibling species or cryptic species or isomorphic species[3]. Among the vectors of secondary

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importance *An. annularis* and *An. philippinensis-nivipes* are also complexes. This phenomenon is not restricted to the Indian anophelines and is also found in other anophelines, and several other insect species and animal groups. To date, a total of 23 species complexes have been identified among anophelines. The number of sibling species so far identified among the Indian anophelines is given in Table I. *An. sundaicus* which is restricted to the Andaman and Nicobar Islands has been identified as cytotype D (unpublished observations) and only a single sibling species of *An. dirus* and one of *An. minimus* found in the north-eastern states are vectors[4]. The role of a second sibling species of *An. dirus*, species E found in Shimoga district of Karnataka is not known. *An. culicifacies* and *An. fluviatilis* are two important species complexes contributing respectively 60-70% and 15% of malaria cases annually in the country[4]. The sibling species of both these complexes exhibit distinct biological characters[4].

Table I. Species complexes among Indian anophelines

Anopheles species	No. of sibling species identified	Sibling species found in India
Vectors		
annularis	2	A,B
culicifacies	5	A,B,C,D,E
dirus	7	D,E (D in north-eastern states and E in Karnataka)
fluviatilis	3	S,T,U
minimus	4	A
sundaicus	3	a fourth cytotype,D
philippinensis-nivipes	3	*nivipes* A
Non Vector		
subpictus	4	A,B,C,D

An. stephensi and *An. varuna* the two malaria vectors in India that have not yet been found as species complexes.

An. culicifacies & *An. fluviatilis* Sibling Species and Malaria Transmission

Members of a species complex exhibit a specific distribution pattern indicating their preference and adaptability to an area. Further, many times they differ in biological characteristics which determine their potential in the transmission of disease namely, host feeding preference, longevity and susceptibility to plasmodium infection and also in resting and biting patterns[5].

An. culicifacies has now been recognized as a complex of 5 species, provisionally designated as A,B,C,D and E, with a specific distribution pattern[3,5]. In India, where all 5 species are found, species A and B are sympatric in northern and southern India with the predominance of species A in the north and that of B in the south; in the eastern states of north India either species B is predominant or is exclusively found. Species B and C are predominant in the western and eastern regions. Species D is found sympatrically with A, B and C in Central India and in a few places in Tamil Nadu and north-western region[6]. Species E has been recently identified in sympatricity with species B in Ramanathapuram district of Tamil Nadu, and its distribution is yet to be established[7]. Similarly *An. fluviatilis* sibling species, S,T and U have exhibited distinct distribution patterns. In hilly forested areas of Orissa, species S is either the predominant species along with species T (<1%) or is exclusively found, while in the foot hill and plain areas of Uttar Pradesh species T and U are sympatric[8,9].

Further, among the members of the *An. culicifacies* complex, only species A,C,D and E are vectors of malaria[5]. However, though species A,C and D have been incriminated as malaria vectors, preference to feed on human host was poor (anthropophilic index not exceeding 3-4%)[3,5]. Thus, only when high densities of these species are found, their role as vectors becomes important. In case of *An. fluviatilis* complex, species S is highly anthropophagic (~90%)[9], and is the only species found with sporozoites so far[3]. Species T and U are almost totally zoophagic.

Malariogenic Stratification and Sibling Species Prevalence

Stratification of areas for suitable and effective malaria control is one of the best strategies. Different entomological, parasitological and environmental parameters can be and have been used for malariogenic stratification. Based on the prevalence of *An. culicifacies* sibling species, the whole country can be divided into 7 major divisions (Fig. 1). Because of the distinct biological characters of *An. culicifacies* sibling species and their specific distribution pattern and sympatric association with *An. fluviatilis* sibling species, the stratification of the whole country is being proposed. A correlation has been found between *An. culicifacies* sibling species prevalence and malaria incidence. Broadly it can be stated that as species B is a non-vector, there would be no malaria in areas where only species B is found. Also in areas where other

sibling species are found in low proportions along with species B the incidence of malaria will be low. Urban areas where *An. stephensi* is responsible for malaria are not being considered under these divisions.

