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IMPACT OF ENVIRONMENTAL CHANGES ON HUMAN HEALTH

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During last few decades effects of anthropogenic activities and their impact on health has been largely recognized and impact of environmental changes on health have been well documented. These environmental changes resulting from the anthropogenic activities are attributed mainly to rise in the atmospheric levels of green house gases (GHG) and depletion of stratospheric ozone layer. This article describes the possible effects of these changes on global incidence of some diseases mainly communicable.

Global Climatic Changes

Built of GHG and Rising Global Temperatures: The historical data clearly shows the built up of GHG in the environment. The pre-industrial concentrations of CO_2, CH_4, N_2O and CF_4 were 280 ppmv, 700 ppbv, 275ppbv and 0 pptv respectively. The levels of these gases in 1994 have risen to 358 ppmv, 1720 ppbv, 312 ppbv and 72 pptv respectively[1]. Chronological record indicate a direct relationship between atmospheric CO_2 levels and average global temperature[2]. According to the United Nations Intergovernmental Panel on Climate Change, anthropogenic GHG emissions are significantly acceleration current warming trends, which have now been considered inconsistent with natural climate variation. The global mean surface air temperature has increased approximately 0.5^{o}C over the past 100 years[3].

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There are uncertainties in climate projections, however, there is now increasing convergence to the perception that the global temperatures due to human activities are rising. In its recent report, World Health Organisation, considers the health impact of global warming as one of the largest public health challenges of the upcoming Century[4].

Vector Borne and Water Borne Diseases: Changes in climate are anticipated to have significant impact on some major vector borne diseases. WHO predictions are depicted in table 1. In recent past there has been resurgence of many of these vector borne diseases.

Malaria: An estimated 1:20 people in the world are affected with malaria, with approximately 350 million new cases occurring every year. An estimated 2 million people die from malaria every year including more than a million young children[5]. In many regions of the world, where malaria transmission has been almost eliminated, the disease has come back, sometimes surpassing the earlier records.

Malaria incidence related to local climatic change has been observed in Rwanda, when in 1987,extension of malaria into higher altitudes resulted after record high temperatures and rainfall. Monthly malaria incidence in high altitude was exponentially affected by change in the minimum temperature. In low altitude zones, rainfall and the mean temperature were the most significant climatic factors[6]. In Zimbabwe, temperature defines malaria distribution as well, since malaria incidence and temperature variations are strongly correlated[7]. Based on such observations, a relatively small increase in winter (minimum) temperature would likely facilitate the spread of malaria into large urban highland populations that are currently malaria-free and immunologically naïve such as Nairobi and Harare. According to malaria models under climate change scenarios, risk of malaria epidemics would rise substantially in both tropical and sub-tropical regions. According to one model an estimated 1 million fatalities per year could be attributed to the climate change by the middle of the next century[8].

Dengue and Dengue Hemmorhagic Fever: Currently, the dengue viruses are transmitted in the tropics between 30^o N 20^o S altitude because frosts or sustained cold weather kills adult mosquitoes and over-wintering eggs and larvae. Warming trends, therefore, can shift vector and disease distribution to higher latitude, as was observed in Mexico when dengue reached an altitude of 1700 m during an unseasonably warm summer in 1988[9]. A direct relationship between biting rates and temperature has been reported from Thailand[10].

Cholera and Algae: Phytoplanktologists, during the last decade, have reported an unusual spread and intensity of algal blooms worldwide. This has been attributed to the wetland loss, poor erosion control management, liberal agricultural application of fertilizers and coastal sewage release, all resulting effluent reach in nutrient that promote algal growth. Warmer sea surface temperatures expected with global climate change could augment these growth-favouring factors.

Zooplankton which feed on algae, can serve as reservoirs for *vibrio cholera* and other enteric pathogens particularly gram negative rods[11]. Large coastal blooms may have contributed to the recent multi-epicentered cholera panepidemic in South America. Using fluorescent antibody techniques, forms of quiescent *V. Cholarae* have been found to persist in the sheaths and exoskeletons of micro-organisms that can revert to a cultural state when nutrients, pH and temperature permits[12]. Climatologists are beginning to question whether large scale changes in marine ecosystems are already indicative of sea surface warming due to green house effect[13].

UV Radiation and Immuno-Suppression: Depletion in the stratospheric ozone has been recognized since 1970s. This depletion is accompanied by greater transmission of biologically destructive ultraviolet B (UV-B, 280-320 nm) to the earth surface. Excessive exposure to UV-B has been shown to immunosuppression effect on laboratory animals. This immunosuppression is due to induction of suppressor T lymphocytes that inhibit the immune response against skin cancer antigens. Subsequent studies in mice, rats and guineapigs revealed that exposing the skin to various sources of UV-B, including sunlight inhibits the generation of contact and delayed hypersensitivity immune responses to a variety of antigens[14]. Effects of UV-B on the immune system, though well known and not yet well characterized may turn out to be even more important by modifying the response to infectious and carcinogenic agents.

Conclusions and Recommendations: The influence of human activity on global climate has been established beyond doubt. These climatic changes have directly or indirectly influenced the human exposure to the environmental hazards. There are several reports which indicate a possible link between rise in the incidence communicable and non communicable diseases and climatic changes. Emergence and re-emergence of diseases have multiple aetiological factors. Climate variability can influence the incidence of diseases through its effects on disease vectors, immuno-modulating effects and through the effect on food production and nutrition. The subject is complex and to decide strategy for disease prevention greater predictive capability needs to be developed.

Table 1. Major tropical vector borne diseases and the likelihood of change in their distribution as a result of climate change.

Disease	Vector	No. at Risk (millions)[a]	No. infected or new cases per year	Present Distribution	Likelihood of altered distribution with climate change
Malaria	Mosquito	2400	300 – 500 million	Tropics/subtropics	+++
Schistosomiasis	Water snail	600	200 million	Tropics/subtropics	++
Lymphatic filariasis	Mosquito	1094	117 million	Tropics/subtropics	+
African trypanosomiasis	Tsetse fly	55	250000 – 300000 cases/year	Tropical Africa	+
Drancunculiasis	Crustacean (copepod)	100	100000/yr	South Asia/Middle East/Central-West Africa	?
Leishmaiasis	Phlebotomine sand fly	350	12 million infected, 500000 new cases/ year[b]	Asia/South Europe /Africa/Americas	+
Onchocersiasis	Blackfly	123	17.5 million	Africa/Latin America	++
American Trypnosomiasis	Triatomine bug	100	18 – 20 million	Central-South America	+
Dangue	Mosquito	2500	50 million/yr	Tropics/subtropics	++
Yellow fever	Mosquito	450	<5000 cases/yr	Tropical South America Africa	++

+ = likely; ++ = very likely; +++ = highly likely; ? = unknown.
a = Top three entries are population prorated projections based on 1989 estimates.
b = Annual incidence of visceral leishmainiasis; annual incidence of cutaneous leishmaniasis is 1-1.5 million cases per year.

Source:Climatic change and human health, World Health Organisation,Geneva, 1996, p.75.

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SCOPE OF ROLL BACK MALARIA INITIATIVE IN MADHYA PRADESH

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Background: Madhya Pradesh is largely tribal with about 63 million population. The entire population of the state is at risk of malaria. The state is divided into 50 districts, of which 15 districts (Balaghat, Barwani, Betul, Chhindwara, Dhar, Hoshangabad, Jabalpur, Khandwa, Mandla, Morena, Ratlam, S. Jhabua, Seoni, Shahdol and Sidhi) and one town (Bhopal) were included in the Enhanced Malaria Control Project (EMCP) supported by the World Bank. This population is receiving additional support in malaria control under the EMCP since 1997. As a result of intensified malaria control, malaria situation has improved substantially over the years as is given in Table 1.

Table 1: Malaria Situation in Madhya Pradesh

Year	Population in millions	Total cases	Pf cases	API	SPR	Pf%
1996	53.76	2,38,222	61,105	4.43	3.48	25.65
1997	56.20	2,28,256	65,106	4.06	3.20	28.52
1998	57.70	2,16,127	61,699	3.75	2.86	28.55
1999	59.13	2,03,249	56,432	3.44	2.58	27.76
2000	60.68	1,94,689	62,228	3.21	2.34	31.96
2001	62.21	1,83,118	60,647	2.94	2.11	33.12

Source: Health Department, Madhya Pradesh Government, Bhopal.

During the eradication phase of the NMEP, malaria was almost eliminated but there were some hard-core areas that did not respond to indoor residual spraying. These foci became the source of malaria spread. Malaria transmission is unstable and perennial throughout the state.[1]

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Tribal population lives in isolation and depends on herbal and local therapies. They suffer from high proportion of haemoglobinopathies. Studies have shown high proportion of asymptomatic carriers in the population. Recent surveys have shown 60-70 school children with predominantly P. falciparum infection. Access to drugs is poor due to terrain and tribal life style. Large parts of the rural population live in inhospitable terrain and remain cut off during the rainy season, which happens to be the main transmission season. Vector breeding potential is high, expansion in irrigation has added enormous breeding grounds for the vector mosquitoes e.g. Narmada irrigation project.[2,3] Continuing construction activities, expansion of towns, industrialization has expanded the scope of malaria transmission by *An. stephensi.* Population movement within the forests, cattle grazing, road construction and many other developmental activities contribute enormously to the spread of malaria. Man mosquito contact is high because of the poor housing, outdoor habits of the population, and settlements near the flowing water source.

