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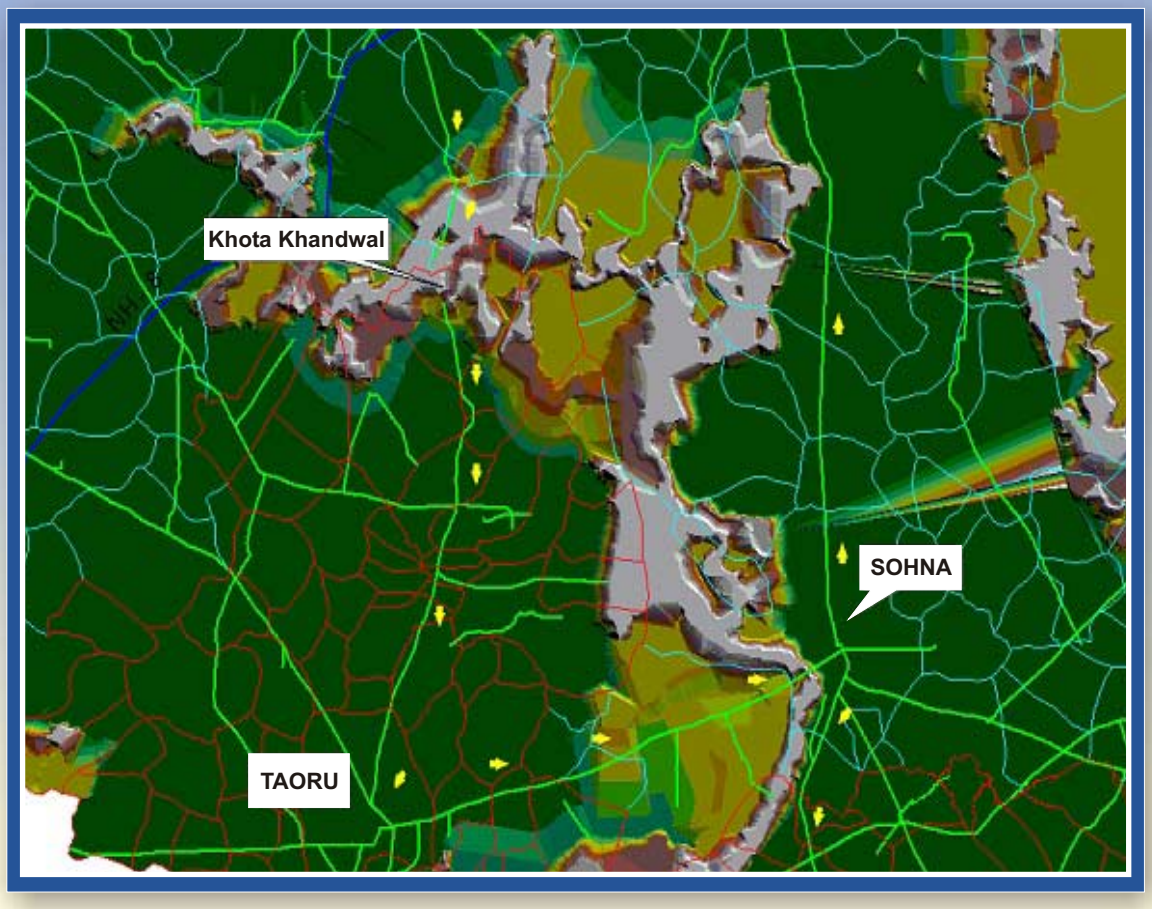

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- **CAN MOSQUITOS NETS TREATED WITH INSECTICIDES PROTECT PREGNANT WOMEN AGAINST THE ADVERSE EFFECTS OF MALARIA?** 1
  Feiko ter kuile
- **RS AND GIS FOR MALARIA CONTROL** 14
  Aruna Srivastava and B.N. Nagpal
- **NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN FROM LOW INCOME FAMILIES OF JABALPUR CITY** 30
  Brijlata Dubey, Smita Pathak and Rajlakshmi Tripathi
- **AWARENESS AND ADOPTION OF FAMILY PLANNING AMONG SANTALS** 36
  Swagata Gupta and Rama Deb Roy
- **COMPARATIVE STUDY BETWEEN TRIBAL AND NON-TRIBAL SPORTS-PERSON OF CHHATTISGARH RELATED TO THEIR MOTOR FITNESS** 46
  C.D.Agashe and Ajay Karkare
- **DEMONSTRATION OF MALARIA CONTROL BY THE USE OF DELTAMETHRIN TREATED CURTAINS IN NATIONAL THERMAL POWER CORPORATION, DADRI, GAUTAM BUDH NAGAR, U.P.** 52
  M.A. Ansari, R.K. Razdan, U. Sreehari and Neera Kapoor

CAN MOSQUITOS NETS TREATED WITH INSECTICIDES PROTECT PREGNANT WOMEN AGAINST THE ADVERSE EFFECTS OF MALARIA?

Feiko ter Kuile[1]

Abstract. *Pregnant women are more susceptible to malaria and its adverse consequences than non-pregnant women. Insecticide-treated bednets (ITNs) have emerged as an efficacious and cost-effective malaria control strategy, and are a key technical element of the Roll Back Malaria strategy, which targets children <5 years of age and pregnant women. This manuscript reviews the available evidence for the efficacy of insecticide-treated nets in the prevention of malaria in pregnancy. To date six randomized controlled studies have been conducted to determine the impact of insecticide treated nets (ITNs) on malaria in pregnancy (N=7122). In addition one non-randomized study of the effect of socially marketed ITNs assessed the impact in pregnant women (N=505). These studies cover a wide spectrum of malaria endemicity including stable-low to moderate transmission, high and markedly seasonal malaria transmission, and intense perennial transmission. These studies show that ITNs reduce maternal malaria parasitaemia and anaemia, and increase the birth weight of the newborn. ITNs, at least in the context of efficacy trials, can provide significant health benefits to pregnant women and their newborns in a wide range of areas with stable malaria transmission. For Africa, the greatest challenge is now to make optimal use of the available resources and make ITNs a key part of malaria control and reproductive health programs in malaria endemic areas.*

INSECTICIDE TREATED NETS(ITNs)

One of the main components of the Roll Back Malaria (RBM) initiative is the use of mosquito nets or curtains treated with insecticides such as permethrin or deltamethrin. Numerous studies, mostly from sub-Saharan Africa have shown that ITNs are able to reduce the incidence of malaria morbidity in children < 5 years of age (reviewed by Lengeler).[1] Five of these studies were large–scale population based randomized controlled mortality trials. The studies showed that ITNs reduce under-five mortality by 14% to 30% and save approximately 6 lives per 1000 pre-school children annually in African villages.[2-6]

ITNs act in several ways to reduce human-vector contact. First, they provide personal protection by acting as a physical barrier to mosquitoes, at least in intact nets.[7] The insecticides such as permethrin also have exito-repellent properties that affect the

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behavior of mosquitoes by reducing the rate of entry into houses and increasing the rate of early exit from houses.[8,9] Lastly, the insecticide has a toxic killing effect on mosquitoes that attempt to feed and rest.[9,10] With the community-wide use of permethrin-treated bed nets and curtains this may result in an area-wide reduction in malaria transmission through a decline in parity and sporozoite rates as well as the overall vector population [11-18] suggesting that mortality of vectors is an important mode action for ITNs. [19] This has been called the 'mass' or 'community' effect of ITNs.

MALARIA IN PREGNANCY

Pregnant women are more susceptible to malaria than non-pregnant women, and its adverse consequences vary based on the pregnant woman's pre-existing level of immunity against malaria. In areas of low-stable or unstable transmission such as in many part of Asia, including India, women do not acquire substantial antimalarial immunity and are susceptible to episodes of acute and sometimes severe malaria, which may result in stillbirths, spontaneous abortions, or maternal death. In areas with higher and stable malaria transmission, *Plasmodium falciparum* infection in pregnancy is characterized by predominantly low-grade, sometimes sub-patent, persistent or recurrent parasitemia. These frequently do not result in acute symptoms but are a substantial cause of maternal anemia and of prematurity and intrauterine growth retardation. Because most of these infections remain asymptomatic, undetected and therefore untreated, prevention of malaria in pregnancy is especially important. Primi, - and secundi gravidae are most at risk, but women of higher gravida are also affected in areas with a high prevalence of HIV or in areas with low or unstable malaria transmission. It is estimated that malaria in pregnancy in Sub-Saharan Africa is responsible for up to 30-35% of preventable LBW, and contributes to 75,000 to 200,000 infant deaths each year [20]. In Asia, *P. vivax* malaria has also been shown to cause significant maternal morbidity, maternal anemia and reduced birth weight, although the overall effect appears to be less severe than with *P. falciparum.*[21-24]

A recent series of studies have shown *P.falciparum* to bind selectively to chondroitin sulfate A (CSA) expressed in the placenta.[25] Unlike primigravidae, women who have had placental malaria in previous pregnancies, possess anti-adhesion antibodies that inhibit placental sequestration of this distinct sub-population of parasites with the CSA-binding phenotype.[26] If this is the main mechanism of the parity specific adverse effects of malaria in pregnancy then vaccination against these specific parasites may one day be possible.[27] Until then, malaria control in pregnancy relies on a three-pronged approach: (1) use of intermittent preventive treatment provided as part of antenatal care (IPT), (2) insecticide treated nets (ITNs), and (3) malaria case management. [28]

Here a summary is provided of the available scientific evidence from controlled trials in Africa and South East Asia that suggest that ITNs are a promising tool in the control of malaria in pregnancy. Some of the remaining research questions are also discussed.

ITNs IN PREGNANCY

To date six randomized controlled studies have been conducted to determine the impact of insecticide treated nets (ITNs) on malaria in pregnancy. In addition one non-randomized study of the effect of socially marketed ITNs assessed the impact in pregnant women.[29-35] These studies cover a wide spectrum of malaria endemicity including stable-low to moderate transmission,[29,30,32] high and markedly seasonal malaria transmission,[31] and intense perennial transmission.[33-35] The first four studies were conducted in the 1980s and early 1990s and showed that in areas with the lowest and most seasonal transmission (Thailand and The Gambia) ITNs reduced malaria parasitemia,[30] maternal anemia,[29,30] and increased birth weight in the rainy season.[30] However, there was no impact observed in areas with higher malaria transmission (Coastal Kenya and Ghana)[31,32] (Table-1). Although the number of studies were limited, it was tempting to hypothesize in the mid 1990s that the impact of ITNs decreases with increasing transmission intensity and that in higher transmission settings, or where there are prolonged seasons of *P. falciparum* transmission, ITNs alone do not prevent the adverse effects of malaria in pregnancy.[32,33,36]

Now one decade later it is apparent that ITNs also have a considerable beneficial impact on the health of pregnant women in areas with the most intense and perennial transmission such as in western Kenya and Tanzania.[33-35] Overall the results from the seven studies completed to date do not support the hypothesis of decreasing efficacy with increasing transmission, but suggest a beneficial effect of ITNs in reducing malaria and the associated adverse consequences in pregnancy over a wide range of malaria transmission settings (Table-1).

MASS EFFECT VERSUS INDIVIDUAL BARRIER PROTECTION

Despite some marked differences in the design of the six out of seven studies that used a randomized controlled approach, comparison of their results provides further insight into the conditions under which ITNs are likely to work. Four of the six studies that used a randomized-controlled design were so-called 'cluster' or 'group' randomized trials, with 'village' as the unit of randomization. The two other randomized-controlled studies assessed the effect of ITNs when distributed as part of antenatal care.