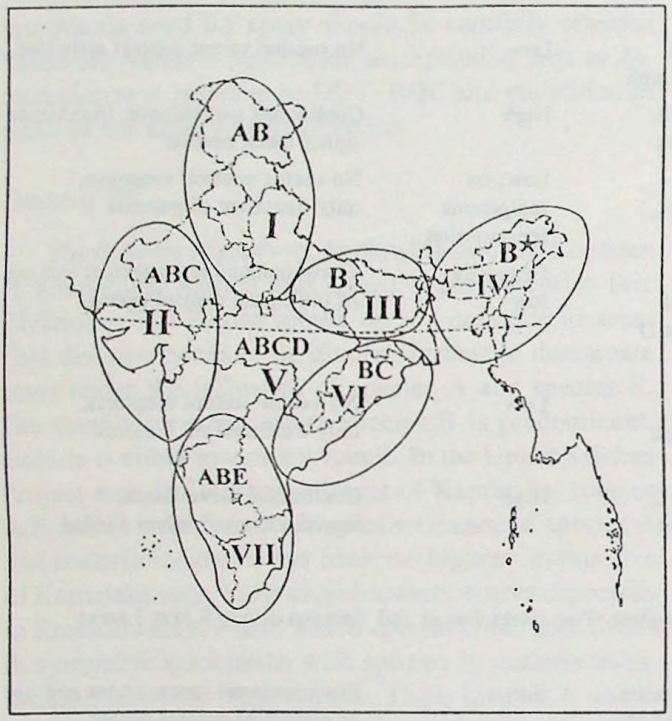

Fig.1. Stratification of India.
I-VII: Major divisions.
A,B,C,D,E: *Anopheles culicifacies* sibling species.
**An. minimus, An. dirus, An. fluviatilis* and *An. philippinensis-nivipes* complexes.

Divisions I and III

Division I includes the states of Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Delhi, north-western Uttar Pradesh (U.P.), and part of north-western Rajasthan. Division III includes districts of eastern U.P., southern U.P. and the State of Bihar except for a few southern districts. In Division I sibling species A and B are sympatric and in northern parts species B is predominant. Species A constitutes the majority of the *An. culicifacies* in areas with canal irrigation . In the sub-Himalayan regions species T and U of *An. fluviatilis* are found. In Division III *An. culicifacies* is exclusively species B.

As an example, the stratification of U.P. (falling in Divisions I and III) and Bihar (in Division III) where longitudinal studies have been carried out, is presented here. In these states a close relationship was seen between the prevalence of *An. culicifacies* sibling species and malaria incidence[10]. Based on these observations U.P. can be stratified into four zones (northern, western, eastern and southern U.P.) and Bihar into two (northern and southern Bihar). Sibling species prevalence, malaria endemicity and suitable control measures for each zone are given in Table II. Occurrence of only species B (a non-vector) in eastern districts of U.P. and in districts of northern Bihar clearly indicates why there has been no malaria in these areas.

For further stratification in the low malarious southern zone of U.P., district Allahabad was chosen[11]. The Ganga and Yamuna rivers divide this district into three regions; *viz. Gangapar, Yamunapar* and *Doaba* (Fig. 2).