There are three malaria vectors in Madhya Pradesh viz., *An. culicifacies*, An. *fluviatilis* and *An. stephensi. An. culicifacies* is the major vector of malaria all over the state. It has become resistant to DDT and BHC, although level of resistance varies greatly. Malathion has not been used in public health. In the last few years, in districts with poor epidemiological response to DDT spraying, particularly in EMCP districts Deltamethrin is being sprayed. *An. fluviatilis* is fully sensitive to DDT and BHC. Studies on the sibling species complex revealed the presence of 4 sibling species (A, B, C and D) in *An. culicifacies* and 3 sibling species (S, T and U) in *An. fluviatilis*.[4] Both *P. vivax* and *P. falciparum* parasites are found, but the percentage of P. vivax is about 60-70 and remains the most dominant infection. The peak season of *P. vivax* begins in July and lasts for 3 months. This follows a declining trend in vivax cases and a sudden rise in *P. falciparum*. During the remaining period until the onset of winters *P. falciparum* is the dominant infection and its percentage may be as high as 99% in some areas. It is notable to mention that high proportion of carriers continue to persist during the winter period as well. There are several reports of chloroquine resistance in *P. falciparum.*[5,6]

Chloroquine is the drug of choice for both *P. vivax* and *P. falciparum.* The National Anti Malaria drug policy is followed in the treatment of malaria.

RBM Initiative: Dr. Gro Harlem Brundtland, on taking over as the Director-General World Health Organization announced on 13th May 1998 that rolling back malaria is one of the World Health Organization's highest priorities. She said, "I propose that together we Roll Back Malaria. Not as a re-vamped vertical programme but by developing a new health sector-wide approach to combat the disease. Why now? Because the call is there. We have enough knowledge, skills and tools to launch a new concerted effort." The intention is to approach malaria in a new way. This would need political mobilization from highest in the governance to lower levels through policy, dialogue and advocacy. RBM movement is backed by global partnership of the heads of WHO, the World Bank, UN Children's fund and UN Development Programme. These agencies committed themselves to join action to Roll Back Malaria in October 1998.

The core concepts of RBM as described by the WHO are: the focus on results-specifically, reducing malaria morbidity and mortality; prioritizing effective malaria action within health sector development; stimulating attention to malaria within the context of partnerships for health sector, human and environmental development at country level; innovative approaches to widespread grass-roots action including community mobilization and empowerment, and more effective means to improve the effectiveness of primary health care providers in the private sector; evidence based action-making a stronger linkage between scientific studies and the provision of services; giving stronger emphasis to the political context within which development decisions are made, ensuring that the politicians are leading the movement, and backing their leadership with strong advocacy and media relations; ensuring that roll back malaria is pathfinder for the approach to handling a range of disease problems, establishing-where appropriate-a common platform which leads to multi-disease action; and fostering a social movement that puts these concepts into practice, in ways that reflect the interests and capacities of different groups at local and country level, and that responds to the needs of children, women and less powerful groups.

RBM- a social movement: The focus of RBM is on partnership between national authorities, civil societies, development agencies and the UN system ensuring their continued and sustained interest in controlling the vectors and the parasite. Action against malaria is fully integrated into the health system, and RBM movement will ensure strategic investments to sharpen the old tools and discover new tools including more effective drugs and malaria vaccines. RBM is aimed to make a difference by halving the world's malaria burden by the year 2010, and halving it again in the following five years. The poor, marginalized, inaccessible populations, children and pregnant women are at the centre of RBM. The RBM movement will demolish artificial barriers that have build up between the health and non-health sectors and the private sector/NGOs.

RBM implementation begins with a focus at the local malaria situation. This would require detailed situation analysis of the determinants of malaria in the target area. The importance of partnership and intersectoral coordination would become obvious as a result of this analysis. The district authorities should coordinate the activities of the partners where health department would play the role of leadership, regulation and resource mobilization. At the centre of the RBM would be the weaker sections of the society i.e. marginalized populations, high risk groups like the children and pregnant women and any other groups identified by the coordination committee. All actions related to malaria control would be integral part of the district health system. WHO has developed detailed guidelines for adaptation at the district level. These guidelines can be obtained from the NAMP/SEARO.

WHO and its Regional offices have set up technical support networks on critical elements of malaria control. These networks are seized with the latest know how in identified issues like the insecticide treated bed nets, drug policies and supply systems, care of the sick child interventions, simple packaging of antimalarial drugs and treatment schedules, referral system for severe malaria cases, training of drug suppliers and safe use of antimalarial drugs, good manufacturing practices for locally produced materials, pricing structure for the antimalarials, epidemic forecasting, and the problem of drug resistance in malaria parasites and insecticide resistance in the malaria vectors. These networks have become functional and can be accessed for high quality reliable information and advice. WHO Regional offices also provide information on the local talents and share regional experience in the management of malaria. The SEARO has established a Technical Support Network in three areas viz., Transmission risk reduction, Drug resistance and policy and Surveillance, information management and response. Research projects of importance to malaria control have been funded and projects on the surveillance, larvivorous fishes and monitoring drug resistance have been funded and a networking system within the countries of the SEA Region has been established. Results of these projects would be used by the programme managers in the control of malaria.

Six Strategies of RBM: In rolling back malaria six strategies have been identified. These strategies are currently in use in the control of malaria in Madhya Pradesh. A critical mass of experienced staff and technical know how related to RBM exists in the state to implement RBM, as described below.

1. *Enhanced Diagnosis and Treatment of Malaria (e.g. new diagnostic test, universal access to treatment, combination drugs).*

In the EMCP districts, Malaria Link Volunteers (MLV) has been appointed in each village. This has strengthened surveillance and the strategy of the early treatment of malaria cases. New microscopes have been provided and the laboratory technicians have been trained. Rapid Detection Test (RDT) was first tested in the country in Mandla as a diagnostic test for rural areas. This test (dipstick test) has been introduced in the high *P. falciparum* areas.[7-11] Drugs have been widely distributed through the Drug Distribution Centres (DDCs) and the Fever Treatment Depots (FTDs). Malaria staff is receiving training in laboratory services, entomology, rural and urban malaria control, surveillance, and supervision.

2. *Disease Transmission Control (Cost effective integration of vector control tools e.g. insecticide treated nets, selective vector control, bio-environmental methods).*

In Madhya Pradesh DDT was the insecticide of choice in malaria control. In areas with poor epidemiological response to DDT spraying Deltamethrin spraying has been introduced. Larvivorous fish introduction programme has received high boost by the involvement of fisheries department. Fish hatcheries have been established at the PHC level and now these are being distributed widely in the rural areas to control mosquito breeding. In selected PHCs insecticide treated mosquito nets have been distributed. ITN was preceded by selection of villages and health education. Vector control activities are based on stratification and integrated vector control methods are applied in a cost effective manner. This strategy has already reduced malaria transmission in the most problematic districts of M.P (see Table 1 above).

3. *Enhanced Surveillance (rapid response, border malaria, and monitoring progress).*

At present early detection of epidemics is based on the rainfall and population migration. Rapid Response Teams have been trained for mobilization within a few days notice and these teams are fully equipped to control malaria outbreaks. Malaria information system is under development and would become operational within a year or so. This would facilitate early detection of epidemics. Some border areas of the state particularly along the Chhattisgarh have high malaria transmission and may be the source of malaria through population movement. Inter-state border meetings are organized to remedy the situation.

4. *Health Sector Development (e.g. decentralization, health equity, package delivery care, changing role of implementers of malaria control to leadership, regulation and coordination).*

District malaria societies have been established in all EMCP districts and malaria control has been decentralized, and made the responsibility of the district health societies, coordinated by the district collector. Members of the society represent different development agencies and the NGOs. The society is mandated to ensure EDPT in all villages of the district and organize malaria control to ensure complete coverage of the malarious areas. The department of health (represented by the District Malaria Officer and Chief Medical Officer) provides information on the malaria situation and suggests remedial measures. The District Malaria Society is responsible for planning and implementation of malaria control in the entire district.

5. *Community Mobilization (empowerment of communities, evidence based planning and ownership).*

RBM is a community based programme where home is the first hospital. This would require empowerment of communities. Planning for malaria control should be evidence based. For various activities related to RBM, district level guidelines have been prepared and distributed. These guidelines should be adapted to facilitate the implementation of RBM. In the RBM all partners enjoy equal rights and privileges. CMO/DMO have a role of leadership, coordination and regulation.