Table 1: Studies of Insecticide Treated Bednets in Pregnancy

1st author Country	Transmission (EIR)	Control group	N_{ITN} N_{cont}	Comments		Anemia[A]	Severe[B] anemia	Maternal malaria	Placental malaria	Low Birth Weight, /difference mean birthweight
Dolan Thailand[29]	Low (<1)	No net	103 204	All gravidae, ANC based randomization	control (N=30 No net)	**PR: 0.5**	Na	RR: 0.51	Na	PR: 0.64
					Control No net + Untreated net (N=204)	PR: 0.73	Na	RR: 0.81	Na	PR: 1.01
D' Alessandro Gambia[30]	Low Seasonal (1-10)	No net or Untreated	305 341	Primigravidae	Rainy season	Na	PR: 1.18	**PR: 0.61**	Na	**+130g**
					Dry season	Na	**PR: 0.32**	PR: 1.11	Na	-135g
Shulman Kenya[32]	Intermediate Seasonal (10-30)	No net	263 228	Primigravidae, village based randomization Hospital ANC attendees		PR: 0.99	OR: 0.71	OR: 0.75	OR: 0.75	0g
Brown Ghana[31]	High Seasonal (300)	No net	1033 928	All gravidae, household kids < 5y		OR: 0.88	OR: 0.80	OR: 0.89	Na	OR: 0.87
ter Kuile Kenya[33]	High Perennial (100-300)	No net	1377 1377	All gravidae	Gravidae 1-to-4	**HR: 0.79[d]**	HR: 0.70[D]	**PR: 0.62**	**PR: 0.77**	**PR: 0.72 +78g**
					Gravidae 5+	HR: 1.00[d]	HR: 1.24[d]	PR: 0.80	PR: 0.72	PR: 1.12 - 27g
Njagi Kenya[34]	High Perennial (100-300)	No net	480 483	Primi+secundi gravidae ANC based randomization		**PR: 0.69**	Na	**PR: 0.70**	**PR: 0.61**	PR: 0.68 +67g
Marchant Tanzania[35]	High Perennial (100-300)	No net	239 266	All gravidae, non-randomized, social marketing		**RR: 0.88**	**RR: 0.62**	RR: 0.77[F]	Na	Na

Bold face reflects statistically significant differences. PR, prevalence ratio; OR, odds ratio; RR, risk ratio; HR, hazard ratio.
A Any anemia (Hb < 11 or 10 g/dl, or Hct < 30%)
B severe anemia, Hb < 8 or 7 g/dl.
D Gravidae 1-to4: N = 451, gravidae 5+: N = 313.
E primigravidae only; 16% (-35-48) in secundigravidae.
F. Significant reduction in high density parasitaemia (RR 0.62 (0.41-0.95)

These latter studies randomized individual women, rather than villages to the different interventions. The effect of ITNs in the group-randomized trials reflects the combined effects of individual barrier protection as well as area-wide reductions in malaria transmission ('community' or 'mass' effect).[14-18] This mass-effect can be exceptionally strong in areas with high coverage of ITNs (high proportion of households with ITN use in a given area), as was recently shown in a large mortality trial in children < 5 years of age in western Kenya. The reductions in mortality and morbidity was similar in control households (not using nets) located in close proximity (300 meters) to ITN villages as in the interventions villages themselves.[14] ITN users in areas with low coverage do not benefit from this community effect. This is important in the interpretation of the results from the few available studies of ITNs in pregnancy. It is likely that the mass killing effect on mosquito populations will have resulted in an underestimate of the impact of ITNs on malaria in pregnancy in the group-randomized trials, as some women in 'control' households may have benefited from area wide reduction of the malaria vector populations.[15,16,18] Similar considerations apply to the earlier study by Dolan et al from the Thai-Burmese border. This study randomized individual women to receive ITNs, non-treated nets or no-nets. All study participants, however, lived in the same densely populated refugee camps and some mass-effect by the treated nets cannot be excluded.[29] Extrapolation of results from group-randomized trials to predict the impact in programs that distribute ITNs to individual pregnant women (for example as part of antenatal care), or vice versa, should thus be done with care if the degree of coverage of ITNs cannot be taken into account.

What evidence do we have that ITNs work when distributed to individual women as part of antenatal care in settings with low ITN coverage? This question was answered by the most recent study from western Kenya, conducted by the Kenya Ministry of Health in collaboration with the Danish Bilharzia Laboratory. The results suggest that ITNs distributed to individual women as part of antenatal care are effective in reducing maternal malaria and placental malaria, as well as maternal anaemia (Table-1).[34]

EFFICACY OF ITNs WHEN USED IN THE SECOND HALF OF PREGNANCY VERSUS USE FROM CONCEPTION ONWARDS

The four group-randomized controlled trials[30-33] and the two randomized trials that distributed ITNs to individual women as part of antenatal care[29,34] also differed in another aspect; the duration of protection during pregnancy. Most women in malaria endemic areas first attend antenatal care in the second trimester or second half of pregnancy. The risk of peripheral malaria parasitemia is greatest in the first 20 weeks of gestation, with malaria infection rates at delivery approximating the levels in the postnatal period.[37] The group-randomized controlled trials that

showed a significant beneficial effect on maternal malaria, anemia, and birth weight, distributed ITNs to all members of a community regardless of whether they were pregnant.[30,33] The bulk of the women included in these studies became pregnant after the intervention was distributed and were as such protected throughout pregnancy, i.e. from (pre-) conception to delivery. Despite the push for ITNs in the control of malaria in pregnancy in the 1990s there was, until recently, a dearth of information about their efficacy when distributed to women in the latter half of pregnancy as part of antenatal care. The two studies from Thailand and western Kenya that assessed the effect of ITNs as part of antenatal care provide the important insight that ITNs can indeed reduce the incidence of malaria and anemia when used from the second trimester or second half of pregnancy onwards.[29,34]

ITNs COMBINED WITH OTHER MALARIA CONTROL INTERVENTIONS

ITNs do not provide a stand-alone solution to the problem of malaria in pregnancy. Additional studies are required to evaluate the cost-effectiveness of programs that use single interventions versus those that use multi-pronged approaches to malaria control in mother and infants, in particular those that combine two preventive approaches as part of antenatal care, such as ITNs combined with chemoprophyaxis or IPT. Only one study has assessed the combined effect of IPT (with sulfadoxine-pyrimethamine) and ITNs. This study used a factorial design and compared the efficacy of ITNs+IPT, ITNs-alone, and IPT-alone with malaria in a control group of women receiving neither intervention.[34] Both interventions alone were found to be effective in reducing placental malaria and maternal anaemia, although the effect of IPT-alone was greater than that of ITNs-alone. A small additional benefit was obtained by combining IPT and ITNs.[34] No information is available of the combined effect of chemoprohylaxis or IPT with chloroquine and ITNs. Further, no studies have looked at the combined effect of ITNs and indoor residual spraying (IRS) with insecticide, a policy that is routinely applied as part of the Enhanced Malaria Control Project (EMCP) in the tribal areas in Central India.

ADHERENCE

High adherence to ITN use by pregnant women has been observed in most of these controlled studies.[29,31,33] Adolescence, being unmarried or cohabiting, and first pregnancy were the main factors associated with not-using an ITN.[31,33,35] Young primigravidae are also the group at highest risk of the adverse effects of malaria in pregnancy.[20,37] This reinforces the need to improve health education strategies that specifically target young girls, possibly using adolescent friendly youth centres or school-based (pre-pregnancy) approaches. Low compliance may be a greater determinant of effectiveness in areas with low ITN-coverage where personal

protection is the main protective mechanism, than in population based programs that also benefit from area-wide reductions in vector populations due to a mass-killing effect of the insecticide.

WHO SHOULD BE TARGETED?

Because the effects of malaria in endemic areas are most marked in primi and secundigravidae, control interventions might be restricted to these high-risk pregnancies. Nevertheless, there are several arguments in favour of targeting all pregnant women, regardless of their parity. First, three of four studies that included women of all pregnancy order showed that the benefits of ITNs extend beyond primi and secundi-gravidae, and includes women of higher pregnancy order. Second, HIV is known to impair a pregnant woman's ability to control malaria, especially among the older multi-gravidae.[38] HIV aggravates the adverse effects of malaria on maternal anemia and pregnancy outcome in women of all pregnancy order,[39] and reduces the efficacy of IPT with sulfadoxine-pyrimethamine.[40] Third, targeting all women may be more practical, whereas targeting younger pregnancies only may create ill-feeling among non-participating members affecting the popularity of the program.[36] Fourth, targeting all, instead of a selected group of high-risk pregnancies will increase coverage and contribute to any community/mass effect on malaria transmission,[14] and the likelihood of attaining the target of 60% coverage of high risk groups as stated in the Abuja declaration.[41]

Last, and probably most important; several studies from areas with intense malaria transmission have shown ITNs to have a marked beneficial impact on malaria, anemia, and growth in infants, even among those aged <6 months.[42-44] Further, recent evidence suggests that women remain at an increased risk of malaria in the post-partum period.[45] Thus, ITNs have the potential to benefit the pregnant woman and the growing fetus during the pregnancy, as well as -uwith continued se - mother and newborn (regardless of their birth order) in the post-partum period, and eventually the mother prior to, and during the next pregnancy. This is one of the most attractive features of ITNs in the control of malaria in pregnancy.

ASIA VERSUS AFRICA

Almost all of the studies discussed here come from sub-Saharan Africa and there is dearth of information from Central and South-East Asia that differs not only in malaria transmission from Africa but also with regard to malaria control measures and socio-cultural attitudes towards malaria. The main malaria vector in sub-Saharan Africa is *Anopheles Gambiae* that bites mainly at night. Several of the main vectors in Asia, including *Anopheles minimus*, *A. maculates, A. culicifacies* and *A. dirus* may bite early in the evening before bed time.[46,47]

INSECT REPELLENTS

DEET containing insect repellents

have recently proved effective in reducing exposure to anopheles mosquitoes in pregnant women in Thailand.[46] The risk of DEET accumulating in the fetus is low and DEET (N-diethyl-m-toluamide) is safe to use in later pregnancy.[48] One randomized controlled trial of insect repellents (20% Di-ethyl-benzamid)for the prevention of malaria in pregnancy showed a non-significant reduction by 28% in the incidence of falciaprum malaria, in a area of very low malaria transmission near the Thai Burmese border.[49] No other studies in pregnant women have been conducted in areas with low or more intense transmission.

CONCLUSION

Much has been learned in the last decade since the first studies of ITNs in pregnant women. It appears that ITNs, at least in the context of efficacy trials, can provide significant health benefits to pregnant women and their newborns in a wide range of areas with stable malaria transmission. Nevertheless, several issues still require further information to improve our understanding, particularly whether there is a role for ITNs in the control of falciparum and vivax malaria in pregnancy in Asia, alone or combined with IRS. For Africa, the greatest challenge is now to make optimal use of the available resources and make ITNs a key part of malaria control and reproductive health programs in malaria endemic areas.[35,50-54]

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RS AND GIS FOR MALARIA CONTROL

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Abstract. *Geographic Information System (GIS) and Remote Sensing (RS) have opened a new horizon for monitoring and control of diseases. MRC has conducted a few studies on application of RS and GIS in estimation of mosquito production, mapping of malaria receptivity, identification of malaria paradigms and vector distribution on the basis of ecological factors, and has developed a GIS based malaria information system. GIS-based information system ensures that if a localized spurt of disease cases occurs, it can be associated rapidly with a likely problem, a specific vector, and a probable human source, so that appropriate preventive action can be taken to arrest any rising trend. Ground validation of GIS results showed a coherence of the results.*

India is the second highest malaria contributing country in the world. Spatial malaria trend in India reveals varying levels of endemicity; most of the regions in the country have unstable malaria except northeastern region. In 1976, there was a countrywide resurgence contributing 6.45 million cases of malaria[1]. In 1977, to contain malaria, the Government of India implemented the modified plan of operation. In early 80s, malaria cases got stabilized to about 2 million but later an increasing trend is being observed and presently about 2-3 million cases are being reported annually. More alarming is the increase of killer malaria, 'The *falciparum* malaria' which constitutes 30-40% of the total malaria cases. WHO's Revised Malaria Control Strategy laid emphasis on selective and sustainable integrated control measures; these are situation specific and need a detailed knowledge of local area[2]. In spite of several survey reports, large areas still remain unexplored[3.4]. The terrain system has undergone radical ecological change due to various developmental activities resulting in change in disease and vector dynamics. There is a need for continuous monitoring vis a vis ecological changes for control measures to be effective. Traditional survey techniques are time consuming and labour intensive and these in no way can cope up with environmental changes that are taking place. Geographic Information System (GIS) and Remote Sensing (RS) have opened a new horizon for monitoring and control of diseases. Geographic Information System, a computer assisted system, facilitate inputting, processing, analyzing, integrating and presenting both spatial and non-spatial information. Using remote sensing new information can be generated at low cost. Satellite data is first projected

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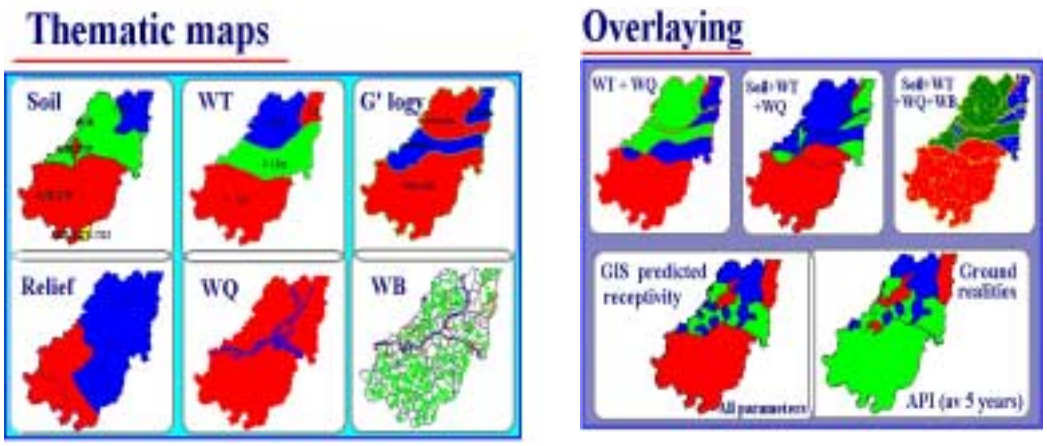
to convert it into real world system using various mathematical transformations, in some cases involving generalize hyper geometric functions or its special cases e.g. Bessel Function(http://search.yahoo./ bin / search / ?fr = iy-google & p= map+ projections+Bessel+functions). Information on land use, water bodies, vegetation, forest cover etc can be used as datasets in GIS for mapping of malaria receptivity and identification of risk factors.