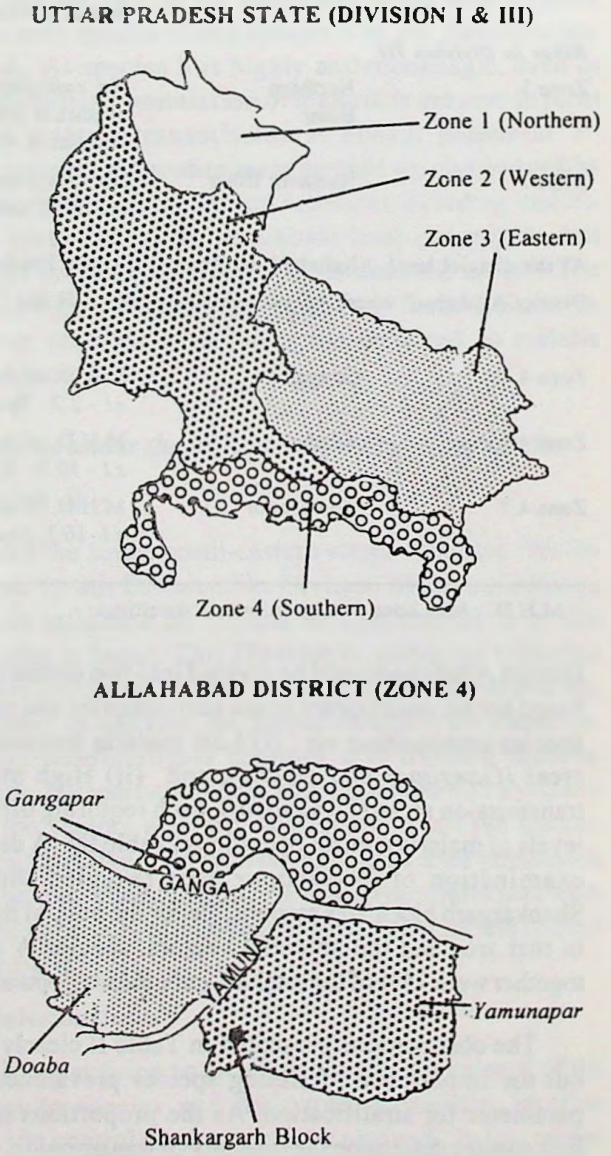

Fig.2. Stratification of Uttar Pradesh state and Allahabad district.

Table II. State and district level stratification based on sibling species prevalence of *An. culicifacies*

Strata		Vector species	Malaria endemicity	Recommended control measures
At the State level				
Uttar Pradesh in Divisions I&III				
Zone 1	Northern U.P.	*An. culicifacies* A&B, proportion of B very high	Low	No routine vector control activities
Zone 2	Western U.P.	*An. culicifacies* A & B, species A predominant	High	Continuous surveillance, Insecticide spray when needed
Zone 3	Eastern U.P.	*An. culicifacies* species B predominant, species A<1%	Low; no indigenous transmission	No vector control measures, only treatment of patients
Zone 4	Southern U.P.	*An. culicifacies* species A, B & C and in a few areas species D	Generally low	Environmental management and use of biological control agents
Bihar in Division III				
Zone 1	Northern Bihar	*An. culicifacies* species B predominant, species A <1%	Low	No vector control measures, only treatment of patients
Zone 2	Southern Bihar	*An. culicifacies* B & C, species C predominant	High	Continuous surveillance, insecticide spray when needed
At the district level. Allahabad in Zone 4 of Uttar Pradesh				
District Allahabad where *An. culicifacies* species A,B and C are prevalent. Two rivers Ganga and Yamuna divide it into 3 areas				
Zone 4. 1	*Gangapar*	M.H.D. of *An. culicifacies s.l* - 2.2; Species B 65.6%	Low	Environmental management and use of biological control agents
Zone 4.2	*Doaba*	M.H.D. of *An. culicifacies s.l* - 10.3; Species B 88%	Low	Same as above
Zone 4.3	*Yamunapar*	M.H.D. of *An. culicifacies s.l* -16.3; Species B 52.7%	High	Continuous surveillance, insecticide spray when needed

M.H.D. : Man hour density in human dwellings.

District Allahabad could be divided into two distinct areas based on *An. culicifacies sensu lato* densities and sibling species composition *viz.*, (i) Low malaria transmission areas (*Gangapar* and *Doaba*), and (ii) High malaria transmission areas *(Yamunapar)*, each requiring different levels of malaria control operations (Table II). A detailed examination of *Yamunapar* area revealed that the Shankargarh block was responsible for the bulk of malaria in that area and the potential vectors, species A and C together were 75% of the total *An. culicifacies* population[12].

The observations presented in Table II clearly bring out the importance of sibling species prevalence as a parameter for stratification. As the proportions of sibling species determine the intensity of transmission, stratification should go down at least upto the block level to achieve cost effective malaria control, where *An. culicifacies* is the principal vector. However, it should be noted that these predictions/forecasts are applicable only when no species other than *An. culicifacies* is the vector.

Based on the observations and analysis by the Malaria Research Centre (MRC), Delhi, and recommendations made for the above two states, a situation analysis of other divisions and broad guidelines for vector control are being suggested. These Divisions can be broadly categorised into 3 groups.