6. *Advocacy (forum for advocacy, strategic investments e.g. mapping, new drugs & vaccines, regional support networks e.g. drug policy, rapid response etc., health impact assessment, research on reform in health system).*

Malaria month (June each year) is organized all over the state. M.P. has a Regional Medical Research Centre for Tribals in Jabalpur to take up research on all aspects of health including malaria. In addition to this a field station of Malaria Research Centre in Mandla is dedicated to malaria research. This field station has already produced excellent work on the epidemiology of malaria, vector biology, demonstrated the bioenvironmental malaria control,[12] which has been adopted by the state, field tested the malaria diagnostic techniques for early detection of malaria (RDT), clinical trials with arteether,[13,14] malaria and pregnancy,[15,16] monitored the drug resistance in malaria parasites, carried out studies on man made malaria, health impact assessment of irrigation projects,[17,18] studies the haemoglobinopathies, and nutritional and socio-economic problems related to malaria.[19-22] The site is currently under consideration by the Indian Council of Medical Research for malaria vaccine trials.

Monitoring and Evaluation: Monitoring and evaluation is an important activity of RBM. WHO has recommended two impact and three outcome indicators to monitor the progress of RBM. These indicators were developed in consultation with the malaria endemic countries. These indicators should be used at the district and state levels.

<u>Impact indicators</u>

1. Malaria death rate (probable and confirmed cases) among target groups (under fives and other target groups).
2. Number of malaria cases, severe and uncomplicated (probable and confirmed) among target groups (under fives and other target groups).

<u>Outcome indicators</u>

1. Proportion of households having at least one insecticide treated mosquito net
2. Percentage of patients with uncomplicated malaria getting correct treatment at health facility and community levels, according to national guidelines, within 24 hours of onset of symptoms; and
3. Percentage of health facilities reporting no disruption of stock of antimalarial drugs (as specified in the national drug policy) for more than one week during the previous three weeks.

Scope of RBM in M.P.: In the South East Asia (SEA) Region the first inception meeting on Roll Back Malaria was held in New Delhi in May 1999 under the auspices of the National Anti Malaria Programme. As a follow up of this meeting piloting of RBM started in the SEA Region and situation analysis of malaria has been completed in 24 districts in the Region. In India, the National Anti Malaria Programme (NAMP) and the Malaria Research Centre (MRC) carried out situation analysis jointly. Five districts were identified for the piloting of RBM. These districts are: Jodhpur (Rajasthan), Goa state, Tumkur (Karnataka), West Mizoram (Mizoram) and Keonjhar (Orissa). Situation analysis has been completed in all the districts. Lessons learned from the situation analysis would be useful in analyzing the malaria situation in various rural and urban areas of Madhya Pradesh. WHO has provided RBM implementation guidelines at the district level and these are in the process of adaptation. It is understood that as soon as the piloting is competed there would be expansion of the RBM activities in other states. In the meantime, various scientific organizations have developed technologies for the implementation of best practices in malaria control. Research has also produced new products for more effective and sustainable malaria control. Some examples are the mapping, resistance monitoring in the malaria parasite and the vectors, vector biology and ecology in relation to malaria transmission,[23,24] bio-environmental control and its expansion throughout the country, selective spraying, insecticide treated mosquito net technology,[25,26] mosquito repellents,[27-30] integrated control, enhanced surveillance through the Malaria Link Worker, arteether for the treatment of severe malaria, Bulaquine for radical treatment, dipstick for early diagnosis, G_6-PD monitoring, quality control, situation analysis techniques and human resource development. With the existing resources, manpower and the technologies available in the state, implementation of RBM would be very effective and a rational approach to sustainable malaria control.

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NUTRITIONAL STATUS OF SOME TRIBES OF ANDAMAN AND NICOBAR ISLANDS

V.G. Rao, A.P. Sugunan * and S.C. Sehgal**

Andaman and Nicobar Islands, Union Territory of India comprising of over 321 islands in the Bay of Bengal, are situated 92^0 to 94^0 east longitude and 6^0 to 14^0 north latitude. The total population of these islands is 280,661 (1991 census) and is constituted by the migrants from mainland India and settlers from Bangladesh and Sri Lanka.

In addition, these islands are home to six aboriginal tribes including four Negrito groups viz. Great Andamanese, Jarawas, Onges, Sentinelese and two Mongoloid groups viz. Nicobarese and Shompens. The total population of these tribes is 26825, which accounts for about 9% of the total population of these Islands. More than 98% of the tribal population is constituted by Nicobarese who are settled in the Car Nicobar Island, Nancowry group of islands and in Harminder Bay of Little Andaman (Fig 1). The population of other tribes is very small and is constantly declining. Andaman and Nicobar Administration have rehabilitated Great Andamanese (N=32) in Strait Island and Onges (N=102) in Dugong creek and South Bay area of Little Andaman Island. Shompens having a population of 157 live deep in the jungles of Great Nicobar Island. Jarawas, who live in the jungles of South and Middle Andaman, were hostile till recently. During the last couple of years, they have shown a willingness to come out of their isolated world and mingle with the mainstream population. The Sentinelese live in the North Sentinel Island and are still unapproachable.

All the tribes are in a state of transition from their primitive life-styles to a more modern way of life. The Nicobarese were the first to adjust to this. They have almost lost their tribal nature and are as modern as any of the settler community. The Onges and Andamanese are changing slowly. They keep many aspects of their tribal culture; at the same time have adopted many

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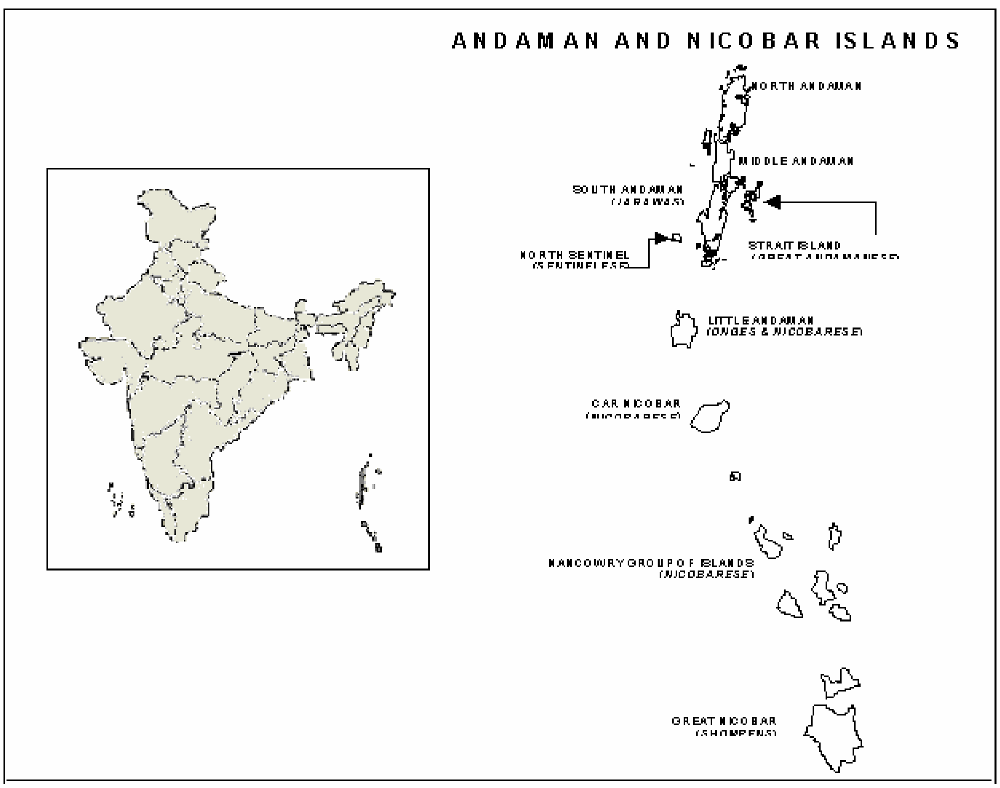
things from the mainstream population. The Jarawas have just come out of their seclusion. The Sentinelese have not yet shown any willingness to shed their hostile attitude towards outsiders. The changes in their environment due to the rapid growth of the settler population, the sharp decline in their population and the transition from the primitive nature to the modern civilization are all causing great stress on them. These conditions have their health impact also. The health needs of the primitive communities are unique.

The important studies, with emphasis on assessment of nutritional status conducted by the Centre on the tribes and their outcomes are being described in the following sections.

