KR 23/3/98

ISSN 0377-4910

ICMR BULLETIN

Vol. 27, No. 11 November, 1997

MANSONIOIDES CONTROL – AN ECONOMIC ACTIVITY

Among the filarial infections in humans caused by *Wuchereria bancrofti* and *Brugia malayi,* the latter constitutes 7.38 per cent of the total infection globally and 9.9 per cent in south-east Asian countries. The total population living in areas endemic for *B. malayi* is estimated to be 1287 million with 4.8 million actually carrying the infection[1]. Extensive research on various aspects of filariasis has enabled the formulation of suitable control strategies to contain this problem, which is more socio-economic in nature. Vector control aimed at interrupting transmission by reducing vector density and parasite control by chemotherapy to reduce man's infectivity to the vector population are the two general approaches of filariasis control. This disease has been controlled successfully in many countries and has been identified as one of the potentially eradicable diseases[2]. Brugian filariasis still exists in India as over 5 million people are at risk of this infection, although there has been a declining trend in many of the endemic foci[3,4]. Besides the conventional methods another potential method available for the control of *Mansonia* mosquitoes is the elimination of the aquatic weeds with which they are closely associated for their survival and propagation[5,6]. In this review, methods that generate income, with vector control as a by-product are discussed in view of their application in large scale operational programmes to control brugian filariasis.

Aquatic Weeds and Public Health Problems

Many floating weeds support the breeding of Mansonioides mosquitoes. Such an association of immatures was first identified as early as in 1905[7]. Gravid females deposit their eggs in the form of clusters under the surface of the leaves of floating weeds and to the roots of which the larvae attach themselves by serrated siphon to obtain oxygen. Thus the survival of immatures is solely dependent upon aquatic vegetation. Different species of *Mansonia* mosquitoes prefer different host plants and therefore the distribution of immatures and their intensity are determined by the community structure of weeds[8,9]. Hence, in brugian filariasis control operations, weed control is of primary concern. Physical removal of aquatic weeds such as *Pistia stratiotes, Salvinia molesta* and *Eichhornia crassipes,* the predominant hydrophytes supporting vector breeding had been adopted as a method of vector control in many areas[10,11]. However, this leads to recurrent expenditure on control operations since aquatic hydrophytes are well known for their rapid vegetative propagation[12]. Chemical means of weed control[13] is not advocated as the host plants of Mansonioides mosquitoes grow in ponds located in houses and other water bodies located close to human habitations. Besides, weedicides are more expensive and hazardous than larvicides.

Division of Publication & Information, ICMR, New Delhi - 110 029

14.11.98
19/3/98

Vegetative Propagation of the Host Plants

E. crassipes, the most common and perennial floating weed in many water bodies with wide distribution is known for its high rate of multiplication. It has been reported that the biomass accumulation for this species is as high as 20 g/m²/day[14]. Preponderate vegetative reproduction and copious seed production in water hyacinth enables this weed to encroach upon newer areas and recolonize the old ones. *S. molesta*, an aquatic fern is known to double its biomass in 2.2 days in mid summer and 5-8 weeks in winter[14]. *P.stratiotes*, another floating weed is also prevalent in most parts of India, particularly in Kerala and West Bengal and is the most preferred host plant for the mosquito vector *Mansonia annulifera*[9]. All three hydrophytes support the breeding of Mansonioides mosquitoes. In addition, a large number of semi-aquatic and emergent vegetation are also known to be the natural host plants for Mansonioides mosquitoes[15]. The host specificity of these mosquitoes differ with species, and the prevalence of hydrophytes primarily determines the prevalence of vector mosquitoes.

Control of Vector Breeding by Elimination of Weeds

Application of adulticide is not recommended as the feeding and resting behaviour of adult females of different species exhibit wide variations[16]. Due to the long duration of immature stages and periodic pattern of detachment behaviour[17], use of larvicide is also not feasible. However, the breeding of these vector mosquitoes can be controlled through environmental management involving deweeding/ fish culture. Such programmes can be implemented effectively only through community participation, where individuals and families assume the responsibility in controlling the disease. To ensure the sustainability of their involvement and the control programmes, some economic incentives to the community is indispensable whereby disease control become a by-product[18]. When the aquatic weeds are targeted to control the breeding of vectors of brugian filariasis, there is a growing emphasis on the economic utilization of weeds.