Wood et al, (1992), at NASA, using RS and GIS capabilities identified high and low anopheline producing rice fields in California with 90% accuracy, nearly two months before peak larval season[5]. In 1994, Beck et al, using GIS, identified flooded pastures and transitional swamps as the important land elements for potential vector breeding sites[6]. In Israel, distance between vector breeding sites and migratory population centers were correlated with malaria incidence using GIS[7]. In India, RS and GIS have been recently used to estimate mosquito production in major water bodies, mapping of malaria receptive areas and identify malaria risk factors in different areas [8-11]. Further, using GIS an attempt has been made to map areas favorable for distribution of Indian anophelines including vectors of malaria [12,13]. A brief account of some of the work done at Malaria Research Centre is presented here.

MAPPING OF MALARIA RECEPTIVITY AND IDENTIFICATION OF RISK FACTORS IN A RURAL A REA

Nadiad taluka comprising of 100 villages with unstable malaria and periodic epidemics was selected for the study. Using topo -sheets and satellite imageries, thematic maps in the scale 1;250,000 on water table, water quality, hydro -geomorphology, soil type, relief, irrigation channels, etc. were prepared. Each map was divided in 2-3 categories, low, medium and high and weights were assigned according to favourable conditions for vector breeding. These maps were sequentially overlaid and integrated using ARC/INFO 7.1 software. The composite map resulted in 13 contours. Contour -12 falling in non-irrigated tract exhibited 95% matching with the ground realities i.e. Annual Parasite Incidence (API) of malaria. Contour 13, an irrigated area did not show an obvious matching but the ground verification resulted in complete reconciliation of cause and effect relationship in explaining malaria epidemiology in the region (Fig.1). The study revealed that the parameters for high malaria in villages of Nadiad were - high water table, soil type, irrigation and water quality[10]. The technique can be used for mapping of malaria receptive areas for appropriate control measures.



(a) **(b)**

Fig. 1: a) Thematic maps of Nadiad Taluka, Kheda distt., Gujarat
b) Overlaying and integration of Thematic maps of Nadiad Taluka, Kheda distt., Gujarat

GIS BASED MALARIA INFORMATION MANAGEMENT SYSTEM FOR URBAN MALARIA SCHEME IN INDIA

Urban malaria control is based upon recurrent anti larval measures at all breeding sites and malaria treatment through passive case detection. An attempt has been made to construct an nformation management system based on Geographic Information System (GIS) for efficient planning, implementation and evaluation of urban malaria control[11]. The present information management system was developed in collaboration with State Health Authority, Tamil Nadu using GIS software ARC/ INFO 7.3.1 and analysis was done using ArcView 3.1 on NT platform and was implemented in Dindigul municipality, district Dindigul, Tamil Nadu. Dindigul, is the district head quarter having a population of about 0.2 million. The town is divided in 8 municipal divisions and 48 wards.

Each ward and the street of the Dindigul town was digitized and assigned a code. Ward wise and streetwise attribute information on 33 parameters was then attached using GIS software. These consisted of ward area, population, number of slums, slum population, street name, number of houses in each street, breeding sources e.g. wells, overhead tanks, tap-pits, ponds and streetwise/ ward wise malaria profile etc.

Some of the basic functionalities of the system developed are given below:

a) Instant Info retrieval: Since the attributed information is attached to wardwise/streetwise, a click of the mouse on the respective geographic unit retrieves the information attached (Fig.2).

b) Zoom in: Any geographic unit can be selected and zoomed in, and from a macro unit one can reach at

the micro level unit. For example, if a ward is selected and zoomed in, from that ward one can reach to the streets and from the street to the houses. Even the house wise information such as name of the house owner, number of family members, their age and sex, malaria history, drug resistance status etc can be attached.

c) Over laying attributes: Every breeding site such as wells, over head tanks, outside storage tanks, inside storage tanks, tap pits etc. were mapped. Overlaying and integration of maps of each breeding site can estimate breeding potential in an area.

d) Situation Analysis: It is also possible to study malaria dynamics both in space and time. One can identify the wards/streets where mosquito vector/larval populations or malaria incidences have increased. By overlying the breeding sources, it is possible to identify specific problematic breeding sites and situation specific control measures can be implemented.

As soon as new data is entered or old updated, revised maps are dynamically generated and GIS capability can highlight the trouble spots. GIS malaria surveillance system was implemented in Dindigul municipality on November 19 1999, The World GIS Day. Health officers from the district and state head quarters Tamil Nadu were trained on the GIS based malaria information management system to aid its proper utilization. A Website was constructed

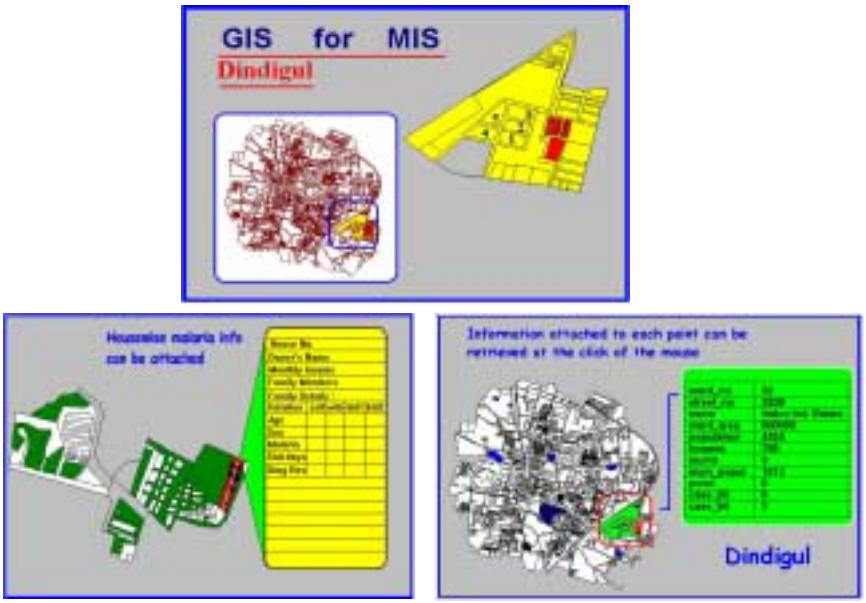


Fig. 2: In total 33 parameters have been attached to streetwise map of Dindigul a click of the mouse on the respective geographic unit retrieves the information attached. The areas can be zoomed in to have micro level over view; it is possible to attach person wise information.

to demonstrate the fast dissemination of information recorded. This eliminated the need for a traditional flow of information; the information is instantly available globally. The program manager at Centre or State HQ can instantly visualize the scenario pertaining to a village/ primary health centre/district or urban area and prepare a rapid response plan to control the disease.

Once the basic infrastructure is ready, it is easy to convert it to surveillance system for any other disease viz. filaria, dengue, DHF. One needs only to replace malaria data with other disease data and add a few disease determinants.

GIS MAPPING OF FAVOURABLE AREAS FOR DISTRIBUTION OF MALARIA VECTORS AND OTHER INDIAN ANOPHELINES

There are 58 species of Indian anophelines out of which six are major vectors of malaria viz. *An. culicifacies, An. fluviatilis, An. stephensi, An. dirus, An. minimus and An. sundaicus* in different ecological settings. A GIS based technique has been evolved to map Indian anophelines including malaria vectors[12,13]. An example of *An. minimus*, a forest fringe species is given below.

An. minimus - a species of forest fringe areas

An. minimus has been the most important vector of malaria along the foothills of Himalaya from Uttar Pradesh to northeast in India. Thematic maps for ecological parameters which mainly governs the distribution of the species viz. forest cover, rainfall, altitude, soil type and temperature published by National Thematic Mapping Organization (NATMO), Govt. of India on 1: 6,000,000 scale were digitized (Fig.3). Digitization, overlaying and analysis was done using ESRI GIS software Arc/ Info NT 8.1 and Arc View 3.2.

Reported distribution was taken as baseline information. Each reported distribution location was mapped on thematic maps to decipher the ecological value at that point. A matrix was formed to represent favourable set of values for species existence. A mathematical model was developed to extract the range of each parameter and integration. The resultant map after integration of thematic maps namely soil; forest cover, rainfall, temperature and altitude using GIS show the areas favorable for *An minimus* (Fig.4).

GIS predicts favorable areas not only in northeast but also in Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Maharashtra, Kerala and Karnataka. In addition some new areas are also exhibited in Kerala, Maharastra, Himachal Pradesh and Sikkim. The results were validated by reported distribution and carrying out precision field surveys in nine locations of four states namely, Uttaranchal, West Bengal, Assam and Meghalaya (Fig.5a&b), amazingly *An. minimus*

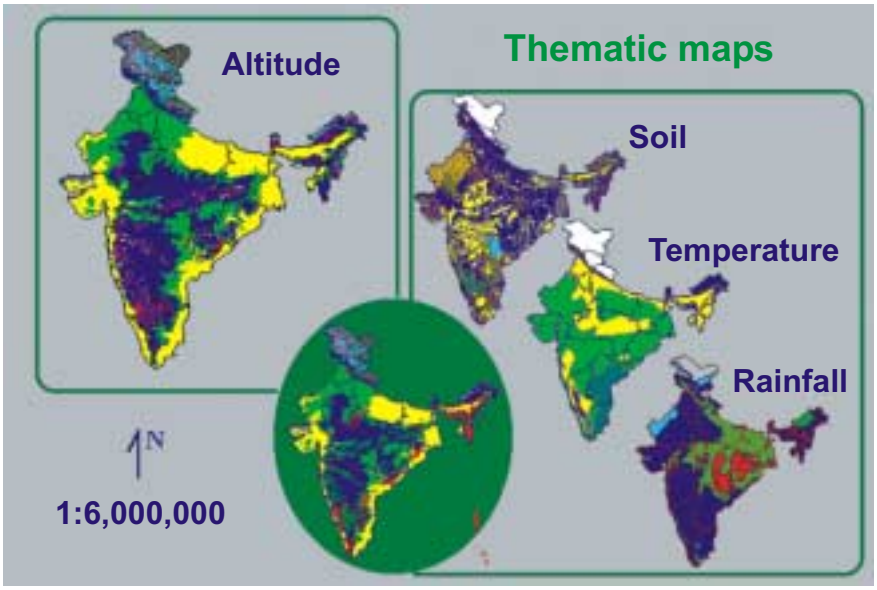


Fig. 3: Thematic maps on ecological parameters Altitude, Rainfall, Forest, Soil and Temperature prepared digitizing plates in Land Resources Atlas of India, (NATMO) Govt. of India (1996) in the scale of 1:6,000,000 by using ARC/ Info 8.1NT on Summagraphic A00 size digitizer. These maps were overlaid and integrated using ARC/ View 3.1 to predict habitats favorable for Anopheline species in India.

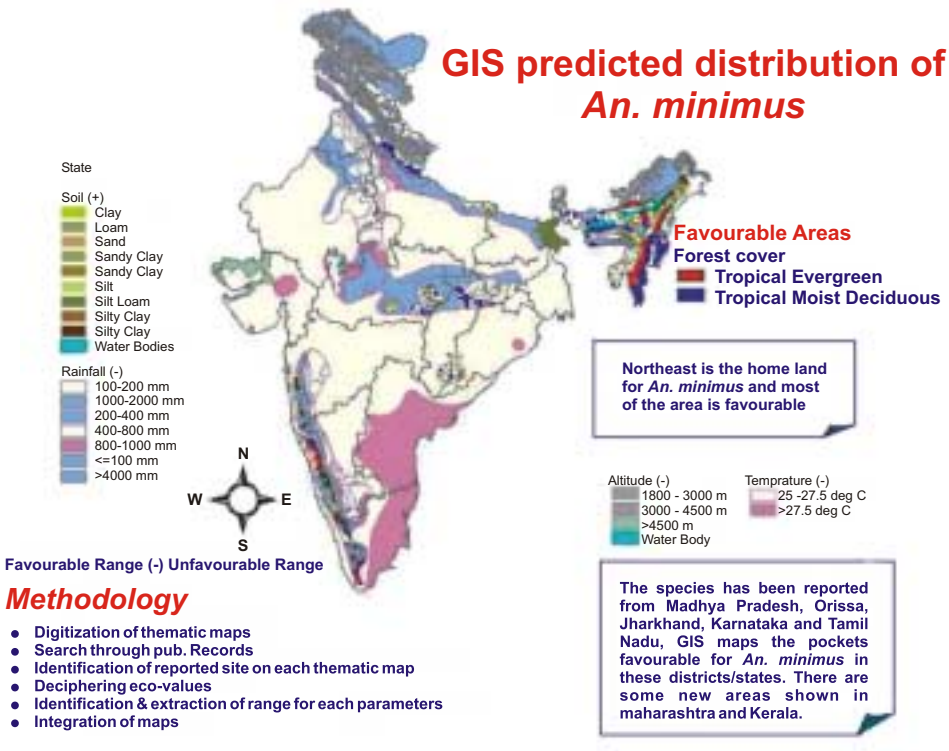


Fig. 4: GIS predicted favourable areas for *An. minimus* in India, shown in Red and Blue colour.