Divisions under the exclusive influence of An. culicifacies sibling species.

Division II

The entire state of Gujarat and districts of north-western and southern Rajasthan, western Madhya Pradesh and north-western Maharashtra comprise Division II.

Species B and C are the most prevalent species and in areas which have come under irrigation, species A is found. Areas with high proportion of species A and C need to be identified and depending on the malaria situation suitable control measures should be adopted. The insecticide used for spray should be carefully selected based on available insecticide susceptibility data as *An. culicifacies* is resistant to DDT, BHC and malathion in most of the areas of this Division.

Division VII

The districts of southern Andhra Pradesh and the states of Karnataka, Kerala and Tamil Nadu comprise this Division. This is also totally an *An. culicifacies* area. This division needs to be divided further to demarcate areas under the influence of species A and species E. The remaining areas where species B is predominant, malaria is either low or not found. In the Upper Krishna Project area in Gulbarga district of Karnataka, species A,B and C were found with predominance of species A and malaria incidence has been the highest in this area of Karnataka state. In Ramanathapuram district especially in Rameshwaram island where species E has been found in sympatric association with species B, malaria transmission has been very intense. Thus, species A and E areas have to be identified and targetted for suitable vector control measures including judicious use of insecticide spray operations. In areas wherever *An.culicifacies* is breeding in wells larvivorous fishes can be used.

Both in Divisions II and VII, mapping sibling species and determining their proportions upto the block level is strongly recommended to identify areas having exclusively or predominance of species B.

Divisions under the influence of An. culicifacies and An. fluviatilis sibling species

Division V

Most of the districts of Madhya Pradesh and northwestern Maharashtra, northern Andhra Pradesh and a part of southern Uttar Pradesh fall in this Division. This Division in central India has all the important vectors, species A,C and D of *An. culicifacies* and species S of *An. fluviatilis*. Transmission of malaria is intense in most of the areas in this Division, *P. falciparum* being the most prevalent parasite. During the rainy season many areas become unapproachable for implementing control measures. Vector surveillance should be regularly done to detect changes in the densities and relative proportions of sibling species for planning preventive strategies. Indoor residual spraying is recommended, as in this area *An. culicifacies* and *An. fluviatilis* are indoor resting. However, in many areas *An. culicifacies* is resistant to DDT, BHC and malathion, therefore insecticides for indoor sprays should be chosen based on susceptibility data. Use of insecticide treated mosquito nets was found effective and this could be another vector control method of choice[13].

Division VI

The entire state of Orissa and districts of southern Bihar, north-eastern districts of Andhra Pradesh and Madhya Pradesh are under this Division. In the plains, *An. culicifacies* C is the vector and in the hilly forested areas both species C and species S of *An. fluviatilis* are found. As species S is highly anthropophagic, even in low densities transmission of malaria is intense. In most areas malaria transmission is almost perennial. *P. falciparum* is the predominant parasite species and deaths are reported. Vector control measures including insecticide spray and use of insecticide treated mosquito nets should be deployed in such hyperendemic areas[14]. The Plains where only *An. culicifacies* is found have to be further stratified to delineate the poor and no malaria transmission areas.

Divisions under the influence of other vector species

Division IV

All the seven north-eastern states comprise this Division. In this Division like Division III *An. culicifacies* has no influence on malaria as only species B of this complex is found. This Division is under the influence of two important malaria vectors, *viz. An. dirus* and *An. minimus*. In addition, *An. fluviatilis* and in the plains *An. philippinensis-nivipes* complex also transmit malaria. Mostly falciparum malaria is prevalent in this Division. All the vectors are fully susceptible to all the insecticides, therefore if effectively used the vector population can be controlled. Insecticide treated mosquito nets were found to be very effective in this Division for the control of malaria[15].