Fig. 1 Habitats of the primitive tribes of Andaman and Nicobar Islands



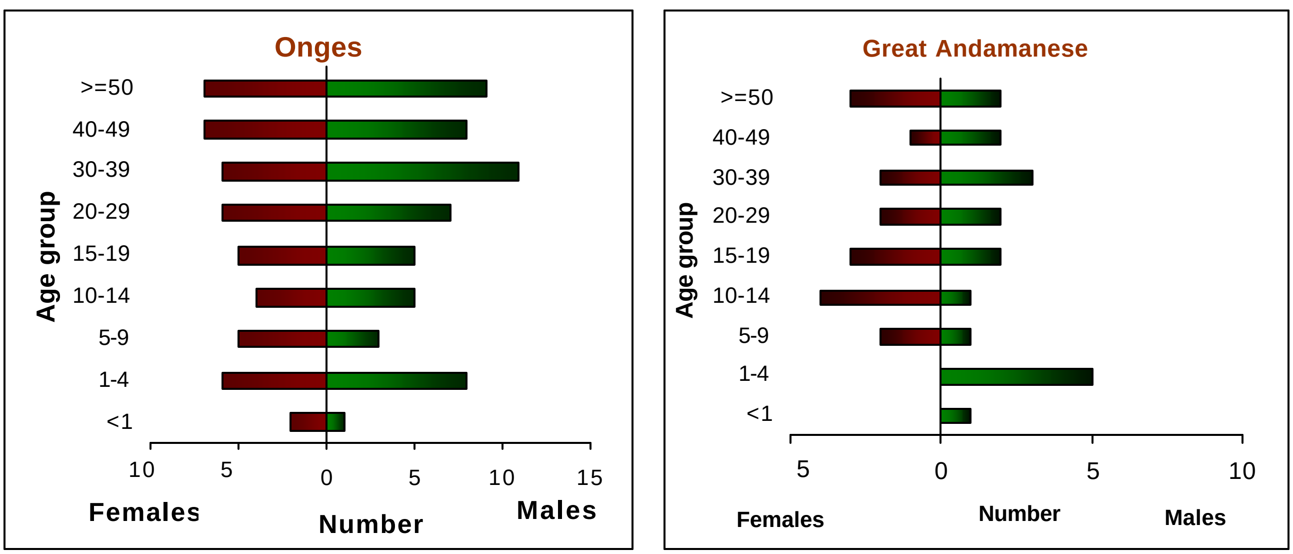
Nutritional status of the tribes

The Centre has carried out studies among Great Andamanese, Onges and Shompens to assess their health and nutritional status. These studies involved diet survey, nutritional anthropometry survey, clinical examination, measurement of hemoglobin concentration and stool examination. In addition, the Centre has also carried out preliminary studies among the Jarawas.

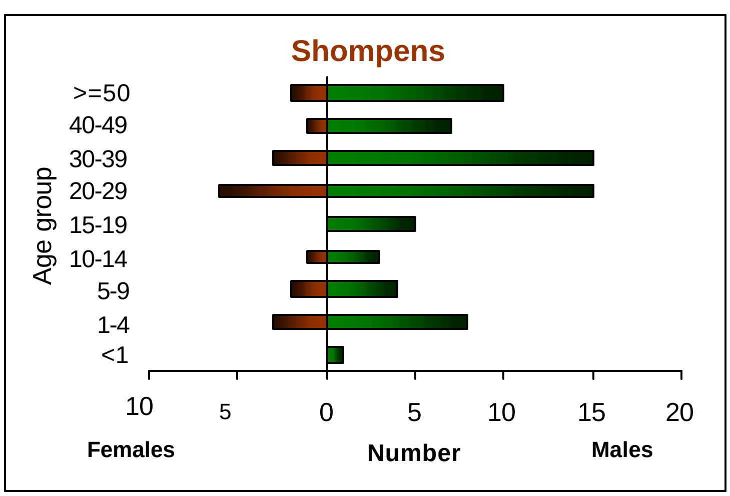
Age and Sex distribution

Age pyramid of Great Andamanese, Onges and Shompens is shown in Fig. 2. Proportion of children aged 14 years or less was 38.9% among Great Andamanese, 32.4% among Onges and 25.6% among Shompens. The sex ratio (females per 1000 males) for these tribes were 894, 842 and 264.7, respectively. Sex ratios of all these tribes were lower than the sex ratio of India (933).

Fig 2: Age pyramid of tribes of A & N Islands



Diet survey:



Diet survey was carried out among Onges and Great Andamanese. Since the cooking and eating habits of Shompens are not well organised, it was not possible to collect accurate information about the types and quantity of food items they consume. Results of the diet survey indicate that the intake of green leafy vegetables (GLV), other vegetables, milk and milk products were much less than the respective recommended dietary allowances (Table 1). Their average daily consumption of fats and pulses was two to four times more than the recommended daily allowance. Average intakes of various nutrients are given in Table 2. Average consumption per Consumption Unit (C.U) of all the nutrients except Iron, Vit. A and Vit. C were above the recommended levels. No family had deficient intake of proteins and fats. Their average daily fat consumption is two to ten times more than the recommended daily allowance.

Table 1. Intake of different food groups by Andamanese and Onges

Food Group	RDA* (gm.)	Great Andamanese		Onges	
		Families consuming less than RDA (%)	%deficit/ excess	families consuming less than RDA (%)	%deficit/ excess
Cereals & millets	460	50	+3.82	6.67	+21.34
Pulses	40	33.3	+28.15	0.00	+283.72
Green leafy vegetables	50	100	-74.42	93.33	-82.84
Other vegetables	60	83.3	-42.2	100.00	-100.00
Roots & tubers	50	33.3	+28.6	73.33	-39.42
Fats & oils	20	Nil	+96.95	0.00	+296.05
Fruits	30	33.3	+32.06	96.67	-85.77
Fish	30	33.3	+31.83	73.33	+95.83
Meats & poultry	30	Nil	+712.36	80.00	-26.97
Milk & milk products	150	100	-86.12	100.00	-82.19
Sugar & Jaggery	30	66.7	+7.3	-	+3.20
Condiments & spices	--	--	--	-	
Nuts & oil seeds	--	--	--	0	-

* Recommended Dietary Allowance

Table 2: Intake of various nutrients by Great Andamanese and Onges

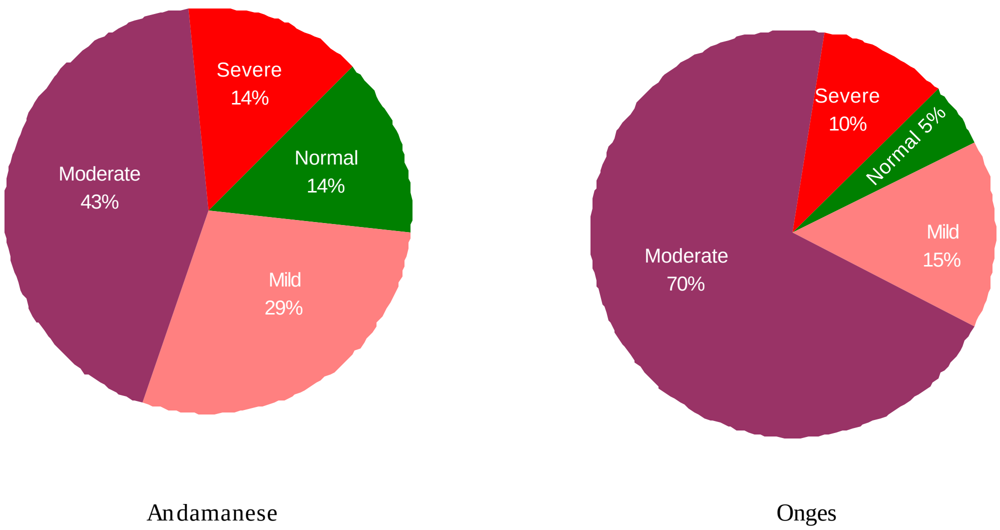
Nutrients	RDA*	Great Andamanse		Onges	
		families with consumption less than RDA(%)	%Deficit/ excess	families with consumption less than RDA(%)	%Deficit/ excess
Protein (g)	60	Nil	+107.2	0.00	+107.38
Total fat (g)	20	Nil	+214.0	0.00	+976.25
Calories (Kcal)	2425	16.6	+19.6	0.00	+100.57
Calcium (mg)	400	16.6	+34.8	6.67	+95.17
Iron (mg)	28	100	-35.7	63.33	-5.83
Vita A (mg)	600	100	-40.6	96.67	-51.16
Thiamin (mg)	1.2	16.6	+25	0.00	+78.33
Riboflavin (mg)	1.4	100	-42.9	36.67	+20.00
Niacin (mg)	16	16.6	+11.9	0.00	+45.18
Vita C (mg)	40	50	+11.3	100.00	-82.30