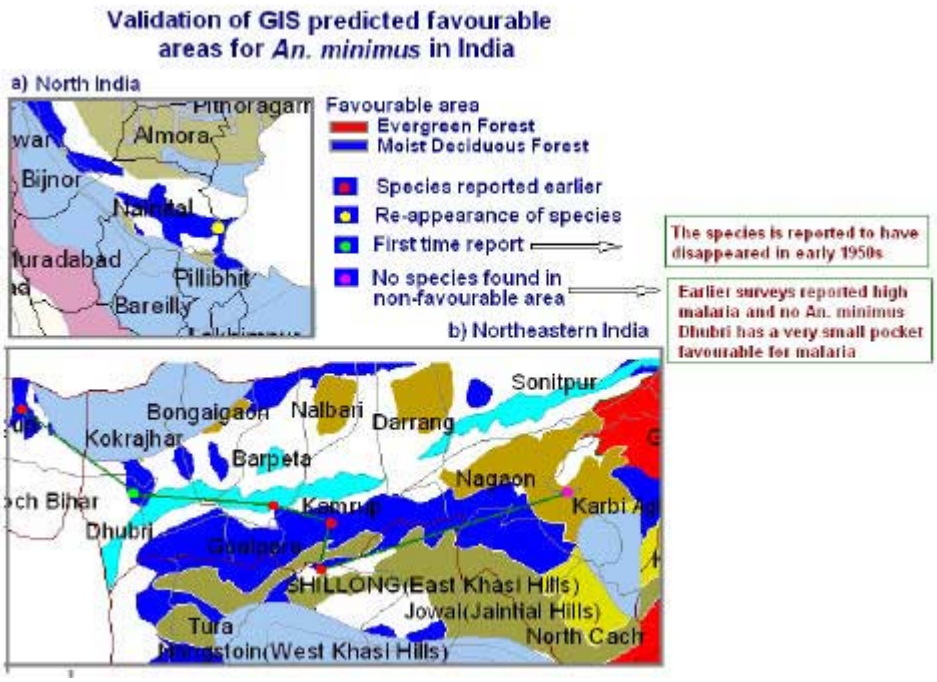


Fig. : Validation spots in GIS predicted distribution areas of An. minimus. Red dots shows areas where the species has been reported, pink dot shows new areas.

was collected from all the locations. In two districts, namely, Banbasa, distt. Champavat (earlier Nainital) of Uttaranchal and Dhubri of Assam, in the former, the species was reported to have disappeared after 1950s, and in later, it was not reported in earlier entomological surveys in both the places *An. minimus* was encountered besides validation of GIS prediction, reappearance of *An. minimus* at Banbasa and first report from Dhubri was established. GIS predicted precisely the location in these districts to conduct entomological surveys where the species could be found. Favourable areas for *An. minimus* in each state was also calculated using GIS and it was found that northeastern states of India is the most favourable, Mizoram has about 90% of its area favourable for *An. minimus*. There are a few avourable areas in Kerala and Maharashtra where till date no reports of *An. minimus* but in future the species could be found here.

The technique can delineate the areas favorable for any species of flora and fauna, which is very useful for precision surveys. The technique is fast and can be easily duplicated in other parts of the country /world. In any disease, once the vector distribution is known species-specific control measures can be formulated in cost-effective manner.

MAPPING OF MOSQUITOGENIC CONDITIONS USING REMOTE SENSING

Mosquitoes are associated with variety of aquatic habitats, which are species specific. Larval breeding ground survey is time consuming, costly and cumbersome. Therefore a feasibility study to use remote sensing images in assessing mosquitogenic potential was carried out. Sanjay lake and its their surrounding area within a radius of 3 kms. in East of Delhi was selected for study. Images of Indian Remote Sensing Satellite (IRS) IA and IB having resolution 36.5 metre of the same region were obtained.

Sanjay Lake is located in the east of the National Capital Territory of Delhi and is surrounded by the urban areas. The length of the lake is about 2 Km. and width is about 150 meter but in actual the perimeter of the water area was about 1500. The lake is meant for fish culture but as such there is no maintenance because most the time the shoreline is polluted and full of vegetations especially with Pistia plant commonly known as Jalkhumbhi. The width of the vegetation on the surface of the water ranged from 0.5 meter to 6 meters depending upon the season.

The satellite IRS passed over Delhi after every 21-day interval at 11 A.M. During the study period data only for 7 dates could be received. The images were rect ified geometrically and radio metrically by Regional Remote Sensing Services Centre, (RRSSC) Bangalore. The images were analyz - ed on 512 x 512 pixel frame. The Sanjay lake shoreline was divided into 50 segments to match with the size of the one pixel (Fig.6). Ground truth information was collected from each segment on each satellite pass. From each segment mosquito larval density were recorded by taking 5 dips at a distance of 6 meters. The type of vegetation and its width on the surface of the water in each segment was also recorded. Adults were also collected from its nearby-situated human dwellings, cattle sheds and man-hour density was calculated.

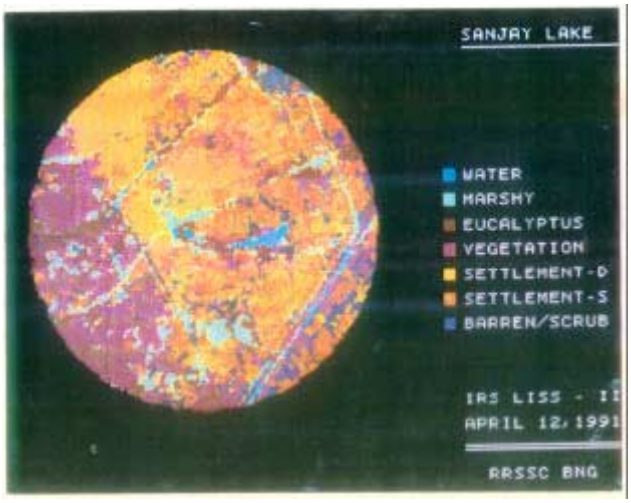


Fig. 6: Classified image of Sanjay lake area, Delhi.

Besides the data collected from Sanjay Lake, larvae from 12 ponds situated in different locations in its surrounding area within 3 km. radius were also collected throughout the study period. Adults were also collected from the dwellings in nearby huts. The size of the selected ponds was more than 36.5 x 36.5 metres. Ground information has also been recorded to monitor for temporal changes in water bodies, vegetations, agriculture cropping pattern etc. Land use classes viz water; vegetation, urban etc. were identified using the ground truth information. The classification was done by selecting training sets. The area between different classes was calculated as 36.5 x 36.5 x no. of pixels and the quantified data has been correlated with ground truth information which was col lected from Sanjay lake and its surrounding areas on mosquito larvae and adults. And the statistics was generated for each class on VAX 11/780 computer.

To find out the mosquito potential per sq.m. of the lake and its surrounding 12 ponds a multiplication factor was calculated. it was assumed that while taking a dip the dipper moves a distance of 0.3 meter, and since r is the radius of the dipper and 2r is the width of the movement area. Using actual area covered by per dip and larvae collected in a dip larvae per sq. mt. were calculated The vegetation area for each segment was calculated by multiplying the width of the vegetation on the surface of water with the length of segment. The false colour composite (FCC) and classified images for all the seven dates were classified. The total 27.7 km land areas have been classified into 7 main classes water, weed, plantation, agriculture vegetation, agriculture fallow barren, urban and barren (Fig.6). Out of these seven land used classes the water is an important class for this study as it supports the mosquito breeding.

The larval density per dip of Sanjay lake varied from 0.13 (February 1992) to 13.54 (November 1991). The number of pixel classified as water in lake and the larval density showed a poor negative correlation (r = -0.233) showing thereby means that increases in water in the lake, decreases the larval density which is a natural phenomenon. The maximum vegetation area was calculated for the month of October 1991 (3126.9 sq.m) and minimum during the month July 1991 (154.5 sq.m.). During the month of January 1991 there was no vegetation. Maximum mosquito production was also observed in the month of October and minimum in the month of July 1991. The correlation of the vegetation area with larval production is positive 0.789. It indicates that with the increase of vegetation the larval production also increases.

Mosquito production in the segments of the where no vegetation was recorded lake was calculated. The maximum production was estimated for the month of November 1991 and minimum for October 1991. The

correlation was also found positive for breeding area with density per dip and larval production. Total larval production and man-hour density of adult mosquitoes collected from the nearby cattle sheds and human dwellings found to have significant correlation with density/dip.

DELINEATION OF MALARIA PARA-DIGMS AND THEIR RECEPTIVITY FOR MALARIA

Mewat is located in the southern part of Haryana, about 120 Km. South of Delhi, it comprised of six blocks, Nuh, Nagina, Taroru, Ferozpur Jhirka and Punhana blocks of Gurgaon district and a small portion of Hatin block of Faridabad district of Harayana (Fig.7).

The total population of the region is 0.69 million spread over 491 villages.

IDENTIFICATION OF PARADIGMS

Using GIS, based on geographic reconnaissance, ecological and socio-economic profile initially five Malaria paradigms, namely, Irrigation command, Catchment, Mining, Urban and Flood prone areas were identified. In Mewat region there are two Command areas: i) Dubalu minor area (A I), within Latitude $28^0$9' to $28^0$3' and Longitude $77^0$5' to $77^0$11'; ii) Banarsi - Umra - Gangwani minor, within Latitude $28^0$1' to $27^0$52' and Longitude $76^0$56' to $77^0$7' (A II), Sections falling in two command areas were identified and are shown in (Fig.8).

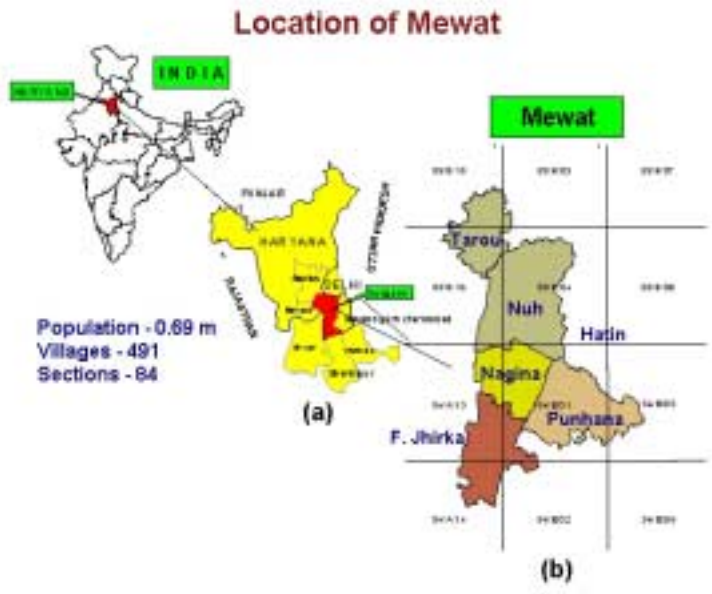


Fig. 7: Location of Mewat region in Gurgaon

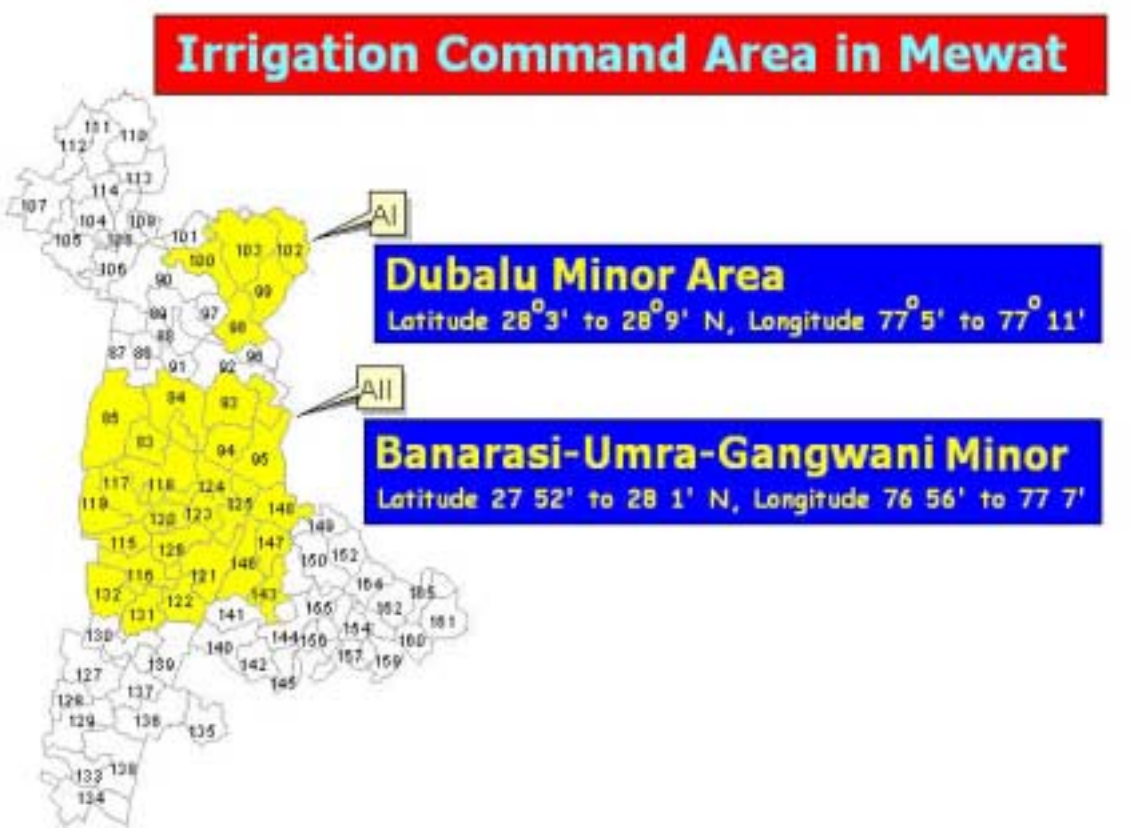


Fig. 8: Sections falling in Command areas AI and AII in Mewat.