Economic Usage of Weeds

Among the aquatic vegetation, members of the family Gramineae are recorded as being the most preferred host plant especially for *Ma uniformis*[15]. Cartoon weeds have been used to make homes, animal feed and decorative craft articles; these weeds have also been grown as a soil binder. Weed control is closely related to the economic utilization of weeds which are varied and complex. The range of economic utility differs at various levels ranging from individual's usage as manure to agencies work to manufacture handicraft, fish feed, *etc.* Any use of aquatic weeds would be economical and far outweigh the money that would otherwise be spent on herbicides to control weeds and the losses and inconvenience caused by the weeds if left uncontrolled.

Feed for livestock

Conversion of aquatic weeds into feed for livestock or other animals had been attempted earlier[19]. The current concept is to utilize a wide spectrum of aquatic weeds which are processed in large quantities as feed for livestock. Aquatic weeds on account of their fibre contents can be an ideal raw material for feed for different animals. Although low fibre content is desirable as in the case of submerged weeds, high fibre content weeds like water hyacinth can also be used as a roughage fodder for ruminants. Water hyacinth contains 25-35 per cent crude protein in its leaves, besides it has adequate lysine content[20].

Feed for fish

A number of edible fishes feed voraciously on aquatic weeds and therefore fish could be considered as potential biocontrol agents. *Ctenopharyngodon idella, Cyprinus carpio* and many other carps are known to feed on aquatic weeds[21]. A study carried out in Kerala shows that the weeds infested in ponds could easily be controlled by stocking the ponds with fingerlings and fries of these edible fishes[22]. *C. idella* can attain a size of 1 kg in one year in warm water and about 4 kg in tropical region[23]. The giant gourami *(Osphronemus gourami)* is an exclusive phytophagous fish and under field conditions these fishes preferably devour *P. stratiotes*, followed by *S. molesta* and *E. crassipes*. The growth rate (g) and survival rate (%) for this fish were found to be 498 ± 153 and 60.0 respectively in one year[22].

Fish culture as a means of weed/vector control

Composite fish culture involving fast growing edible varieties of carps such as *Catla catla, C. carpio, Labeo rohita, Labeo fimbriatus, Cirrhina mrigala* and *C. idella* is an economic approach for weed control and thereby vector control. This strategy has been successfully demonstrated in Kerala for control of Mansonioides mosquitoes[18]. Based on the overall survival rate of

21.71 per cent of the fingerlings of carps and the average growth rate of 0.736 kg in one year, the average yield has been estimated to be 90 kg per pond of 100 sq. m. fetching an income of around Rs.1800/- besides reduction in vector breeding status from 80.6 to 28.2 per cent in these ponds.

Soil amendments

The soil can be improved using compost of weeds. Aquatic weeds grown in ponds on harvesting have been utilized as a good source of manure. It has been reported that water hyacinth turns into compost in 12 days, which is rich in potash and a source of organic matter[12]. Harvested weeds are piled on shore for two or three days. Animal dung, soil and ash are mixed with the weeds to accelerate decomposition. This manure increases the fertility of the soil and thereby the crop yield[24].

Source of paper pulp

Use of *E. crassipes* as a source of paper pulp is also one of the methods of economic utilization. This weed can be a good substitute with other weeds such as *Typha sp.* and *Phragmites sp* for paper making. Besides, the weeds can be a source for raw material for fibre glass, resin, *etc*[12].

Source of energy

E. crassipes plants produces methane under anaerobic condition, while decomposing. Higher water content of the weed is useful in maintaining the anaerobic bacterial decomposition to produce methane. An investigation carried out in USA has proved that each kilogram of water hyacinth produced 370 l biogas containing 69 per cent methane[24].

Handicrafts

Water hyacinth is extensively used in the Thailand as a principal raw material for the manufacture of various handicrafts such as toys, baskets, carry bags, *etc.* This provides employment for rural folks, where the raw materials are abundantly available[25].

Weed Control – An Alternative for Disease Control

Mansonioides control is thus possible through control of weeds, as control of immatures and adults using insecticides is not practical. Further, weeds can be a potential raw material for various cottage and large scale industries in the rural areas, providing employment opportunities to the local population. Hence the economic potential of these weeds should be exploited. In this process health and economic progress can go hand in hand, in an eco-friendly environment.