* Recommended Dietary Allowance; # Consumption Unit

Nutritional anthropometry

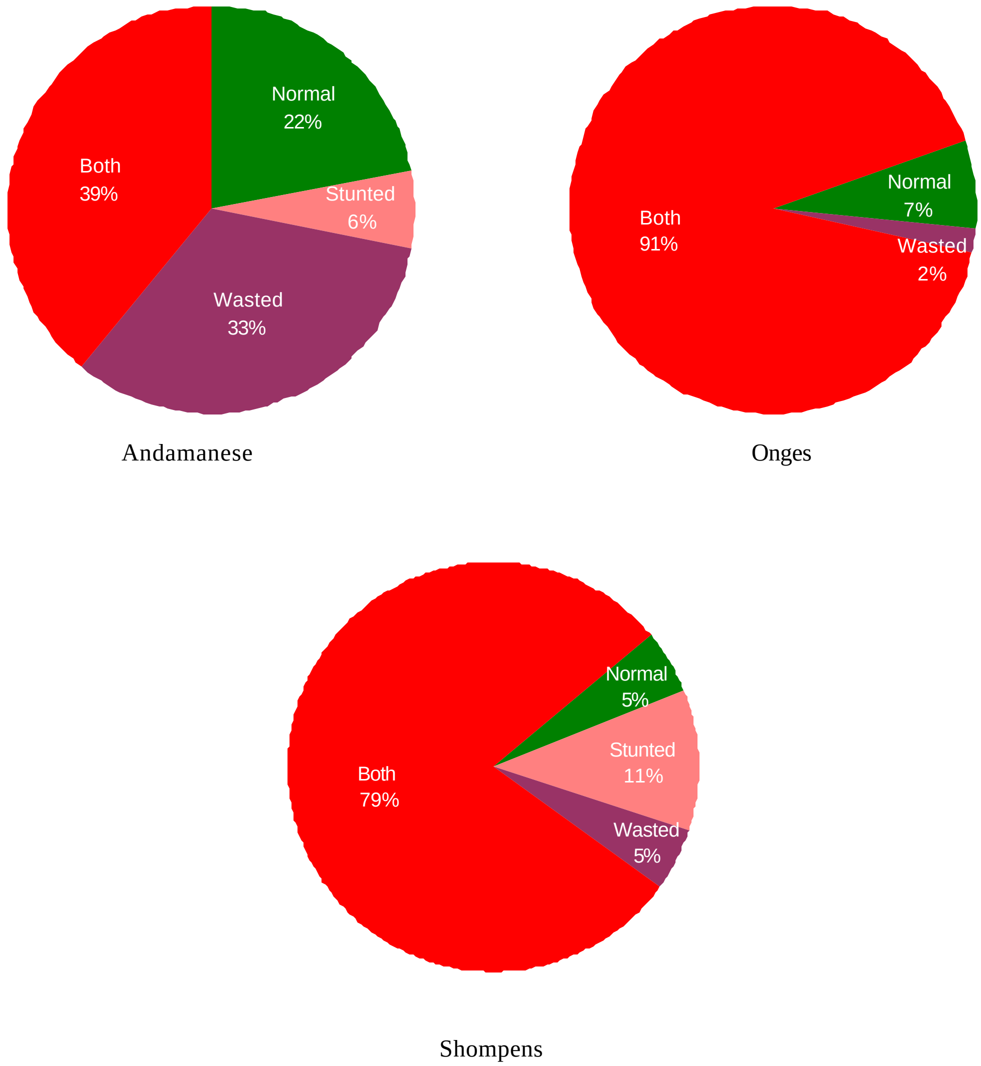
Results of the anthropometric studies indicate that malnutrition is common among the tribal children. Prevalence of malnutrition among children aged 6 years or less in different tribes is given in Figure 3. Fifty Seven percent of Great Andamanese children, aged 6 years and less, were having moderate to severe degree of malnutrition and another 28.6% had mild degree of malnutrition making the prevalence of under-nourishment among preschool children 85.6%. On the other hand, 85% of the Onges children in this age group were having mild to moderate degree of malnutrition and 10% had severe degree of malnutrition making the prevalence of under-nourishment among pre-school children 95%. Majority of the Shompen children under five years of age (66.67%) had low weight for height compared with the NCHS reference data and more than 58% of the under-fives had weight for height 2SD less than NCHS reference data for their age and sex.

Figure 3. Prevalence of malnutrition among preschool children by Gomez grades



Prevalence of malnutrition among the children aged 19 years or less, showed that 77.8% of the Great Andamanese, 92.7% of the Onges and 94.7% of the Shompens were malnourished (Figure-4).

Figure 4. Prevalence of malnutrition among children under 19 years of age as per Waterlow's classification



Nutritional deficiency signs

Anemia was found very common among all the three tribes. 94.3% of Great Andamanese, 86.6% of the Onges and 85.5% of the Shompens were found anemic, as per WHO definition of anemia. Other nutritional deficiency signs observed were conjunctival xerosis, bitots's spot and angular stomatitis.

Intestinal parasitic infestations

Prevalence of intestinal parasitic infections was found to be very high among Onges and Great Andamanese. All the 40 Onges and 29 of 30 (96.7%) Great Andamanese examined were found to harbour one or more types of intestinal parasites. The commonest parasites encountered among them were *Ascaris Lumbricoides* (90% and 43.3% respectively) followed by *Trichuris trichura* (37.5% and 93.3% respectively).

Besides, being a predisposing factor for malnutrition, intestinal parasitic infestations is considered as a general indicator of the local level of development, as wherever the living conditions are poor, high prevalence of soil-transmitted helminthic infections are encountered. In the case of Andamanese tribe, it is not poverty in the strict sense that is responsible for this, as they have no scarcity of resources. The Andaman and Nicobar Administration provides them with all the necessary facilities. Probably lack of awareness and poor hygienic practices that are responsible for this high prevalence of infestations. In spite of having sanitary latrines in their settlement, majority of them prefer to defecate in the open. Though there are four sanitary wells in their settlement, built by the Andaman and Nicobar Administration, storage and handling of drinking water in all the families was found to be unhygienic. With all these adverse factors of poor environmental sanitation, unhygienic personal habits, high prevalence of micro-nutrient deficiency disorders etc. the community appears to be at a high risk for infections and infestations. The children in such a community become the victims of the vicious cycle of malnutrition-infection-malnutrition.

Programmes for saving such a marginalized community should be based on comprehensive packages with components of nutrition, environmental sanitation and personal hygiene, health and nutrition education and provision of safe and adequate drinking water. Nutritional programmes should be so designed that besides the requirement of protein and energy, micronutrient requirements are also met. Provision of safe and adequate drinking water does not end with construction of sanitary water sources only. The community should also be educated to keep the sources away from contamination and proper ways of storing and handling drinking water. Associated factors of malnutrition such as parasitic infestations, repeated infections etc. should also be controlled with programmes like periodic mass deworming. Such programmes should be able to break the vicious cycle of malnutrition-infection-malnutrition.

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K-OTAB – A NOVEL VECTOR CONTROL TOOL FOR TRIBAL COMMUNITY

*C.J.Babu****

INTRODUCTION

Malaria eradication was a possibility four decades back but it has come to a stage where this will remain as a dream only unless and until we get a potential vaccine. Now a days, the countries are aiming at malaria control with available vector control tools and also with potent malarial drugs. Malaria problems are mostly prevalent in tribal community and also in urban areas. With concentrated efforts, the problems of other areas are under control.

New vector control tools are required and essential for the effective control of malaria problems in tribal and urban areas. In this direction, a new tool developed as a tablet formulation of Deltamethrin technical product viz. K-Otab is discussed in this paper. Its effectiveness and trial results etc. are enlisted here in detail.

MATERIAL AND METHODS

K-Otab is a tablet formulation of Deltamethrin and it is of the size of 1 gm. with 250 mg. of Deltamethrin Technical. This is enough to impregnate one single mosquito net of the size of 10 sq. mt.

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The net treatment is done with dispersing the tablet in water required to treat one net. In case of nylon nets, 250 ml. of water is taken in a plastic tub and one tablet is thoroughly dispersed in water and then the net is fully immersed in such a way that all the sides pick up enough of the quantity and equally distributed. The net is rotated fully in this tub containing water and tablet disbursed. The net is then dried in shade either by spreading it on a plastic sheet or by hanging. In case of cotton net it needs 1 to 1½ Lt. of water and the treatment procedure is same. The nets are distributed in the community for preventing man-mosquito contact.

RESULTS

Insecticide treated bednets help in controlling mosquitoes bites in two ways i.e. physical and chemical[1]. It reduces the morbidity of diseases like malaria and other vector borne diseases and also help in minimising the mortality. It also helps in controlling nuisance mosquito biting.

WHO studies have shown mean reduction of 25% in child mortality. WHO states that such treated nets could save the life of approx. 5,00,000 African children per year. Malaria costed African countries, South of Sahara more than $ 200 Billion in 1997. K-Otab laboratory trials were carried out in Gambia. With dosage of 20 mg / sq. m., the bio-assay cone study with exposure time of 3 min. showed 100% kill even after 24 weeks against *Anopheles arabiensis* and was compared with SC formulation (Fig.1). Even up to three washes, the results were good.

FIELD TRIALS

Abroad :

In Gambia, K-Otab trials conducted during 1999 revealed the efficacy lasting for 20 weeks with 25 mg / sq. mt. (Fig.2). This was compared with Permethrin and Deltamethrin SC formulation[2].