Conclusions

By stratifying an area based on the prevalence of the mosquito species and their role in malaria, location specific control measures can be planned. In low receptive areas where the prevalence of vector species is less, bioenvironmental methods *viz* source reduction using major and minor engineering works and use of biological

control agents can be adopted for sustainable malaria control. High receptive areas with predominance of vector species should be targetted for insecticide use. Taking into consideration local factors such as climatic conditions, cultural aspects especially in relation to sleeping habits and economic status, spraying or insecticide treated mosquito nets can be chosen as the vector control measures. This would save costs on insecticides, prolong the life of the existing insecticides by not promoting the development of resistance in vector species and prevent environmental contamination by insecticides. It will also help in the optimum utilization of limited resources by diverting supplies to endemic areas which have serious malaria problem. The case studies reported bring out the importance of microlevel stratification at least upto the block level to achieve cost effective malaria control.

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This write up has been contributed by Dr. Sarala K. Subbarao, Director and Dr. Nutan Nanda and Dr. K. Raghavendra, Sr. Research Officers, Malaria Research Centre, Delhi.

ABSTRACTS

Some Research Projects Completed Recently

Family environment in the elderly with chronic respiratory disease.

The prospective study was carried out in 100 elderly patients (aged 60 years and above) suffering from chronic obstructive airway disease to determine the relationship between the family environment and characteristics of the disease (*viz.* its duration and severity), perception of the family environment by the patients and caregivers, and medical support services available. The caregivers included sons, daughters, spouses and close relatives.

Using semistructured interview schedules significant correlation was observed between the duration and severity of the disease, availability of medical support services and patient's perception of his/her family environment. A fair degree of agreement was observed in all the subscales of the family environment scale (FES). In the relationship dimension,

high scores were recorded in cohesion and expressiveness indicating to a large extent the commitment, help and support that family members provide to each other and that the family members are encouraged to act openly and express their feelings directly. Low scores of both patients and caregivers on the issue of family conflict also indicated a supportive family environment. High scores on the independence subscale predicted a tendency to be assertive and self sufficient.

The study thus revealed that both the elderly patients and caregivers felt quite positively about their families and perceived their families as supportive characterized by high cohesion and expressiveness and low conflict associated with family member's better adjustment and greater ability to deal with stress, especially when coping with personal physical illnesses.

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Soneja, S., Dey, A.B., Desai, N.G. and Kumar, V. Family environment in the elderly with chronic respiratory disease. *Indian J Psychiatr 39 (Suppl):* 30, 1997.

Analysis of the natural history of Perthes' disease in India.

A retrospective study involving review and analysis of radiographs and records of 518 patients of Perthes's disease was undertaken to determine the natural history of the disease and to know whether the natural history of the disease is altered by the current treatment protocol as also to decide whether current treatment protocol needs to be modified.

The study revealed that the onset of Perthes' disease was around 8.5 yr of age; the male : female ratio of the affected children being 70:30. Bilateral involvement was noted in 5% of the patients and extensive femoral head involvement was very common.

It was found that the disease runs a very slow course and the average total duration of the disease is around 4 years. In children under 12 years the disease could be divided into clearly identifiable stages ((IA, IB, IIA, IIB, IIIA, IIIB and IV) based on plain radiographic appearances. The duration of the different stages increased in ascending order (IA < IB < IIA < IIB < IIIA < IIIB). The duration of each stage was not altered by surgery or influenced by the extent of epiphyseal avascularity, sex of the patient or the age at onset of the disease.

Metaphyseal osteoporosis developed in over 95% of the patients and persisted throughout the course of the disease. Metaphyseal cysts were seen in much smaller proportion of children compared to metaphyseal osteoporosis. These were seen most commonly during the later part of stage I and during the stage of fragmentation of epiphysis (stage II) after which the frequency of cysts decreased markedly.

Acetabular changes including bicompartmentalisation and ischium varum occurred with increasing frequency from the onset of the disease till the stage of revascularization. However, this did not appear to be related to the extent of epiphyseal avascularity or the extent of epiphyseal collapse.

Metaphyseal widening increased progressively from stage IA to IIIB and the extent of widening was distinctly less in children who underwent surgery. Epiphyseal extrusion occurred early in the disease and progressed till stage IIIB; the magnitude of extrusion being less in operated hips.

The natural history of the disease was altered by containment surgery in the form of (i) reduction in the degree of epiphyseal extrusion; (ii) significant reduction in the degree of metaphyseal widening; (iii) minimization in the extent of femoral head enlargement; and (iv) the femoral head had a much higher chance of retaining its sphericity.