For flood prone area, contour map generated by HARSAC was used to develop a 3D TIN model (Fig 9a). It did not show undulations in central Mewat hence dense contours were redigitized and 3D model was developed (Fig.9b). Sections falling in low-lying areas were identified which are likely to be flooded during heavy rains or inundation of flood waters from the adjoining states (Fig.9c).

From the natural drainage map (Fig. 10a), watersheds were developed by HARSAC (Fig.10b), this constituted catchment area and sections falling in catchment area were identified and extracted. Area complementary to this was called as Non-catchment area (Fig.10c).

Semi urban/ urban and mining areas were shown in land use map (Fig.11) prepared by HARSAC using Remote-sensing images. Section map was overlaid on land use map for identifying geographic location of the semi urban/ urban and mining areas (Fig.11).

Flood Prone Area in Mewat

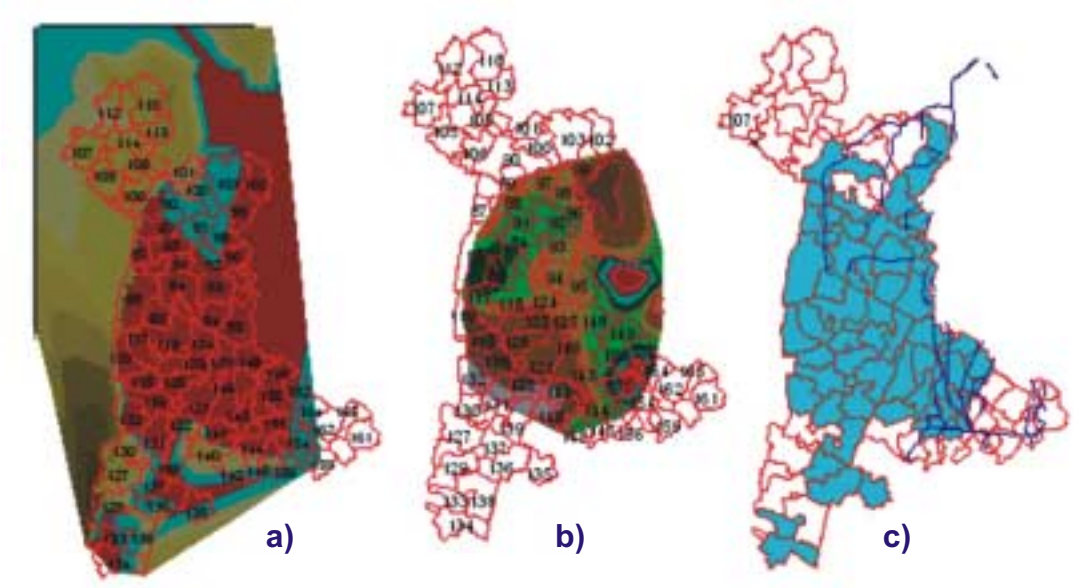


Fig. 9: a) 3D model taking sparse contours
b) 3D model using dense contours
c) Sections falling in flood prone area

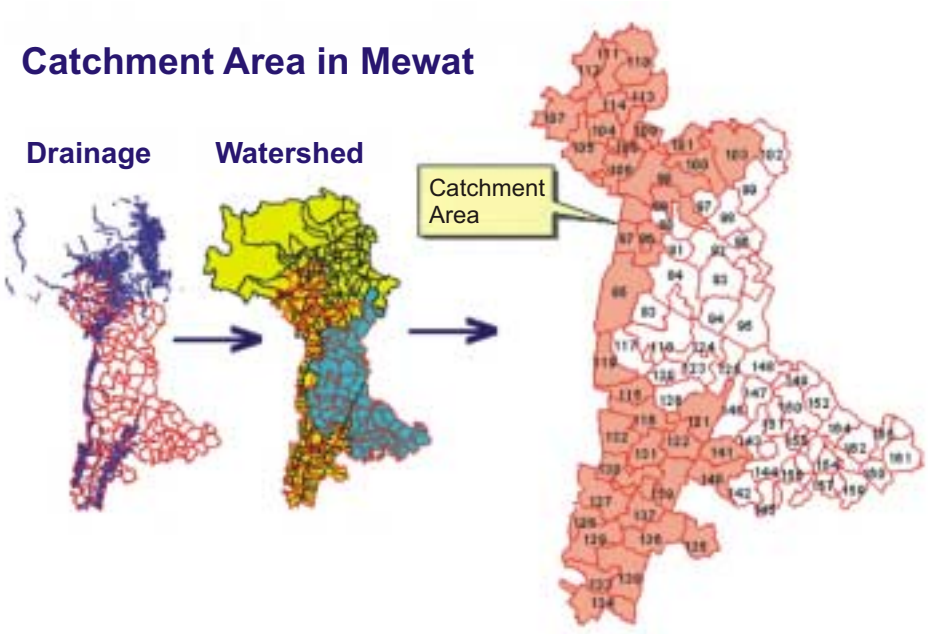


Fig. 10: a) Showing natural drainage in Mewat
b) Watershed
c) Area complimentary to catchment area was taken as non_catchment area.



Fig. 11: Location of Urban/ semi urban and Mining area.

MALARIA RECEPTIVITY BY PARADIGM

It may be seen from the Fig.12 that during 1991 overall API in all the paradigms was around 5, then declined to around 2 API by 1993, again increased during 1994 and 95 representing pre-epidemic phase when it touched around 7 API in all paradigms. Epidemic phase started in 1996, 1997 was post epidemic years and 1998-1999 once again represent the inter epidemic period. During 1996 different paradigms responded differently, maximum amplification occurred in urban/ semi urban paradigms with API about 45. This was followed by flood prone; Command area A-II and non-catchment paradigms, which exhibited same amount of amplification and API, reached around 40. Mining paradigms showed about 20 API. The lowest malaria was observed in Command area AI (about 10 API). By 1998 malaria incidence reached below 2 API in all the paradigms. Further decline continued to reach API below 1 by 1999 subsequently in 2000 and 2001 API reached below 0.5 in all paradigms.

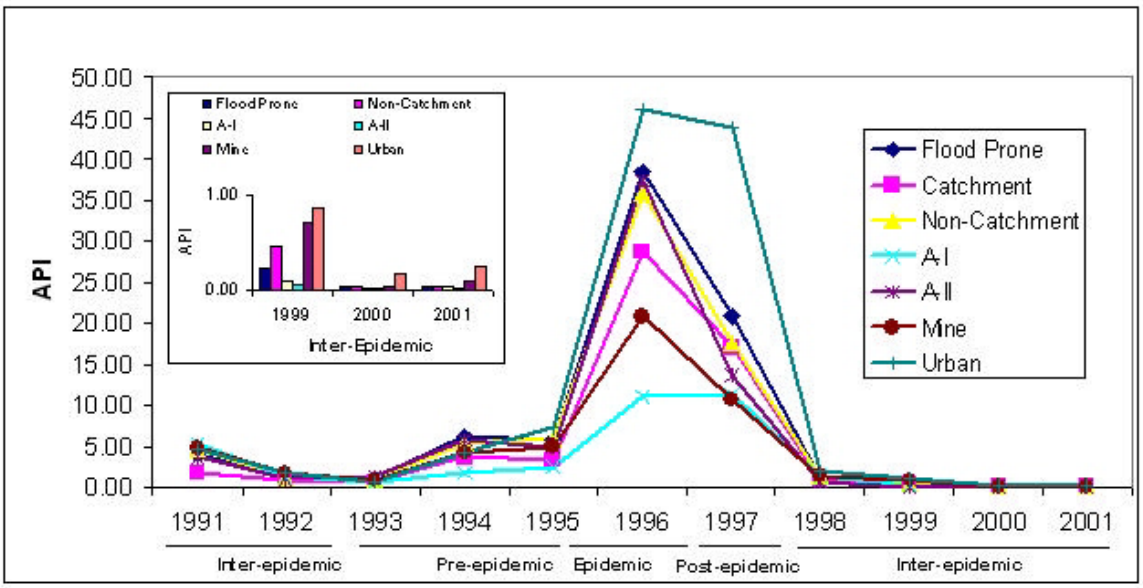


Fig. 12: Paradigm wise through different epidemic phases in Mewat (1991-2001).

SPATIO-TEMPORAL DYNAMICS OF MALARIA DURING 1991-2001 EPIDEMIC CYCLE

Spatio-temporal distribution map of malaria for the years 1991 to 2001 depicted spatial spread of various epidemic phases (Fig.13). The sections other then < 2 API were extracted for the years 1993 and 1998 and overlaid on paradigm maps to study eco_epidemiological profile of malaria during inter epidemic phase. It reveals that in 1993 and 1998, the years of similar malaria situation in the last two inter-epidemic period, flood prone paradigm, irrigation command area II and non-catchment retained active pockets of malaria transmission, amplification started in 1994-1995 (pre-epidemic phase) and engulfed all paradigms by 1996 (epidemic year).

Further, malaria was related to various other parameters and the following investigations were done.

Malaria today has occupied various ecological niches; its control requires a thorough understanding of spatial and temporal changes in vector abundance and disease. RS can help in quick data management and GIS can provide valuable information regar - ding distribution and interaction of disease risk factors, morbidity and mortality patterns and health resources allocation. RS and GIS empowers us to see the landscape in an entirely new spatial dimension. GIS is one of the few tools meeting the need of monitoring the distribution of a disease in space and time, therefore, GIS has an important role to play in the management of control of tropical diseases as it meets needs of prompt situation analysis in decision-making.

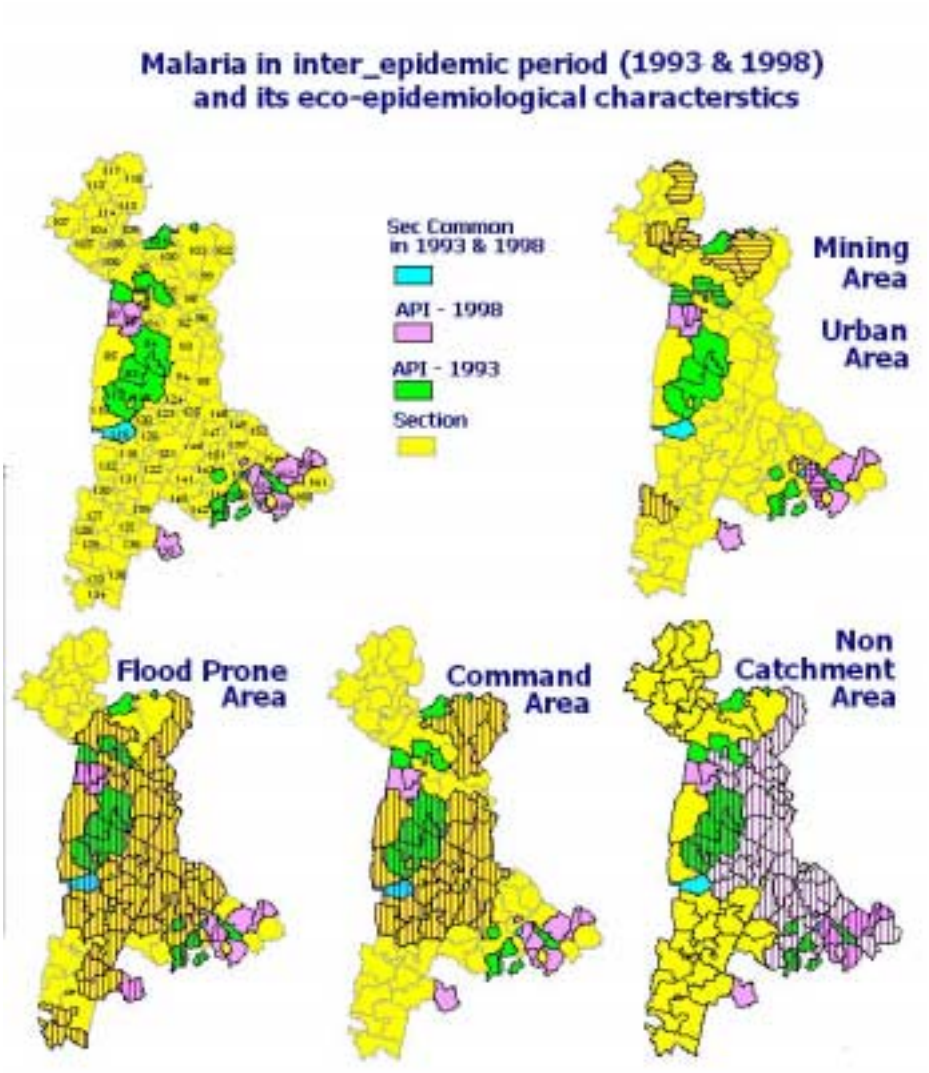


Fig. 13: GIS identifies malaria active sections during inter-epidemic period and their related paradigms. It reveals that active pocket confined to three paradigms namely Flood prone, non-catchment and Command area All.