In India :

MRC field station at Nadiad carried out laboratory trials and a field trial with K--Otab in the near by villages. This was done on cotton, nylon and polyester nettings with 25 mg a.i/sq .mtr, dose and was evaluated against *Anopheles culicifacies* and *Anopheles stephensi* in the laboratory and also in 3 villages of Kheda district during June'01- April'02. Bioassay studies revealed the lasting efficacy of all three types of nets until the end of 10 months study[3].

K-Otabs were distributed in tribal areas of Orissa, viz. Malkangiri Dist, which reports many deaths and maximum Pf cases. In this area, 2000 tablets were distributed and the results revealed efficacy of treated nets. It has been found that 100% mortality in bio-assay was observed for 95 days against *Anopheles culicifacies* and 196 days against *Anopheles fluviatilis*. The percentage of reduction in malaria incidence was 36.1%. A total of 60-80% of people used the bednets and no body complained of any side effects after using the same. This study was conducted by Chief District Medical Officer, District Collectorate and VCRC Field Station, Malkangiri[4].

Similar studies were conducted in Keonjhar by Chief District Medical Officer and Collector alongwith District Welfare Officer. The field evaluation conducted with K-Otab showed the impact on reducing the vector density and also the bio-assay test revealed 100% mortality against main vector *Anopheles fluviatilis*. The fever cases dropped down dramatically in residential schools where nets were mainly distributed[5].

CONCLUSION

In conclusion, K-Otab treated nets were found to be effective from 6 – 8 months. In areas with malaria transmission of about 6 months duration, a single treatment of nets would provide effective control of malaria. The advantage of tablet formulation are many like no measuring of insecticide required, easy to use, simple unit dose, safety in use and handling, easy to store, transport and distribution, easy disposal of packets. The best advantage of K-Otab as a vector control tool is the ability to sustain this at the community level and to help in cutting down the malaria transmission in the difficult terrain like tribal areas where it is causing unending agony and deaths due to malaria

Fig.1. Efficacy of K-Othrine Moustiquaire® SC 1% and K-O Tab® 25% against *Culex quinquefasciatus* at 20 mg ai/m² after 24 weeks and after 0, 1 and 3 washes

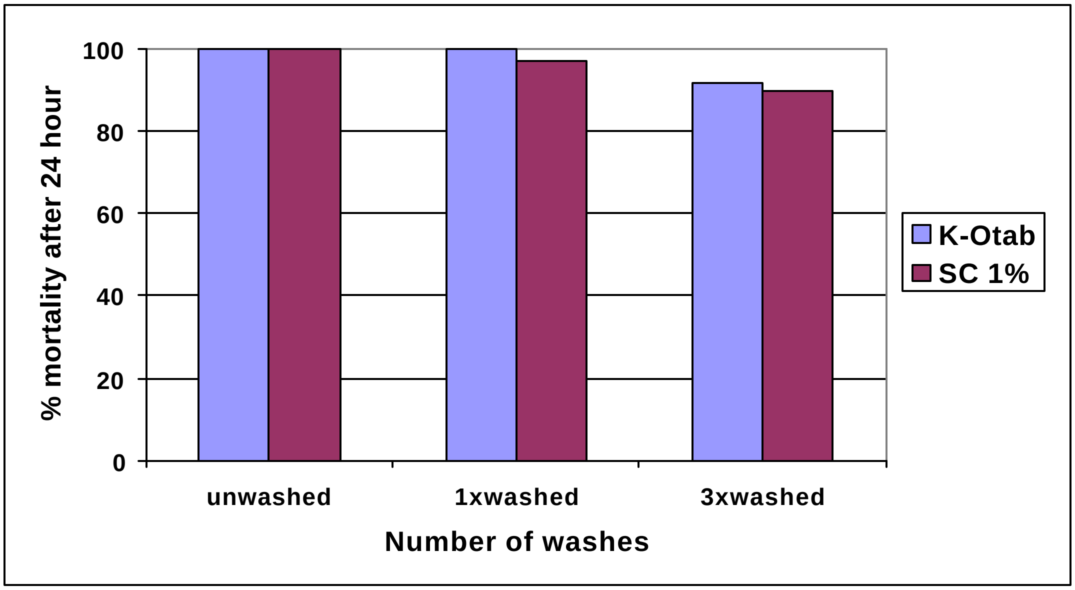
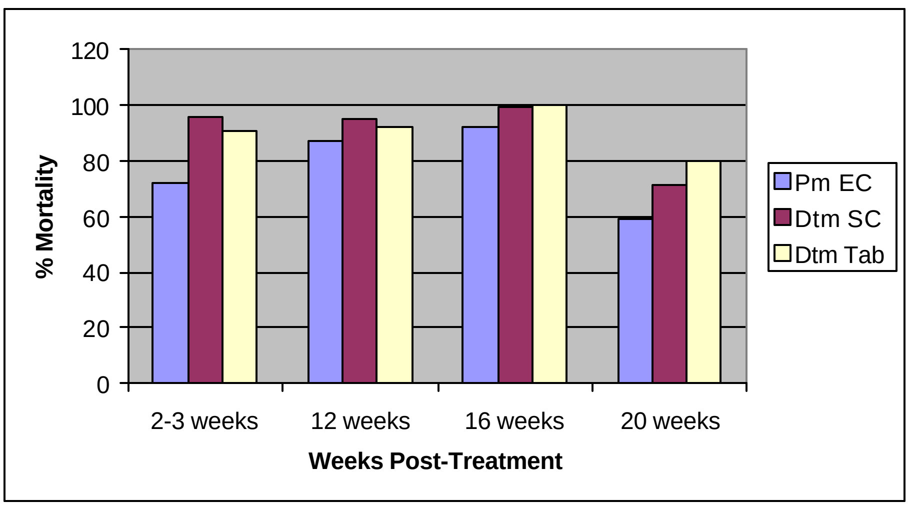


Fig.2. Evaluation of K-Otabs in MRC / WHOPES Trials The Gambia, 1999



GLC Analysis on Fresh Nets	Permethrin	-	446.20 mg/m²	(target 500 mg)
	Deltamethrin SC	-	23.01 mg/m²	(target 20mg)
	Deltamethrin Tablet	-	14.73 mg/m²	(target 25mg)

Acknowledgement

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DIURNALLY SUB-PERIODIC BANCROFTIAN FILARIASIS IN ANDAMAN AND NICOBAR GROUPS OF ISLANDS, INDIA

A.N. Shriram and S.C. Sehgal**

The global burden of lymphatic filariasis is estimated to be at least 120 million people infected primarily by *Wuchereria bancrofti* and to a lesser extent, by *Brugia malayi* and *B. timori*[1]. In India, lymphatic filariasis is endemic in 18 states with approximately 454 million people residing in endemic areas and 48.11 million people are infected, thus posing an important public health problem[2]. India alone accounts for 40% of the global prevalence of infection[3]. *Wuchereria bancrofti* causing Bancroftian filariasis is the most prevalent species accounting for about 98% of the microfilaraemics and is distributed widely in this country. Brugian filariasis caused by *Brugia malayi has* restricted distribution and is reported to occur in Kerala but scattered foci of low prevalence are reported in Orissa, Assam, Madhya Pradesh, Andhra Pradesh and Tamil Nadu with over 90 million people at the risk[4]. Bancroftian filariasis is transmitted by *Culex quinquefasciatus* (ubiquitous breeder in polluted habitats) while Mansoniodes mosquitoes that breed in close association with hydrophytes such as *Pistia*, *Eichhornia* and *Salvinia* are the vectors of Brugian filariasis[5]. The sub-periodic form of lymphatic filariasis transmitted by *Aedes niveus* in India is prevalent only in the Nicobar group of Andaman and Nicobar Islands[6-11]. Prevalence, epidemiology, vector incrimination, transmission dynamics and feasibility of elimination in view of demographic, epidemiological and entomological features are discussed in this report.

Andaman and Nicobar Islands: Topography and climate

Andaman and Nicobar islands, an archipelago of over 570 islands, big and small, lie as a long and broken chain of about 700 km in length in the Bay of Bengal between 6 degree and 14 degree North latitude and 92 degree and 94 degree East longitude (Fig 1). 86% of the land area is covered with dense evergreen forests with many exotic and endemic species of flora and fauna.