References

1. World Health Organisation. Lymphatic filariasis: The disease and its control. *Tech Rep Ser 821:* 3, 1992.
2. World Health Organisation. Vector control for malaria and other mosquito-borne diseases. *Tech Rep Ser 857:* 1995.
3. Rao, C.K., Russel, S. and Chandrasekharan, A. Some aspects of epidemiology of *Brugia malayi in India. J Commun Dis 10: 261, 1978.*
4. Rajagopalan, P.K., Krishnamoorthy, K. Panicker, K.N. and Sabesan, S. Epidemiological assessment of different intervention measures for the control of malayan filariasis in Shertallai, South India. *Misc Publ VCRC 17:* 18, 1990.
5. Antonipulle, P. David, H.V. and Karunaratne, M.D.R. Biology and control of *Taeniorhynchus (Mansonioides) uniformis,* Theobald, the chief vector of rural filariasis in Ceylon. *Bull WHO 19:* 295, 1958.
6. Burton, G.J. Studies on the bionomics of mosquito vectors which transmit filariasis in India. I. Attachment of *Mansonia annulifera* and *Mansonia uniformis* larvae to host plants occurring in *Pistia* tanks in Kerala, South India. *Indian J Malariol 13:* 75, 1959.
7. Goeldi, E.A. Os mosquitos no para. *Memmus Goeldi Paraense 4:* 106, 1905.
8. Burton, G.J. Method of attachment of pupae of *Mansonia annulifera* (Theo) and *Mansonia uniformis* (Theo) to *Pistia stratiotes. Bull Entomol Res 55:* 691, 1964.
9. Rajendran, G., Krishnamoorthy, K., Sabesan, S. and Panicker, K.N. Field observations on the host plant selection by Mansonioides mosquitoes for oviposition and larval attachment. *Trop Biomed 10:* 1, 1993.
10. Iyengar, M.O.T. Studies on the epidemiology of filariasis in Travancore. *Indian Med Res Memoir 30:* 1, 1938.
11. Chandrasekharan, A., Das, M., Krishna Rao, C.H. and Rao, Ch. Pilot project for the control of *Brugia malayi* filariasis. Part I. Some aspects of bionomics of vectors. *J Commun Dis 8:* 179, 1976.
12. Gupta, O.P. *Aquatic Weed Management.* Today and Tomorrow Printers and Publishers, New Delhi, p.247, 1987.
13. Yap, H.H. Review on the control of brugian filaria vector, especially *Mansonia* species. *Proceedings of WHO Regioal Seminar on Control of Brugian Filariasis* held at Kuala Lumpur, Malaysia, 1985, World Health Organization, Geneva, p.131, 1985.
14. Farrel, T.P. Control of *Salvinia molesta* and *Hydrilla verticillata* in Lake Moondarra, northwest Queensland: Seminar on Management of aquatic weeds. Australian Water Resources Council, Department of Natural Resources: Canberra p.57, 1979.

15. Krishnamoorthy, K., Rajendran, G. and Panicker, K.N. Aquatic vegetation and their natural hospitality to the immatures of *Mansonia* mosquitoes, the vector of *Brugia malayi* in Shertallai, Kerala, India, *Southeast Asian J Trop Med Pub Hlth 25:* 760, 1994.

16. Wharton, R.H. The biology of *Mansonia* mosquitoes in relation to the transmission of filariasis in Malaya. Institute for Medical Research Kuala Lumpur Bull 11: 30, 1962.

17. Rajendran, G., Krishnamoorthy, K., Sabesan, S. and Panicker, K.N. Attachment behaviour of immatures of *Mansonia annulifera* (Theobald) 1901. *Indian J Med Res 89:* 192, 1989.

18. Panicker, K.N. Jayasree, M. and Krishnamoorthy, K. A cost benefit analysis of fish culture strategy towards the control of Mansonioides in Shertallai, Kerala State. *Indian J Med Res 95:* 157, 1992.

19. Mitchell, D.S. Supply of plant nutrient chemicals in lakes. *Geophysical Monograph Series 17:* 165, 1973.

20. Bagnall, L.O., Casselman, T.W., Kesterson, J.W., Easley, J.F. and Hellwig, R.E. Aquatic forage processing in Florida. *Trans Am Soc Agri Engg 20:* 221, 977.

21. Panicker, K.N., Srinivasan, R. Viswam, K. and Rajagopalan, P.K. Larvivorous potential of some cypriniformes fishes. *Indian J Med Res 82:* 517, 1985.