ACKNOWLEDGEMENTS

The authors are highly grateful to Ms. Rekha Saxena, Senior Research Officer and Mr.Sanjeev Gupta, Programme Assistant for assisting in preparation of maps and analysis.

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NUTRITIONAL STATUS OF PRE-SCHOOL CHILDREN FROM LOW INCOME FAMILIES OF JABALPUR CITY

Brijlata Dubey[1], Smita Pathak[1] and Rajlakshmi Tripathi[1]

Abstract. *A comprehensive survey was carried out to assess the nutritional status of 150 pre-school children of 1 to 6 years from low-income families of Jabalpur city. The results of present study shows that dietary intake of nutrients was low in these children. About 17.3% of children were suffering from vitamin A deficiency; where as 24% of pre-school children were suffering from anaemia. The most common illness reported were cold, cough, fever and measles.*

INTRODUCTION

Children and their well being are basic concerns of every nation. Their health is not only an indicator to the socio-economic status and standard of living of the country but also reflects the values and beliefs of society. "A healthy good child is happiness to the parent, eternal joy to the mother, apple of eye of the family, leader of the community, thrill of the society and hope of the nation"[1.]

Children, our future citizens form an important segment of the Indian population. They contribute to the vital human potential and impart strength to the national economy and development. Better the nutritional status of the children, higher will be the nation's development. Therefore, their nutritional status is of great significance. Nutritional status of the children is also known to affect their physical and mental performance.

Nutrition in childhood is the basis for survival and good health in adulthood. Inadequate nutrition in childhood may lead to malnutrition, growth retardation, reduced work capacity and poor mental and social development[2.]

Malnutrition and vitamin A deficiencies are important public health problems among young children of socio economically backward families in many parts of the world. Several studies related to food and nutrient intake of population of poor socio-economical status have been carried out in rural and urban areas. However not much information is available on the dietary habits and nutritional status of young children. Hence the present study was undertaken to determine the dietary pattern and nutrient intake of the children under the age of 6 years residing in the low-income families of Jabalpur city.

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MATERIALS AND METHODS

150 Pre school children (1 to 6 years) of low-income families from different areas of Jabalpur city were selected at random for the present study. Survey was conducted by a house-to-house visit. Information was collected regarding socio-economical status, living conditions, income, age and education of parents, number of children, their age, height, weight and sex. A food frequency questionnaire was used to obtain a dietary pattern of the children. The information regarding the food, beverages and snacks consumed by the child was obtained by interviewing the child's mother. The dietary intake data of each child was calculated with the help of the tables of nutritive values of Indian foods and was compared with recommended daily intake for children by ICMR.[3,4]. Anthropometric measurements were recorded. Gomez classification, weight for age, was used for measuring the grades of malnutrition in children. Informations were collected about the health of the child from the records of municipal health center in the area, which included presence of any diseased condition, nature, duration and treatment of the disease.

RESULTS AND DISCUSSION

Occupation of the members of the selected families

The families surveyed in this study were selected at random from different areas of Jabalpur city. Some of these families were extremely poor and illiterates. Besides overcrowding, and poor environmental sanitation, these people have influence of urbanization in one hand and on the other hand follow rural practices, believe in superstition and showed ignorance in personal hygiene. Most of the people were labourer, working in factories or private services etc.

Pattern of the diet

Mostly missi roti (whole-wheat flour + chana flour chapati) with onion chutney was consumed in breakfast. Sometimes bread with tea was consumed. Rice with tuar or lentil dal was consumed. The vegetables like tomatoes, potatoes and green leafy vegetables like amaranth, spinach, lal bhaji were consumed in small quantities. Seasonal fruits like banana, guava jamun and mangoes were consumed occasionally. Soybean oil and groundnut oil were used as main cooking oil. Protein rich foods like eggs, milk and poultry foods were consumed occasionally, as such food items are expensive and these families cannot afford to purchase them.

Prolonged breast-feeding was the habit in these children. up to the age of 3 years, children were fed on breast milk. About 84% of the children up to the age of 2 years were on the breast milk and about 72.8% of the children between the age of 2-3 years were still breast fed. Supplementary feeding was started between the ages of 1 to 2 years. Locally available snacks like murmura, chana biscuits, bread or dal-rice formed the main supplement. Tradition, customs and availability in the house were found to determine the choice of these foods as supplements.

Many factors influenced the growth and development of the infants, most important being adequacy of milk. Since the women in these families were also not well nourished, children could not enjoy the benefits of prolonged breast-feeding and were found to be suffering from various deficiency diseases.

Dietary intake

The mean dietary intake of foodstuffs and nutrient of children from different age groups are presented in Table-1 & 2. The cereal consumption varied from 189 to 215g. depending on the age. The intake of staple foods (cereals and millets) were higher than the recommended dietary allowances of ICMR. The children in the age group of 1-2 years who still were breast fed mainly derived their nutrient content from the breast milk. After the age of 3 years the role of breast milk as a source of nutrient was negligible. The intake of protective food was found to be inadequate.

The dietaries of the 1-2 year old children contained predominantly cereals with least attention to the protective food items such as green leafy vegetables, other vegetables, fruits and milk. The target families though were flesh food eaters, by economic compulsion, included flesh foods only once a week. The cooking practices adopted by the mothers included discarding the excess water after cooking the cereals and vegetables and cutting the vegetables into very small pieces. Further, food taboos existed such as 'Hot' and 'Cold' foods. Majority of the children were having two meals in a day. Before going to school, they had breakfast, which comprised of tea and chapatti usually with pickle or vegetable. After coming back from school at about 2 p.m., some of them had some left over foods. The menu for the dinner was rice, dal with vegetables like potato and onion and was served very early (5-6 p.m.) and this appeared to be because of the unavailability of electricity. The important energy yielding foods, oils and sugars were low in the dietaries. Similarly the consumption of sugar and milk in small quantities was mainly in tea only. Consumption of green leafy vegetables by the children was low in general, although a variety of these including spinach, mustard leaves, fenugreek leaves and bathua were available at very low prices. Very few of them consumed leafy vegetables daily and majority did not consume because of their dislike and infrequent inclusion of the food item on family menus. Consumption levels of all other foodstuffs in both the age groups were less than the recommended level (Table-1). The caloric intake of children of 1-3 years of age group was 980kcal whereas in 4-6 age group it was 1380Kcal. The low caloric content of the diet was because of low sugar and fat intake as compared to RDA reported by ICMR 1989. It was observed that intake of nutrients were also lower than the RDA (Table-2). The cumulative effect of deficient diet might have affected the anthropometric measurements.. The overall deficit in weight in both age groups might be due to low intake of energy, protein,calcium and Vitamin A.

Table 1: Average (per cu/day) consumption of foodstuffs (g/ml) by the subjects

Foodstuffs (g/ml)							
Age Group (Yrs.)	**Cereals and Millets**	**Pulses**	**GLV**	**Other Vegetables, Roots and Tubers**	**Milk products**	**Fats and Oils**	**Sugar and Jaggery**
1 - 3	189	8	7	15	25	5	8
RDA*	175	35	40	30	300	25	30
4 - 6	215	15	12	25	20	8	10
RDA*	270	35	50	50	250	25	40

* Recommended Dietary Allowances, ICMR 1989

Table 2: Average intake of nutrients (cu/day) by the subjects

Nutrients									
Age Group (Yrs.)	**Calories (Kcal)**	**Protein (g)**	**Calcium (mg)**	**Iron (mg)**	**Vit-A (µg)**	**Thiamine (mg)**	**Riboflavin (mg)**	**Vit-C (mg)**	**Niacin (mg)**
1 - 3	980	20	135	7.5	216	0.42	0.56	5.2	12.5
RDA*	1240	22	400	12	400	0.60	0.70	8.0	40.0
4 - 6	1380	24	220	9.8	285	0.76	0.85	9.6	15.6
RDA*	1690	30	400	18	400	0.9	1.00	11.0	40.0

* Recommended Dietary Allowances, ICMR 1989.

Table 3: Percentage distribution of the subjects by Gomez classification

Gomez grades					
Age Group (yrs)	**No. Surveyed**	**Normal**	**Mild**	**Moderate**	**Severe**
1 to 3	88	9	61	30	Nil
4 to 6	62	11	68	21	Nil

Table 4: Percentage of deficiency and infections diseases among the selected children

Deficiency and Infections Diseases	No. of Surveyed Children (n=150)	Percentage (%)
Cold	22	14.7
Cough	29	19.3
Fever	19	12.7
Measles	07	04.7
Dental Caries	11	07.3
Anaemia	36	24.0
Vitamin A deficiency	26	17.3

Clinical status

The nutritional status of preschool, children in terms of weight for age profile (Table-3) showed a higher proportion of children in mild (61%) and moderate grades (30%) in 1-3 age group. Data indicated that 9% of preschool children (1-3 yrs) were found to be normal; 11% of children were normal while 68% in mild and 21% in moderate grades of malnutrition in 4 – 6 years age group.

Present study shows that among 150 children (1-6 years), 24% children were suffering from anaemia, 17.3% from vitamin A deficiency, whereas 7.3% suffered from dental caries and 4.7% were victims of measles. Other most common illness reported were cold, cough and fever (Table-4). Earlier workers reported similar findings.[5,6]. Sinha(1984) reported that about 37% children in I.C.D.S. area and 54.3% children in Non I.C.D.S. area had hemoglobin level less than 11%.[7]

CONCLUSIONS

The prevalence of malnutrition appears to be age related. The high prevalence of malnutrition among the children indicated that the foods consumed by these children were of poor quality or were inadequate to meet their growing needs. The reasons behind the widespread malnutrition could be ignorance, illiteracy and poor eating habits and inadequate nutrient intake. The major determinant of the nutritional status of these children were age, household income, number of children in the family, duration among hem, education of the parents, poor personal hygiene, unsatisfactory environmental conditions and poor sanitary facilities. Consumption of protective foods is inadequate. Even if these foods are available, poverty or purchasing power of the community is a limiting factor. It is concluded that nutrition education plays a major role in improving the nutritional status of vulnerable groups in developing countries like India.

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AWARENESS AND ADOPTION OF FAMILY PLANNING AMONG SANTALS

(A STUDY IN JHARGRAM BLOCK OF MEDINIPUR, WEST BENGAL)

Swagata Gupta[1] and Rama Deb Roy[1]

Abstract. *'Awareness of family planning' and 'methods adopted for controlling Childbirth' are two basic indicators of the reproductive health consciousness of mothers. These two factors are related with some socio-economic and demographic characteristics like age, economic status, educational level, occupational pattern and the number of children of mothers. The present paper is prepared to compare this health consciousness of Santal and Non-santal mothers living in five villages of Jhargram Block of the District of Medinipur in West Bengal. On the whole, 63.6 percent Santal and 87.0 percent Non-santal mothers have awareness on family planning. The family planning methods have been adopted by 45.0 percent Santal mothers among whom 70.0 percent have gone for complete sterilisation through tubectomy. In the Non-santal group 76.9 percent mothers have adopted family planning methods and 78.3 percent of them had complete sterilisation. For improving the situation it is necessary to educate and motivate the people particularly the santal mothers towards utility of family planning methods and at the same time it is also necessary to strengthen the existing govt. health facilities in the locality.*

INTRODUCTION

Awareness of family planning and methods adopted for controlling child birth are two basic indicators of the general health consciousness of mothers. 'Awareness' is related here with 'knowledge about usefulness of family planning method'. These two basic factors are somehow related to a large extent with the socio-economic background of the mothers where do they belong. A demographic study on minor population group is very important in the present context. The minority group considered in this study, 'Santal' is a major tribe in West Bengal. According to the Census of 1991 they constitute 53 percent of the total tribal population in West Bengal and 65 percent in the Medinipur District[1]. An attempt has been made to draw a comparative picture with

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other 'Non-Santal'[a] group of population living together in the same villages. Keeping in mind the basic objective of this study, five representative villages on the basis of proportionate content of Santal and other tribal and non-tribal population were chosen from the list of villages of the 1991 Census of West Bengal. Four villages under the Integrated Tribal Development Project (ITDP) where more than 50 percent are tribal population, were included in the sample[b]. The relevant social and economic characteristics considered in the present study are the age, economic status, educational level, occupational pattern and the number of children of the mothers. An attempt has been made in the present paper to compare health care practices followed by the santal and the non-santal mothers in Jhargram Sub - division of the district of Medinipur in West Bengal. Currently available studies on the tribes of West Bengal have been thoroughly examined to look in to the similar theme. But this particular subject of study was less availed and thus left enough scope for an intrusion in the field[2].