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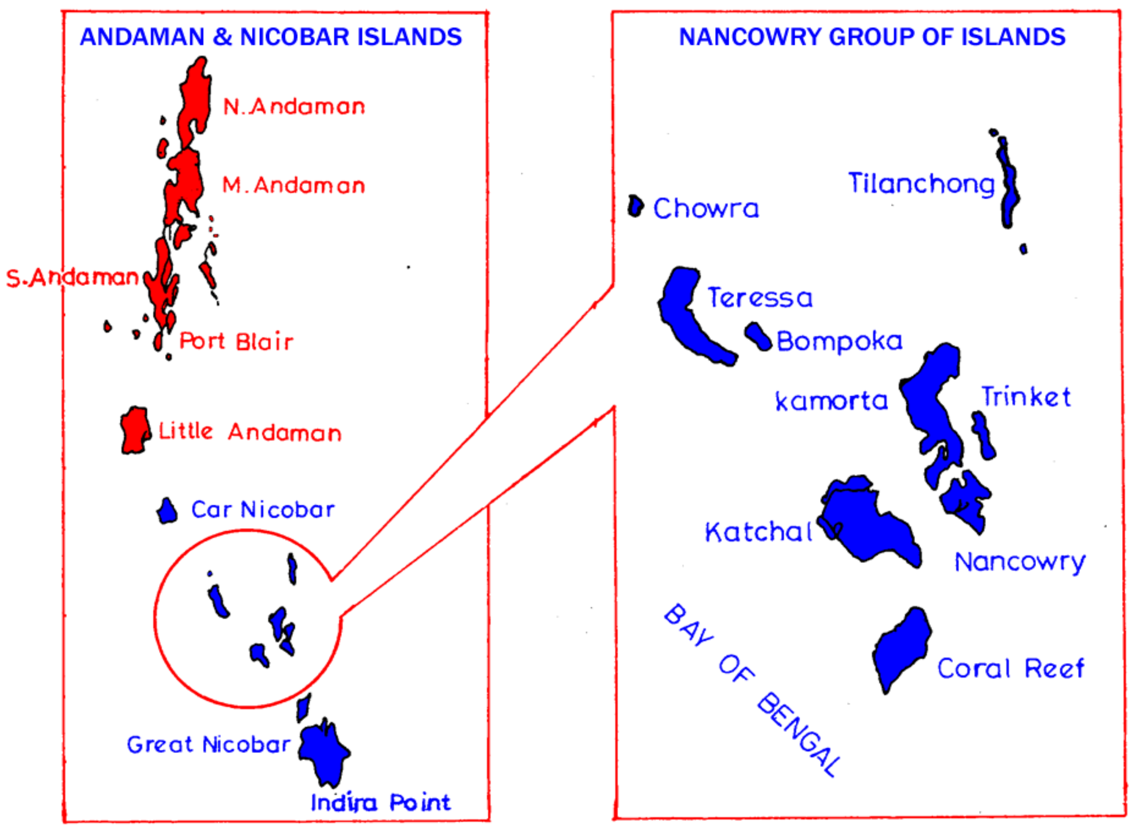
Fig. 1 India Map showing location of Andaman and Nicobar islands

These islands are grouped into two districts, Andaman and Nicobar. They are elevations of continuous submerged ridge, which extend almost unto Australia. On the Eastern side of the ridge lie Sumatra, Java, Bali and other islands of Indonesia. The Andaman and Nicobar group of islands are separated from each other by a ten-degree channel. Ranges of low hills enclosing narrow valleys are characteristic topographic feature of Andamans, while the Nicobar group is generally flat except Great Nicobar and Nancowry group, which are hilly. The soil of the Nancowry group is porous coral sand, which quickly absorbs the rainwater leaving hardly any stagnation. The total surface area of these Andaman & Nicobar Islands is 8249 sq. Kms. Both the groups of islands are rich in tropical forests and natural vegetation. Only a small part of the land is under wet cultivation. Cons iderable areas are under coconut and arecanut plantations. The climate is highly humid (Relative humidity about 80%) and warm with temperature ranging between 23^0 C and 30^0 C. The area receives heavy rainfall from May to January, influenced by both south-west (May to October) and north-east (November to January) monsoon. In the other months rainfall is generally low with February being the driest month.

Prevalence of sub-periodic filariasis in Nicobar group of islands

In India, diurnally sub-periodic *W. bancrofti* is prevalent only in Nicobar group of islands, where it is a major public health problem in the remotely located Nancowry group of islands[8, 9,11]. Nancowry group of islands is a small pocket comprising of seven remotely located islands, viz., Bompoka, Chowra, Kamorta, Katchal, Nancowry, Teressa and Trinket with about 20000 people mainly inhabited by Nicobarese who are at the risk of acquiring this infection (Fig. 2)

Fig 2. Andaman and Nicobar islands



The prevalence of lymphatic filarial infection in these islands was first identified by Wilcock as early as 1944[6]. He found that 5.8% of the population surveyed in Nicobar group of islands was positive for *W. bancrofti,* while the Andaman group of islands was free from filariasis. Subsequently, a sample survey carried out in 1958 by Basu showed the prevalence of *W. bancrofti* in Port Blair (Andamans) and Nancowry (Nicobars). In Nicobar Islands, 7& 9% infection rates were detected in human population surveyed by day and night respectively.

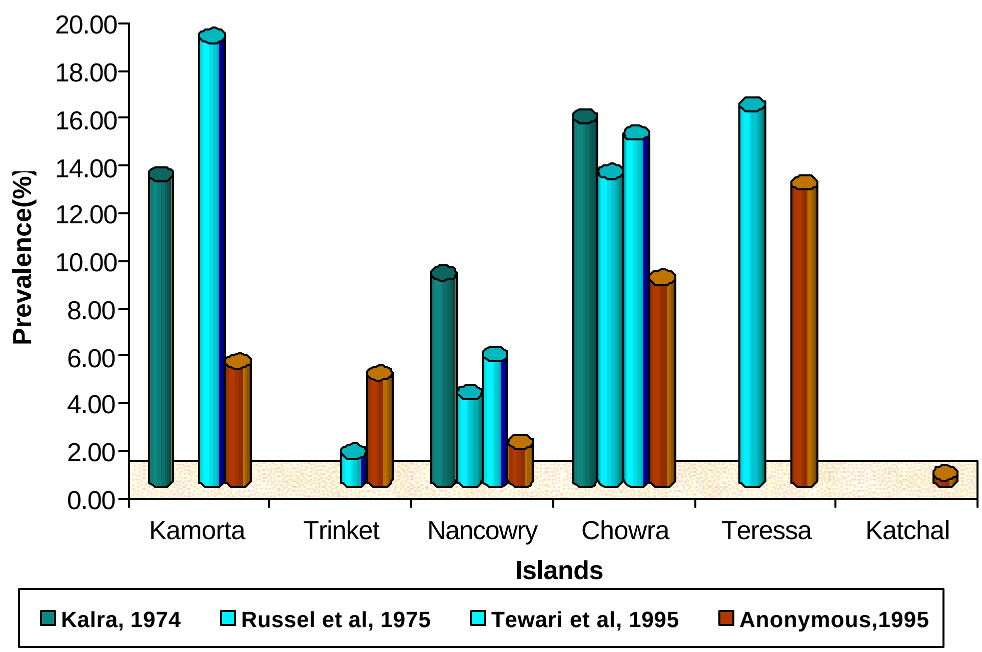
The first report of diurnally subperiodic *W. bancrofti* among tribes was from studies undertaken by Kalra during 1974[8]. Only two villages in Kamorta Island and one in Nancowry Island were covered during this survey, which showed mf rates of 12.3 and 1.7% respectively.

Russel and his associates[9] did a day and night survey of 6250 and 491 individuals in four islands of Nicobar district and Port Blair town (Andamans). The survey showed two distinct forms of *W. bancrofti* infection viz., a nocturnally periodic form in Port Blair and a sub-periodic form in Nancowry and Chowra islands. A low mf rate (0.3%) in Car Nicobar, medium (4.9% and 3.9%) in Port Blair and Nancowry respectively and high rates of 15.8% in Teressa and 13.4% in Chowra were recorded. Clinical manifestations were recorded among 90 of the total 6741 individuals with both men and women being affected. Elephantiasis in association with hydrocele was the commonest disease manifestation encountered during the survey.

After a gap of another 15 years, another survey was carried out by Tewari *et al*., during the monsoon season, which confirmed the existence of sub-periodic filariasis in Nancowry group of islands[11]. This survey showed that the mf rate was lowest in Trinket (1.2%) and highest in Kamorta (18.7%). The overall disease rate was only 1.9%, the highest recorded from Chowra. Elephantiasis of the legs was the predominant disease manifestation. No information on the prevalence of hydrocele was available.