22. Panicker, K.N., Jayasree, M., and Krishnamoorthy, K. Utility of food fishes for the control of mosquito vectors of Malayan filariasis in Shertallai, Kerala. *J Biol Control 5:* 18, 1991.

23. Jhingran, V.G. *Fish and fisheries of India* (2nd Edition). Hindustan Publishing Corporation, Delhi (India), p.954, 1975.

24. Brij Gopal. *Aquatic Plant Studies:* 1. *Water Hyacinth*, Elsevier Science Publications, New York, U.S.A., p.129, 1987.

25. The Royal Project of Folk Arts and Crafts for Farmers. The Support Foundation, Thailand, National Council of Women of Thailand, p.61, 1984.

This write-up is contributed by Dr. K.N. Panicker, Dy. Director (Sr. Grade), Dr. R. Srinivasan, Technical Officer, Dr. G. Rajendran, Sr. Research Officer and Dr. K. Krishnamoorthy, Asstt. Director, Vector Control Research Centre, Pondicherry-605006.

ABSTRACTS

Some Research Projects Completed Recently

Characterization of the antigens of *Helicobacter pylori* and the specific serological response in asymptomatic colonization and infective upper gastrointestinal diseases

The study was carried out on endoscopic gastric biopsies of patients with various gastrointestinal disorders to isolate, characterize immunologically and study the strain variation in antigenic structure of *Helicobacter pylori*.

A total of 555 endoscopic gastric antral biopsy samples from 504 consecutive patients with dyspeptic symptoms were studied for their *H. pylori* status. Smear microscopy, rapid urease test and culture isolation revealed 46,43 and 23 per cent positivity respectively for *H. pylori*.

SDS-PAGE protein analysis of 20 *H. pylori* clinical isolates and *H. pylori* reference strain (ATCC 49503) for strain variation showed a common pattern with all isolates consistently having nine major protein bands (molecular weights 90, 65, 60, 48, 35, 31, 28 and 21 kDa). There were detectable strain variations limited to the less prominant bands at 48-60 (1 band), 35-42 (3-4 bands) and 21-28 (3 bands) kDa regions.

Western blot enzyme immunoasay (WB-E1A) of electrophoretically separated proteins of clinical isolates of *H. pylori* and the reference strain using hyperimmune rabbit serum showed major common immunoreactive components at 21, 28, 42, 48, 65, 70 and 116-120 kDa zones. Some minor immunoreactive bands which showed strain variations were limited to 26-32 (1-2 bands), 30-40 (4-5 bands) and > 120 kDa (1-2 bands). WB-E1A with serum samples from patients and controls showed four reactive bands in the molecular weight range of 45-65 kDa in all subjects irrespective of their *H. pylori* status or histopathological severity of the lesion. In contrast 4-5 immunoreactive bands between 21 and 45 kDa were found only in patients with positive *H. pylori* status and evidence of active gastritis.

A total of 120 family members of 40 dyspeptic patients (20 each age and sex matched *H. pylori* positive and *H. pylori* negative) were screened for seropositivity for *H. pylori* using an ELISA, developed in house and validated. Twenty nine of the 69 (42%) family members of the positive and 20 of 51 (39%) of the negative group were found seropositive for *H. pylori* antibodies; with no significant difference between the two groups. Seropositivity increased with age from 34 per cent at < 20 years of age to > 80 per cent in the 6th decade. No family clustering could be found on the basis of seropositivity. There was a strong correlation of seropositivity with upper gastrointestinal symptoms in the family members of the *H. pylori* positive group.

Pallab Ray
Department of Medical Microbiology,
Postgraduate Institute of Medical
Education and Research, Chandigarh.

Publication:

Chatha, I., Ray. P., Bhasin, D.K., Panigrahi, D., Khanna, T., Vaiphei, K., Singh, K. and Singh, H. Western blot analysis of serological response to *Helicobacter pylori* in acid peptic disease. *Indian J Med Res 105:* 170, 1997.

Evaluation of dexamethasone-cyclophosphamide pulse therapy as curative treatment of pemphigus

Clinical trials were carried out between 1991-1996 in 251 pemphigus patients to evaluate the efficacy of dexamethasone-cyclophosphamide pulse (DCP) therapy. Patients with a confirmed diagnosis by Tzanck smears, histopathology, direct immunofluorescent (DIF) test on clinically uninvolved skin and indirect immunofluorescent (IIF) test for serum titres of intercellular antibodies, were included in the study.