METHODOLOGY AND DATA

This is a case study based on the empirical analysis of the statistical information on the behavioral patterns of mothers towards their own health care practices. The data set has been prepared on the basis of information collected by interrogating 129 santal and 108 non-santal mothers in the age group of 15-49 on a complete enume-raion basis in five villages of the Jhargram Block of the Medinipur district during 1997-98. It may be mentioned that 90.7 percent mothers are currently married, 8.5 percent are widow and 0.8 percent are separated in the Santal group while the corresponding figures in the Non-Santal group are 92.6 percent, 6.5 per cent and 0.9 per cent respectively.

For analytical purposes mothers have been classified into three broad age groups. Their economic status has been classified into three categories such as 'very poor', 'poor' and 'not poor' on the basis of per capita monthly consumption expenditure of the households where they belong. 'Very poor' mothers live in the households where monthly per capita consumption and expenditure is up to Rs. 299 only. Similarly, 'poor' mothers and 'not poor' mothers are in the households where monthly per capita consumption expenditures are Rs.300-599 and Rs.600 and above respectively. In order to examine the literacy rate mothers have been divided into two groups - illiterate and literate. Mothers who cannot read and write and those who have no formal or below primary level of education have been classified as 'illiterate'[c]. Mothers who have passed 'primary' level and above, have been classified here as 'literate'. Similarly, when occupation is considered, mothers have been divided into two broad groups as 'workers' and 'non -workers'. Further mothers have been grouped into three classes based on number of children - such as one child, 2-3 children and 4 or more children[3].

Using ratio method interrelationships between the above two health indicators of mothers and the social and economic characteristics have been determined to have a comparative analysis of the Santal and the Non-Santal mothers.

RESULTS AND DISCUSSION

Distribution of mothers having awareness and adopting methods of family planning (both currently using and ever used mothers) by socio-economic characteristics in five villages of Medinipur District has been presented (Table.1). As a whole, 63.6 percent Santal and 87 percent Non-Santal mothers have awareness of family planning. According to the NFHS-2, this awareness level is much higher for the state of West Bengal as a whole. About 99 percent of the currently married women seem to know at least one modern family planning method. The family planning methods have been adopted by 45 percent Santal mothers, among whom 70.7 percent have gone for complete sterilisation through tubectomy (Table.2). In the Non-Santal group 76.9 percent mothers have adopted family planning methods and among them 78.3 per cent had complete sterilization. The bracketed figures in Table 1 show the percentage shares of total number of mothers undergoing tubectomy for complete sterilization. In a similar comparison with the state level data shows that 67 percent married women in West Bengal use some family planning method. Although the use of family planning methods does not vary widely among socio-economic groups at the state level, it seems that in the rural area the difference between Santals and Non-Santals is a remarkable one and that the shares of both of awareness and family planning methods adopting mothers are more among Non-Santals than among Santals. In both the groups the most common family planning method chosen by mothers is complete sterilization. The state level corresponding figure is 32 percent[4].

Mothers have been classified into three age groups, 15-24, 25-29, 40-49 and it is seen that mothers in all the age groups are aware of family planning and they also adopt family planning methods both among Santals and Non-Santals. It must be pointed out that Non-Santals mothers in all the age groups are more advanced both in awareness level and using family planning methods including complete sterilization (tubectomy).

Following the criterion of economic status it is observed that in the 'very poor' group 51.4 percent Santal and 80.4 percent Non-Santal mothers are having awareness of family planning. In the 'poor' group 57.1 percent Santal and 89.5 percent Non-Santal mothers have awareness of family planning. And, in the 'not poor' class 80 percent Santal and 93 percent Non-Santal mothers have awareness of family planning. It is, therefore, seen that awareness of family planning increases with increase in economic status in both the groups and in all

Table 1: Distribution of mothers having awareness and adopting methods of family planning by some socio-economic characteristics

Items	Number		Awareness(%)		F.P. method adopted (%)	
	Santal	Non-Santal	Santal	Non-Santal	Santal	Non-Santal
Age group						
15-24	23	20	56.5	75.0	13.0(4.3)	60.0(35.0)
25-39	85	66	69.4	95.5	55.3(41.2)	83.3(72.7)
40-49	21	22	47.6	72.7	38.1(23.8)	72.7(45.5)
Economic status						
Very poor	35	46	51.4	80.4	42.9(31.4)	63.0(52.2)
Poor	49	19	57.1	89.5	38.8(26.5)	89.5(68.4)
Not poor	45	43	80.0	93.0	53.3(47.8)	86.0(65.1)
Literacy						
Illiterate	93	55	57.8	81.7	45.1(35.3)	66.7(53.3)
Literate	36	53	85.2	93.7	44.4(18.5)	89.5(68.7)
Occupation						
Worker	100	65	63.0	84.6	44.0(31.0)	70.8(60.0)
Non-worker	29	43	65.5	90.7	48.3(34.5)	86.1(60.5)
No. of children						
1	19	9	42.1	77.8	10.5(0.0)	22.2(0.0)
2-3	59	72	74.6	90.3	49.2(39.0)	84.7(65.3)
4+	51	27	58.8	81.5	52.9(35.8)	74.1(66.7)
Total	129	108	63.6	87.0	45.0(31.8)	76.9(60.2)

Note : The bracketed figures in the above table show the percentage shares of total mothers undergoing tubectomy for complete sterilisation.

economic classes the shares of Non-Santal mothers are remarkably more than those of the Santal mothers.

It is again observed that 42.9 percent Santal mothers in the ‘very poor’ group adopt family planning methods of which 73.2 percent have undergone tubectomy. In this economic class 63 percent Non-Santal mothers adopt family planning methods of whom 82.9 percent had gone for complete sterilization. In the 'poor' group 38.8 percent Santal and 89.5 percent Non-Santal mothers adopt family planning methods of which 68.3 percent and 76.4 percent are respectively tubectomy cases. In the 'not poor' group 53.3 percent Santal and 86 percent Non-Santal mothers use family planning methods. Here also the share of Non-Santal mothers is much higher than that of the Santal mothers. Tubectomy cases in this economic class are 89.7 percent for Santal mothers and 75.7 percent for Non-Santal mothers.

If the level of education of mothers is considered, it is evident from the table that both literate and illiterate Santal and Non-Santal mothers are aware and they adopt methods of family planning with some variations in the shares. In both the communities quite naturally, the percentage share of literate mothers having awareness is more than that of the illiterate mothers. In the literate group 85.2 percent Santal and 93.7 percent Non-Santal mothers are aware of family planning. The corresponding figures for illiterate mothers are 57.8 percent and 81.7 percent respectively. Among Santals the percentage share of literate mothers using family planning methods, however, is less than that of the illiterate mothers, the percentage shares being 44.4 percent and 45.1 percent respectively. Another significant point to note here is that among the literate Santal mothers adopting family planning methods 41.7 percent have undergone tubectomy while the corresponding share of the illiterate mothers is 78.3 percent. In case of Non-Santal mothers a close relation between literacy and methods adopted for family planning is observed - among literate mothers 89.5 percent adopt family planning methods, which comes down to 66.7 percent for illiterate mothers. It is found that 76.8 percent literate and 79.9 percent illiterate Non-Santal mothers using family planning methods have gone for complete sterilisation. If a comparison is made between mothers of Santal and Non-Santal communities it is evident that both for literate and illiterate groups Non-Santal mothers are more advanced in all respects than the Santal mothers.

Mothers' occupation has also been related with their awareness and family planning methods adopted for birth control. It is seen that in both the groups the share of non-working mothers is higher than that of the working mothers both for awareness and methods adopted for family planning. Among Santals, 63 percent working mothers are aware and 44 percent mothers adopt family planning methods of whom more than 70 percent opted for complete

sterilisation. In the non-working group 65.5 percent mothers are aware and 48.3 percent mothers adopt family planning methods with a share of 71.4 percent mothers undergoing tubectomy. Among Non-Santals 84.6 percent working mothers are aware and 70.8 percent mothers adopt family planning methods of whom 84.7 percent had tubectomy. In the non-working group 90.7 percent mothers are aware and 86.1 percent adopt family planning methods with a share of 70.3 percent tubectomy cases. It is, therefore, observed that the shares of Non-Santal mothers with respect to awareness and adoption of family planning methods are higher for both working and non-working groups than those of the Santal mothers.

When number of children is related with mothers' awareness and methods adopted, the following observations were recorded. Among Santals 42.1 percent mothers with one child are aware and 10.5 percent mothers adopt family planning methods and none of them has gone for complete sterilization. In the same group among Non-Santals 77.8 percent mothers are aware and 22.2 percent mothers adopt family planning methods. Here also no mother has undergone tubectomy. In the next group of mothers having 2-3 children, 74.6 percent are aware and 49.2 percent mothers adopt family planning methods among whom 79.3 percent had tubectomy among Santals. Amongst Non-Santal mothers in the same group 90.3 percent are aware and 84.7 percent adopt family planning methods with a share of 77.1 percent having tubectomy. In the group of mothers with 4 or more children 58.5 percent among Santals are aware and 52.9 percent adopt family planning methods with 67.7 percent tubectomy cases. In the Non-Santal community the figures for aware and family planning methods adopting mothers are 81.5 percent and 74.1 percent respectively. The share of mothers having tubectomy is 90 percent for this group of mothers adopting family planning methods. Here also the Non-Santal mothers seem to be more advanced than the Santal mothers. It may be mentioned here that Santal mothers' awareness level and share of adopting family planning methods are less than those of the non-Santal mothers due to the fact that Santal mothers do not adopt family planning methods to a considerable extent because of their superstitions and prejudices; many of them believe that they can't worship if they undergo complete sterilization. Parents' desire for one and more male child also plays an important role in keeping mothers having 4 or more children from adopting any family planning method.

A percentage distribution of mothers using different types of family planning methods has been presented in Table-2. Majority of mothers adopting family planning methods in both the Santal and the Non-Santal groups use modern family planning methods like contraceptive pills, IUD and female sterilization, the percentage shares being 86.2 and 90.4 respectively. The most popular method, however, is

complete sterilization of females by tubectomy - 70.7 percent Santal and 78.3 percent Non-Santal mothers adopting family planning methods have gone through this method. This occurs mainly due to the fact that in most of the cases relatives and health workers either force or convince mothers to have legation after 2/3 childbirths. The level of self-motivation is still very low and superstitions and prejudices regarding use of family planning methods still play a vital role among them.

Finally, let us examine the causes of non-using family planning methods by Santal and Non-Santal mothers (Table-3). The main causes are the following -misconception, ignorance, do not find any necessity, demand for more children, demand for a male child, ill health and willing to adopt method in near future. In this group of mothers 80 percent among Santals are either ignorant or desire to get more children while corresponding figures for Non-Santal mothers is 73 percent. Illiteracy may be designated as the main reason of 'misconception' and 'ignorance' criterion. Among Santals 75 percent and 50 percent Non-Santal mothers who have misconception are illiterate. Similarly in case of mothers who have ignorance about family planning methods 90 percent among Santals and all in Non-Santal groups are illiterate. 'Demand for more children' Is another important factor for not using any family planning method. Seventeen Santal and 10 Non-Santal mothers do not adopt any method because they desire more children. In the Santal group 65 percent among them have one child, 29 percent 2 children and 6 percent 4 children. In the Non-Santal group 50 percent have one child and 50 percent 2 children. Similarly, 'demand for a male child' has also a role to keep mothers away from using family planning methods. In the present study 9 Santal and 2 Non-Santal mothers are grouped by this criterion. Nearly 90 percent Santal mothers of this group have only girl child/children, but the rest 10 percent likes to get one additional son in spite of having earlier one. Non-Santal mothers in this group have no male child.