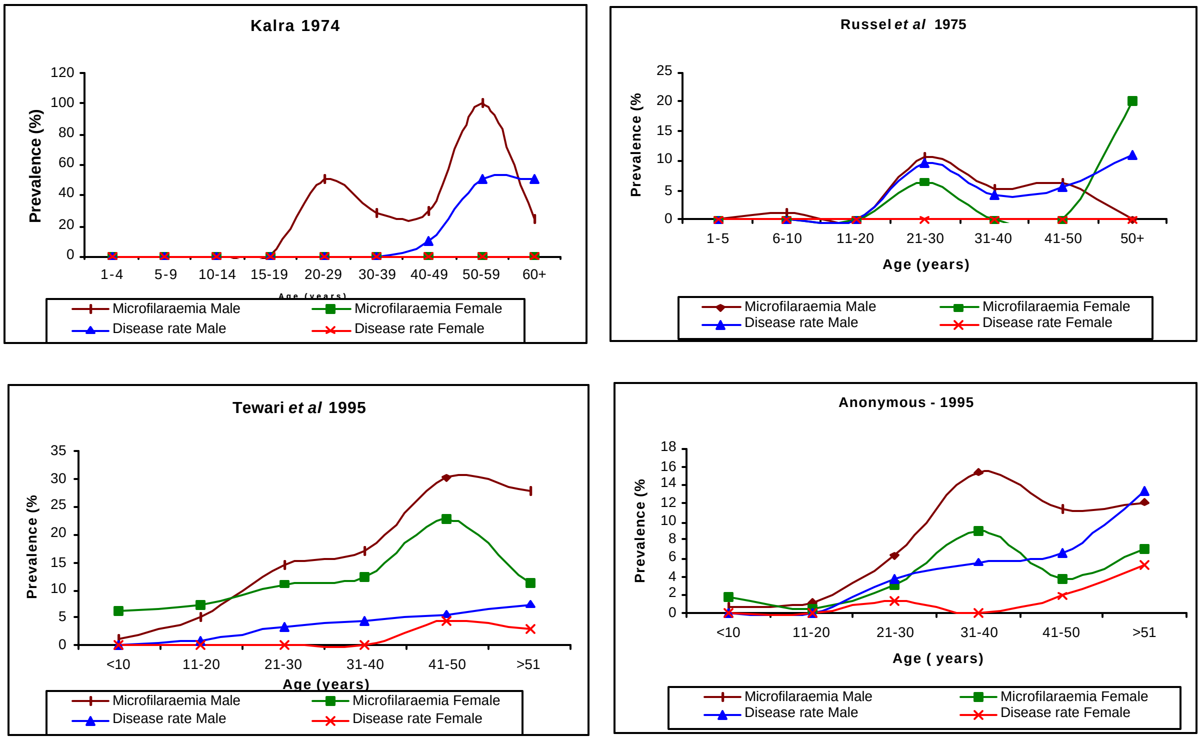
This Centre carried out a survey in the year 1995[12] in six of the seven islands of Nancowry group. A total of 1991 subjects were examined for presence of clinical manifestations of filariasis and for the presence of microfilaraemia. The microfilaria ranged between 0.29% (Katchal) and 12.5% (Teressa), while the disease rate was 0.27% (Nancowry) to 5.88% (Teressa). Thus field studies undertaken during several points of time in the past four decades by several workers have shown varying microfilaraemia levels in the remotely located Nancowry group of islands, indicating that this form of filariasis is an important public health problem (Fig 3).

Fig 3. Microfilaraemia prevalences in Nancowry group of islands



Age and gender specific pattern of disease observed in the studies undertaken so far show that microfilaraemia and disease prevalence was higher in males when compared to females. The microfilaraemia rate was low in children below 10 years old in both the sexes and increased with increasing age (Fig 4).

Fig. 4. Age and Gender wise prevalence of microfilaraemia and disease observed in different studies.



Mosquitoes Implicated in Filariasis Transmission

At least four mosquito species/species groups viz., *Aedes (Finlaya) niveus* group, *Aedes scutellaris* group, *Mansonia (Mansoniodes) dives* and *Anopheles sundaicus* were reported to bite the aborigine tribes in the jungles of Nancowry group of Nicobar islands[8]. Only one specimen of *Aedes (Finlaya) niveus* group of mosquitoes was naturally found infected, but none was found with infective stage larva. The role of *Aedes scutellaris*, which is an established vector in some of the South East Asian countries[13-15] was not ascertained during this study. A year later when *Russel* and *co-workers* [9] carried out similar survey, in the same group of islands (Kamorta), natural infection was found in *Cx. quinquefasciatus* collected from human dwellings. One out of 150 mosquitoes was found to harbour infective stage larva. This suggests the probable co-existence of both periodic and sub-periodic forms of *W. bancrofti* in Nancowry group of islands. During this survey, known vectors of subperiodic form of this species were however not checked. A study carried out by *Tewari et al., 1995* [11] showed that aborigine tribes who enter the forests are commonly bitten by *Aedes (Finlaya) niveus* and *Aedes (Stegomyia) scutellaris*. *Aedes (Finlaya) niveus* was found naturally infected with *W. bancrofti* with infection and infectivity rates of 1.1% and 0.9% respectively. *Culex (Culex) quinquefasciatus* was recorded in very low densities and on dissection was found not to be infected.

Transmission Dynamics

All the earlier studies discussed in the previous sections including the entomological studies of Tewari and his co-workers were based on short-term observations. Information on transmission dynamics of this form of filariasis was lacking. Against this backdrop the Regional Medical Research Centre, Port Blair undertook a systematic long-term study quantifying various population and transmission parameters to understand the transmission of this sub-periodic form of filariasis, for the first time in one of the endemic islands. The findings of this study showed that diurnally sub-periodic filariasis is transmitted only by *Ae. niveus. Aedes niveus* was the most predominant man-biting mosquito constituting about 90% of the mosquito species collected. *W.bancrofti* infection was found in 96 of the 3625 mosquitoes with an infection rate of 2.64%. 18 mosquitoes were found with L3 stages with an infectivity rate of 0.5%. The infection rate ranged from 1.04% in the month of August to 4.10% in the month of January whereas the infectivity rate ranged from 0% (July & August) to 1.54% in the month of January. Transmission of the infection was found to be perennial. The Annual biting rate (ABR) was 21851, Annual infective biting rate (AIBR) 108.49, Annual transmission potential (ATP) 167 and the Risk of infection Index (RII) 1.28 [16].

Conclusions and Perspectives of control strategy

While the prevalence of periodic form of *W. bancrofti* has been reported from some islands of Andaman group including Little Andaman[17] diurnally subperiodic form of *W. bancrofti* is known to be prevalent only in Nicobar group of islands. Of the 13 islands in this district, information on the prevalence of filariasis is available only for Nancowry group of islands, comprising 7 islands. The situation in the rest of the six islands of this district is yet to be explored. From the earlier surveys it is evident that at least 5562 Nicobarese are at the risk of infection. Area specific extrapolation of survey results showed that there were 793 mf carriers and 71 patients in the known endemic areas of Nicobar group of islands (Tewari *et al*, 1995) [11]. While only sub-periodic form of *W. bancrofti* was recorded at Chowra, Kamorta and Trinket islands, there are indications of prevalence of both periodic and sub-periodic forms of this species in Nancowry Island. This endemic zone is situated in the middle of the district and the distribution of this infection in the islands located north and south of this belt is not yet known. Further epidemiological investigations to understand the spatial distribution of this infection as well as that of the periodic form and to estimate the disease burden due to lymphatic filariasis should be the future areas of research. Besides, characterization of physiological races of *W. bancrofti* employing morphological, biochemical and molecular tools could address several persistent issues among the researchers.

Vector control programmes, which may reduce or eliminate transmission in endemic tracts, are operationally difficult and cost prohibitive in settings such as Nancowry group of islands as the vector of this infection breeds primarily in tree holes spread out in vast jungle tracts and bite human during their activity in the forest. The adults are exophagic and exophilic [8,11] and therefore none of the adulticidal measures would be operationally feasible and cost-effective. The other constraints in adopting vector control as the principal tool for decreasing the prevalence of filariasis are parasite's prolonged life span[18] and complex population dynamics [19] which make it impossible to effectively interrupt transmission. As this area is inhabited exclusively by tribal community, which depends on forest produce for their livelihood, their frequenting the forest is unavoidable. In this context choosing a rational approach for control with least financial and operational overhead assumes significance. The only alternative method of containing this infection is use of microfilaricidal drugs to liquidate the parasite load in the community. The available methods for this are selective administration with DEC and periodic administration of annual single dose DEC chemotherapy.

The number of rounds of annual single-dose treatment with antifilarial drugs required to interrupt transmission is not yet known. Experience in China suggests that once microfilaraemia prevalence was decreased to below 1%, a critical threshold was reached and the prevalence of infection almost continued to drop to zero during the next 10 years without further mass treatment. Whether the same threshold could be achieved with annual single dose mass treatment is unclear. Further, in some South Pacific islands, 1% prevalence appears to be steady state, and in some areas, recrudescence has occurred after infection prevalence was reduced to 1% or lower. Thus, apparently it appears that several rounds of single dose mass administration are needed to eliminate this infection.

India being a signatory to the resolution of World Health Assembly[20] aimed at elimination of filariasis. Towards meeting this goal, a strategic plan needs to be developed. The present anti-filarial measure followed in these islands is restricted to administering selective chemotherapy with Diethyl carbamazine (DEC) under the National Filaria Control Programme and the tool used for detecting the microfilaraemics under this programme is not sensitive and control could be achieved only if all/most of the microfilaraemics in a community could be detected using a sensitive tool and a complete course of treatment given. Considering the typical eco-geographical island situation with closed communities it would be worthwhile to explore this strategy using a sensitive tool to screen the population and subsequently administer DEC therapy selectively on a pilot scale. Follow up of individuals would be easy as compared to other settings where migration of individuals poses problems to control programmes. This strategy appears to be a pragmatic proposition, which could ultimately lead towards elimination of the foci of infection from these islands.

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