Dexamethasone (100mg) in 500 ml of 5 per cent dextrose was given intravenously (iv) on three consecutive days with 500 mg of cyclophosphamide iv preferably on day 2, followed by daily oral cyclophosphamide (50mg) on subsequent days. The high doses of dexamethasone and cyclophosphamide were repeated at 4 weekly intervals till the patients achieved complete clinical remission (phase I) and continued to be in remission at least for six months (phase II). Daily low oral dose of cyclophosphamide was continued (phase III) and stopped after one year and the patients were followed up at 6 monthly intervals for as long as possible (phase IV). Serum titres of intercellular antibodies were determined at various phases of the study.

Thirty eight patients could not complete the treatment, while five died during treatment. Of the remaining 208 patients, 11 were in phase I, 30 in phase II and 44 in phase III; 123 patients who had completed the treatment were in remission without any maintenance therapy in 1996. The duration of post-treatment follow up in these patients was more than 2 years in 34 patients and less than 2 years in 89 patients.

The relapse rates were found to be 19 per cent (4 out of 21) in patients who received irregular treatment and 11 per cent (12 out of 132) in patients who received regular treatment during phase II. These 16 patients were given a second course of DCP. Of these, 3 patients continued to have active disease (phase 1), 6 were in remission but still had to complete the treatment schedule (phase II and III). Seven patients were in phase IV; the duration of post-treatment follow up being more than 2 years in one patient and less than 2 years in 6 patients.

There was a progressive reduction in the serum titres of intercellular antibodies as treatment progressed, but these changes were not uniform in all the patients.

From the data generated during this study it may be concluded that DCP therapy regimen can cure pemphigus leading to quick recovery and low incidence of side effects. If DCP is not given strictly as per the schedule, patients are likely to relapse requiring a second course of DCP.

J.S. Pasricha
Department of Dermatology,
All India Institute of Medical Sciences,
New Delhi

ICMR NEWS

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

Meetings of the Expert Groups (EGs)/Project Review Committee (PRC) held at New Delhi:

EG on Antiretrovirals and HIV/ AIDS	October 15,1997
EG on use of butylated hydroxy arisole in chewing and bubble gums	October 17, 1997
EG on nutritional analysis of some of agriculture produce cultivated in different types of soils using fly ash	November 5-6, 1997
PRC on Mental Health, Neurology, Orthopaedics, Environmental Health and Biomedical Engineering	November 11, 1997

Participation of ICMR Scientists in Scientific Events:

Dr. A.P. Dash, Dy. Director, Regional Medical Research Centre, Bhubaneswar, participated in the II International Congress of Vector Ecology at Florida (October 19-24, 1997).

Dr. H.N. Saiyed, Director, National Institute of Occupational Health, Ahmedabad, participated in the International Conference on Occupational Safety and Health in the Informal Sector at Bali (October 21-24, 1997).

Dr. V.P. Sharma, Director, Malaria Research Centre (MRC), Delhi, participated in the workshop on Neem for Management of Vectors of Malaria, Elephantiasis and Kala-azar at Mbita, Kenya (October 24-28, 1997).

Dr. Srikanth Tripathy, Asstt. Director, National AIDS Research Institute, Pune, participated in the IV International Congress on AIDS in Asia and the Pacific at Manila (October 25-29, 1997).

Dr. Neeru Singh, Dy. Director, MRC, Delhi, participated in the symposium on Malaria in Pregnancy at Kishumu, Kenya (November 10-12, 1997).

Dr. N. Lakshmaiah, Dy. Director, and Dr. S. Bapu Rao, Asstt. Director, National Institute of Nutrition (NIN), Hyderabad, participated in the II International Workshop on Fluorosis and Defluoridation of Water at Addis Ababa (November 10-12, 1997).

Dr. K. Vijayaraghavan, Dy. Director (Sr. Grade), NIN, Hyderabad, participated in the workshop on Prevention and Control of Micronutrient Malnutrition through Food-based Actions in SAARC Countries at Dhaka (November 17-20, 1997).