It can be concluded that the protocol of treatment being followed currently offering surgery (varus derotation with trochanteric apophyseodesis) to children under 12 yr of age (provided the disease has not progressed beyond stage II) seems to have a sound basis and needs no modification as the results of operative treatment are satisfactory.

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ICMR NEWS

The following meetings of various technical groups/ committees of the Council were held :

Meetings of the Task Force (TF)/Expert Group (EG)/ Project Review Committee (PRC) and other meetings held at New Delhi :

Meeting on Interferon Trial	July 1, 1999
TF on Protozoal Infection	July 5, 1999
PRC on Virology	July 13, 1999
EG on Monitoring of quality of bulk monovalent oral polio vaccine	July 15, 1999

Participation of ICMR Scientists in Scientific Events :

Dr. S.S.A. Zaidi, Senior Research Officer, National Institute of Occupational Health, Ahmedabad, participated in the VII Nordic Symposium on Trace Elements in Human Health and Disease at Helsinki (June 16-18, 1999).

Dr. Hema Joshi, Sr. Research Officer, Malaria Research Centre, Delhi, participated in the IV International meeting on Molecular Epidemiology Evolutionary Genetics in Infectious Diseases at Senegal (June 21-24, 1999).

Dr. Lalit Kant, Sr.Deputy Director-General, ICMR, participated in the XXII session of the Joint Coordinating Board for Special Programme for Research and Training in Tropical Diseases at Geneva (June 24-25, 1999).

Dr. Nita Mawar, Asstt. Director, National AIDS Research Institute, Pune, participated in the workshop on Social and Behavioural Research related to the Implementation of HIV Vaccine Trials in Developing Countries at Geneva (June 28-30, 1999).

Dr. P.R. Narayanan, Director, Tuberculosis Research Centre (TRC), Chennai, participated in the II meeting of the Global Tuberculosis Research Initiative of the WHO at Casablanca (June 29-July 1, 1999).

Dr. P.Udayasekhara Rao, Dy. Director, National Institute of Nutrition (NIN), Hyderabad, participated in the III International Food Data Conference at Rome (July 5-7, 1999).

Dr. B. Ravindran, Dy. Director, Regional Medical Research Centre, Bhubaneswar, participated in a conference on Parasitic Helminths: From Genome to Vaccine at Edinburgh (July 8-11, 1999).

Dr. V. Kumaraswamy, Dy. Director, TRC, Chennai, participated in the workshop on Control and Elimination of Lymphatic Filariasis at Atlanta (July 7-13, 1999).

Dr. Kamala Krishnaswamy, Director, NIN, Hyderabad, participated in the LII Annual Convention of the Philippine Association of Nutrition on Nutrition Perspectives for the Next Century at Manila (July 12-13, 1999).

ICMR AIDED SYMPOSIA/SEMINARS/WORKSHOPS/COURSES/CONFERENCES

Symposium/Seminar/Workshop/ Course/Conference	Date & Place	Contact Address
Workshop on Medical Communication: Writing in the Margins	July 24-25, 1999; (at Hyderabad)	Dr. Taraprasad Das, Organising Secretary of the Workshop, L.V. Prasad Eye Institute, Hyderabad-500034.
Workshop on Stereology, Image Processing and Quantitative Image Analysis in Biomedical Research	July 26-28, 1999; (at New Delhi)	Dr. Shashi Wadhwa, Professor, Department of Anatomy, All India Institute of Medical Sciences, New Delhi-110029.
International Symposium on Atraumatic Restorative Treatment	August 12-14, 1999; (at Chennai)	Dr. S. Balagopal, Organising Secretary of the Symposium, SHIRAZ-47, 3rd East Street, Kamraj Nagar, Chennai-600041.
Biennial National Conference of the Association of Gerontology on Challenges of Ageing in the 21st Century	August 20-21, 1999; (at Hyderabad)	Sh. K.R. Gangadharan, Organising Secretary of the Conference, c/o Heritage Medical Centre, 7-1-59/4 & 8, Ameerpet, Hyderabad-500016.

Symposium/Seminar/Workshop/ Course/Conference	Date & Place	Contact Address
National Symposium and Update on Problem Areas in Diagnostic Oncopathology	October 8-10, 1999; (at Sevagram)	Dr. N. Gangane, Organising Secretary of the Symposium, Department of Pathology, Mahatma Gandhi Institute of Medical Sciences, Sevagram, Wardha-442102.
International Conference on Man, Environment and Nature	November 26-28, 1999; (at Calcutta)	Prof. Sunirmal Chanda, Covenor of the Conference, Centre for Study of Man and Environment, Parivesh Kendra, CK-11, Sector-2, Salt Lake City, Calcutta-700091.
International Symposium on Chemotherapy: Problem and Perspectives in 21st Century	November 28-29, 1999; (at Lucknow)	Dr. R.C. Saxena, Head, Department of Pharmacology, K.G. Medical College, Lucknow-226003.
Indo-European Seminar-cum-Workshop on Advances in Human Cytogenetics	December 6-9, 1999; (at Lucknow)	Dr. S.S. Agarwal, Head, Department of Medical Genetics, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow-226014.

COUNCIL'S TRAINING PROGRAMMES FOR 1999-2000

Leprosy

At the Central JALMA Institute for Leprosy, Agra:

- Training Course for Medical Officers Working under the National Leprosy Eradication Programme (September, 1999).

Reproductive Biology

At the Institute for Research in Reproduction, Mumbai:

- Training Course in Molecular Techniques in Ovarian Function (September 27-October 2, 1999).
- Training Course on Cytological Detection of Reproductive Tract Infections (December 13-17, 1999).

Endocrinology

At the National Institute of Nutrition,, Hyderabad:

- Annual Certificate Course on Endocrinological Techniques and their Application (August 1 - September 15, 1999).

Nutrition

At the National Institute of Nutrition, Hyderabad:

- M.Sc. in Applied Nutrition (June 1, 1999-February 28, 2000).
- Postgraduate Certificate Course in Nutrition (December 1, 1999-February 28, 2000).

Laboratory Animal Technology

At the National Centre for Laboratory Animal Science, National Institute of Nutrition, Hyderabad:

- Training Course for Laboratory Animal Technicians (June 14-July 30, 1999).
- Training Course for Laboratory Animal Supervisors (September 1-November 30, 1999).

Medical Entomology:

At the Vector Control Research Centre, Pondicherry:

- Postgraduate Diploma Course in Medical Entomology (from July 1999).

Biomedical Statistics

At the National Institute of Epidemiology, Chennai:

- Basic Course in Statistics for Medical Officers (July 1999).
- Training Course in Field Epidemiology (November, 1999).

Haematology

At the Institute of Immunohaematology, Mumbai:

- Training Course in Transfusion Medicine for Blood Bank Medical Officers (August 31-October 29, 1999).
- Training Course in Blood Group Serology and Blood Bank Methodology for Blood Bank Technicians (August 31-September 30, 1999).
- Training Course in Advanced Haematology and Immunohaematology (October 11-29, 1999).

INDIAN COUNCIL OF MEDICAL RESEARCH

Establishment of National Institute of Epidemiology

In pursuance of the approval of the Governing Body of the Council at its meeting held on 28.1.99, the DG, ICMR sanctions the merger of CJIL Field Unit, Avadi with Institute for Research in Medical Statistics (IRMS), Chennai. The merged Institute will be known as the National Institute of Epidemiology (NIE) to be located in the erstwhile IRMS premises at Chennai.

The objective of the Institute would cover the following broad areas:

(i) To develop the sciences of epidemiology and biostatistics.

(ii) To develop human resources in epidemiology and biostatistics.

(iii) To act as a clearing house for the two disciplines and emerge as a resource for epidemiology.

(iv) To do networking of the various ICMR and non-ICMR Institutes at the National level for epidemiological purposes.

(v) To provide consultancy.

INDIAN COUNCIL OF MEDICAL RESEARCH

Grant-in-aid for organising Seminars/Symposia/Workshops

The Council provides partial financial assistance for organising Seminars/Symposia/Workshops. Applications for grant of financial assistance (complete in all respects in the prescribed proforma), will be considered only if furnished at least four months before the date of commencement of the Seminar/Symposium/Workshop, *etc.*

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