ICMR AIDED SYMPOSIA/SEMINARS/WORKSHOPS/COURSES/CONFERENCES

Symposium/Seminar/Workshop/ Course/Conference	Date & Place	Contact Address
Seminar on Current Status of Thalassaemia in India and National Workshop on Carrier Detection and Antenatal Diagnosis of Thalassaemia	November 13 and 14-15, 1997; (at Lucknow)	Dr. Sarita Agarwal, Organising Secretary, Department of Medical Genetics, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow-226014.
International Conference on Advances in Reproductive Medicine	November 15-18, 1997; (at Calcutta)	Dr. Sudersan Ghosh Dastidar, Organising Secretary-ICARM'97, Infertility Clinic and I.V.F. Centre, 208, Rash Behari Avenue, Calcutta-700029.
Asia-Pacific Congress on Head and Neck Cancer	December 11-14, 1997; (at Mumbai)	Dr. Ashok R. Mehta, Chairman of the Congress, Department of Surgery, Tata Memorial Hospital, Mumbai-400012.

COUNCIL'S TRAINING PROGRAMMES

Reproductive Biology

At the Institute for Research in Reproduction, Mumbai:

- Workshop on Basic Molecular Biology for Clinicians (December 2-11, 1997).

Nutrition

At the National Institute of Nutrition, Hyderabad:

- Postgraduate Certificate Course in Nutrition (December 1, 1997-February 28, 1998).

Occupational Health

At the National Institute of Occupational Health, Ahmedabad:

- Training Course on Environmental Hygiene Practice (November 10-14, 1997).

Laboratory Animal Technology

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

- Training Course for Laboratory Animal Supervisors (September 1-November 29, 1997).

ICMR PUBLICATIONS

	Price (Rs.)
Nutritive Value of Indian Foods (1985), by C. Gopalan, B.V. Ramasastri and S.C. Balasubramaniam, Revised and Updated (1989), by B.S. Narasinga Rao, K.C. Pant and Y.G. Deosthale (Reprinted 1995)	23.00
Growth & Physical Development of Indian Infants and Children (1972, Reprinted 1989)	10.00
Studies on Weaning & Supplementary Foods (1974, Reprinted 1996)	15.00
Studies on Pre-School Children (1974, Reprinted 1984)	6.00
A Manual of Nutrition (Second Edition 1974, Reprinted 1995)	6.00
Low Cost Nutritious Supplements (Second Edition 1975, Reprinted 1994)	4.00
Menus for Low Cost Balanced Diets and School Lunch Programmes Suitable for North India (Second Edition 1977, Reprinted 1994)	4.50
Menus for Low Cost Balanced Diets and School Lunch programmes Suitable for South India (Fourth Edition 1996)	6.00
Some Common Indian Recipes and their Nutritive Value (Fourth Edition 1977, Reprinted 1995) by Swaran Pasricha & L.M. Rebello	10.00
Nutrition for Mother & Child (Third Edition 1978, Reprinted 1994) by P.S. Venkatachalam & L.M. Rebello	9.00
Some Therapeutic Diets (Fifth Edition 1996) by Swaran Pasricha	7.00
Nutrient Requirements & Recommended Dietary Allowances for Indians (1990, Reprinted 1995)	16.00
Fruits (Second Edition 1996) by Indira Gopalan & M. Mohan Ram	20.00

Count What You Eat (1989, Reprinted 1994) by Swaran Pasricha	9.00
Diet & Diabetes (Second Edition 1993) by T.C. Raghuram, Swaran Pasricha & R.D. Sharma	18.00
Dietary Tips for the Elderly (1992) by Swaran Pasricha & B.V.S. Thimmayamma	3.50
Diet and Heart Disease (1994, Reprinted 1996) by Ghafoorunissa and Kamala Krishnaswamy	26.00
Depressive Disease (1986) by A. Venkoba Rao	58.00
*Medicinal Plants of India Vol.2 (1987)	136.00

* 25 per cent discount allowed to individuals.

These publications are available on prepayment of cost by cheque, bank draft or postal order (bank and postal charges will be extra) in favour of the Director-General, Indian Council of Medical Research, New Delhi. Money orders are not acceptable. All correspondence in this regard should be addressed to the Chief, Division of Publication and Information, Indian Council of Medical Research, Post Box No.4911, Ansari Nagar, New Delhi-110029 (India).

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.*

EDITORIAL BOARD

Chairman
Director-General
I C M R

Members
Dr. Badri N. Saxena
Dr. Bela Shah
Dr. Lalit Kant

Editor
Dr. N. Medappa

Printed and Published by Shri J.N. Mathur for the Indian Council of Medical Research, New Delhi
at the ICMR Offset Press, New Delhi-110 029
R.N. 21813/71