CONCLUSIONS

To conclude the discussion, it may be mentioned that during last two decades a special emphasis was given by the Government of India to spread education among all. National policies were also formulated to make people conscious about family planning and its implications. Education by itself has an important impact on the understanding of many of the problems including health. These policies are being implemented in the rural sector through government functionaries of Gram Panchayats, Local Hospitals and Health Centres etc. Sometimes people are also expected to be motivated by publicity through media and the advises of the health workers. But in general terms, it may be said that, in this part of the

Table 2: Distribution of Santal and Non-Santal mothers using different kinds of family planning methods

F. P. method used	Number		Percentage	
	Santal	Non-Santal	Santal	Non-Santal
Total	58	83	100.0	100.0
A) Any modern method	50	75	86.2	90.4
i) Pill	7	7	12.1	8.4
ii) IUD	1	1	1.7	1.2
Iii) Female sterilization	41	65	70.7	78.3
iv) Male sterilization	1	2	1.7	2.4
B) Any traditional method	8	8	13.8	9.6
i) Herbs and roots	4	-	6.9	-
ii) Rhythm / safe period	4	8	6.9	9.6

Table 3: Distribution of Santal and Non-Santal mothers not using any family planning method

Reason for not using any method	Number		Percentage	
	Santal	Non-Santal	Santal	Non-Santal
Total	71	26	100.0	100.0
Misconception	8	2	11.3	7.7
Ignorance	31	7	43.7	26.9
Widow/separated	5	2	7.0	7.7
Demand for more children	17	10	23.9	38.5
Demand for a son	9	2	12.7	7.7
Ill health	-	2	-	7.7
Willing to adopt later	1	1	1.4	3.8

state of West Bengal mothers of both the groups of Santals and Non-Santals have not yet become much conscious about their health care. They are mostly illiterate and engaged in agriculture and allied services earning very poor income. A positive relation of their health consciousness with education and a negative relation with occupation have been revealed from the present study. The positive relation with education is sufficiently justifiable. Negative relation with occupation may be due to the fact of earning very low income with much labour. The condition of non-working mothers is better than that of the working mothers both socially and economically so that they may afford more time and money in the direction of health care for themselves. Due to low literacy rate and social and economic backwardness Santal and Non-Santal mothers do not follow adequate health care practices available within their reach. A striking fact noticed here is that the mothers are not at all aware of using condom or birth control. There is only one health centre in Dakshinsol and it seems that regular visits of the health worker are helpful to feel mothers about their motherhood. It may, therefore, be suggested that besides motivations they should identify the actual need for family planning methods / services and also arrange to supply those at their easy reach.

NOTE

a. Non-Santal community includes other tribes - Lodha, Bhumij and O.B.C. and other Upper Hindu Castes.

b. Keshiya (J.L.No.-734) -fully Santal, Krishnagar (J.L. No. - 404) - 75% Santal, Dubrajpur (J.L. No.- 733) - 65% Santal, Uttarsol (J.L. No. - 420) - 62% Santal and Dakshinsol (J.L. No. - 425) - 17% Santal.

c. Although some of them attended school for 1/2 years, they declared that they are unable to read or write anything.

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COMPARATIVE STUDY BETWEEN TRIBAL AND NON-TRIBAL SPORTS-PERSON OF CHHATTISGARH RELATED TO THEIR MOTOR FITNESS

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Abstract. *Present study has been aimed to identify the difference of motor fitness between tribal and non-tribal sports person. 150 tribal boys (Av. age 15.53 yrs) and 150 non-tribal boys (Av. age 15.26 yrs), 150 tribal girls (Av. age 15.34 yrs) and 150 non-tribal girls (Av. age 14.02 yrs) are selected as sample. All tribal samples are selected from Krida Parisar of Chhattisgarh state. Modified JCR motor fitness test prepared by Cooper (1965) was administered to each subject. Results revealed that both tribal boys and girls were having significantly high speed and agility ($p<0.01$). In vertical jump tribal boys were superior ($p<0.01$). No difference was found on this dimension in tribal girls and non-tribal girls. Regarding chin-up tribal boys showed significantly more strength compared to non tribal boys ($p<0.01$), but surprisingly non-tribal girls were superior in chin-up item compared to tribal girls. Results indicated that tribal boys and girls were much more fit than non-tribal boys and girls in motor fitness.*

INTRODUCTION

Motor fitness refers to that neuro-muscular condition that permits strenuous work; the basic components of motor fitness being such factors as strength-primarily as muscular endurance, speed, agility, endurance, power and flexibility. It entails the basic elements of vigorous physical activity. The term "motor fitness" came into being during World War II to describe that condition that (1) involved more muscular strength and muscular strength as well as systemic endurance (the three aspects that represent the basic connotation of physical fitness) but (2) did not encompass more than basic body coordination and fundamental skills (characteristics of motor abilities and performance tests, such as hand-eye or foot-eye coordination, or balance). Generally tests designed as physical fitness tests are actually tests of motor fitness. Physical fitness is generally used to refer to the functional capacity of the individual for a specific task or mode of living. Motor fitness might be conceived as physical fitness in action involving basically fundamental skills.

Thus motor fitness adds to the components of physical fitness, namely, muscular strength and endurance and cardiovascular function the factors of speed, agility, power and

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flexibility. For clarification purposes these 'additives' are defined as: speed - rapidity of movement to accomplish a specific task, such as: the 50 -yard dash; agility - ability to change, both rapidly and accurately, the position or direction of the body through large ranges of movement; power (muscular or explosive) - exertion of maximum muscular force in the shortest possible time interval to accomplish a specific task, composed of both speed and strength; and flexibility - extent of the range of movement of articulating body segments about a joint which is specific to that joint and generalizable only as a profile of the specific joints measured.

So conceived, motor fitness encompasses efficient performance under demanding conditions in lifting, carrying, climbing, running, dodging, jumping and swimming. As an area of measurement, motor fitness represents an important consideration of overall appraisal, namely, the functioning of the individual that is fundamental to all physical activity.

Sports scientists and physical educators made an attempt to see the relationship of motor fitness with different sports event[1-3]. Some studies are related with the body shape and size, and its impact on motor fitness tries to see the relationship of motor fitness with anthropometric measurement.[4-8]

Motor fitness is an important factor, which affect performance of player during competition. In present study attempt has been made to make comparison between tribal and non-tribal sports persons.

SAMPLE

150 tribal boys (Av. age 15.53 yrs) and 150 non-tribal boys (Av. age 15.26 yrs); 150 tribal girls (Av. age 15.34 yrs) and 150 non-tribal girls (Av. age 14.02 yrs) were selected for the study. All tribal samples were taken from the Krida Parisar of Chhattisgarh State and non-tribal samples collected from various parts of the Chhattisgarh State. All the 600 samples were engaged with different sports events. The distribution of samples along with their events has been presented in Table 1.

TOOLS

To measure motor fitness following components namely speed, agility and strength are assessed by Cooper (1965) test.[9] It is modified version of JCR test. To measure speed and agility shuttle run (100 yards), strength by using chin-ups and explosive strength by vertical jump were used. The tests are highly valid and reliable.

PROCEDURE

To conduct this study all three events were administered to each sample one after another with sufficient rest between each item. For measuring agility and speed, the 100 yard shuttle run was conducted. Subject had to cover 20 yard course in 5 times. It was counted nearest in seconds. The second item was chin-ups for measuring arm and shoulder strength. In this item subject had to hang on bar with overhead grip in a straight

position. He had to pull up his body in upward direction without swing till the chin reaches above the bar height. Subject had to perform it repeatedly without any rest. The successful chin up was counted in numbers. After giving complete rest in between each test item, the subject was asked to perform next event i.e. vertical jump, which measures explosive strength. In this item the marking was made on wall in centimeters. Initially the subject had to put chalk powder on tip of his fingers and, he had to stand close to the wall and he had to put mark on the wall as high as possible without raising heels. After that he had to take jump in vertical direction and try to reach as high as possible and put mark on the wall. The difference between high and low mark by the subject was counted in centimeters. These three items exhibited motor fitness of the subjects.

ANALYSIS AND INTERPRETATION

Data collected from all the 600 samples was analysed with the help of t-test to identify motor fitness between the groups. Results are presented in Table-1, 2 & 3. The first component was shuttle run, which measures speed and agility. Tribal boys showed higher speed and agility (m = 27.35) compared to non-tribal boys (m = 29.39) and the difference is statistically significant (Fig.1). In vertical jump tribal boys showed (m=39.64) significantly more ability to jump (explosive strength) as compared to non-tribal boys (m=34.83).The third component of motor fitness was chin-up to measure arms strength. In comparison, it was found that significantly tribal boys (m=7.80) showed more strength compared to non-tribal boys (m=4.98) (Fig.1).In girls section surprisingly 40 tribal girls and 25 non-tribal girls scored 'zero' (0) in chinup item. Therefore it was decided that shuttle run and vertical jump comparison would be done with only those subjects who scored '0' in chinups. Results showed by these groups in shuttle run revealed that tribal girls were significantly faster ($p<0.01$), (M=32.28) than the non-tribal players (M=38.82). The t-value of 12.12 showed that tribal players were superior in terms of speed and agility. In Vertical jump, tribal and non-tribal groups belonging to this group did not show any difference. (t=1.66)

Remaining 110 tribal girls and 125 non-tribal girls were compared on 3 items of motor fitness. In chin-ups surprisingly non-tribal girls (M=1.84) significantly showed more strength than the tribal girls [$p<0.05$](M=1.58). But no significant difference was found in vertical jump among tribal and non tribal girls. In shuttle run tribal girls showed that they were much faster (M=32.47 seconds) than the non-tribal girls (M=35.64 seconds).

RESULTS AND CONCLUSION

Tribal sports person (boys) were superior in term of motor fitness. They had shown their superiority in all the components of motor fitness i.e. shuttle run (Speed and agility), chin-ups (arms and shoulder strength) and vertical jump (explosive strength) compared to non-tribal sports person. Results revealed that the group of girls who scored 'zero' in chin-ups (arms

Table 1: Comparison of motor fitness among tribal and non-tribal boys

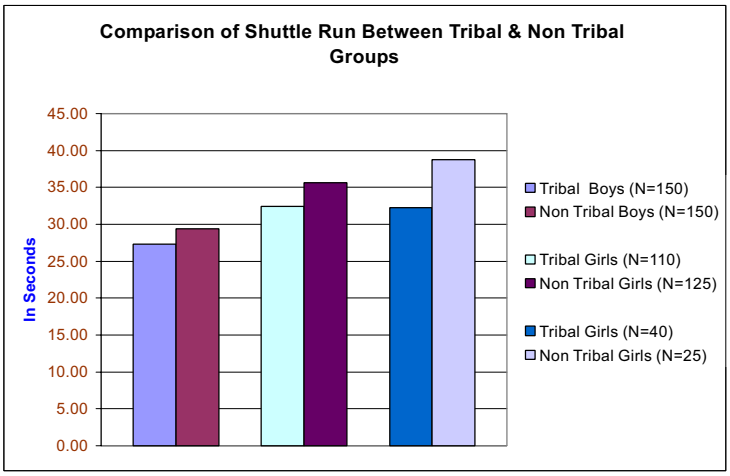
Characters	Tribal Boys(N=150)	Non-Tribal Girls(N=150)	t-value	Level
Shuttle Run (In Seconds)	27.35±1.65	29.39±2.94	7.34	0.01
Vertical Jump (In Centimeters)	39.64±9.64	34.83±9.04	4.46	0.01
Chin up (In Numbers)	7.80±4.28	4.98±4.77	5.40	0.01

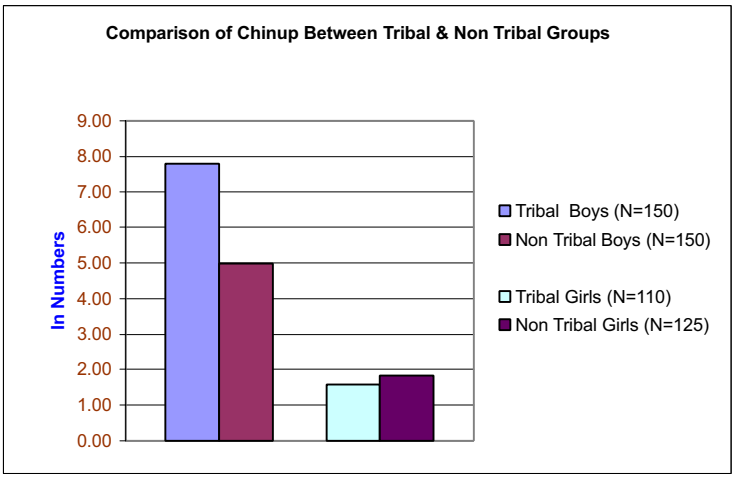
Table 2: Comparison of motor fitness among tribal and non-tribal girls (cases who scored 'zero' in chin-ups)

	Tribal Girls(N=40)	Non-Tribal Girls(N=40)	t-value	Level
Shuttle Run (In Seconds)	32.28±1.96	38.82±2.20	12.12	0.01
Vertical Jump (In Centimeters)	27.75±5.08	26.12±2.83	1.66	NS

Table 3: Comparison of motor fitness among tribal and non-tribal girls

	Tribal Girls (N=110)	Non-Tribal Girls (N=125)	t-value	Level
Shuttle Run (In Seconds)	32.47±2.09	35.64±2.74	10.03	0.01
Vertical Jump (In Centimeters)	27.72±5.23	28.60±5.01	1.31	NS
Chin up (In Numbers)	1.58±.96	1.84±.88	2.20	0.05


Comparison of Shuttle Run Between Tribal & Non Tribal Groups
In Seconds
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Tribal Boys (N=150)
Non Tribal Boys (N=150)
Tribal Girls (N=110)
Non Tribal Girls (N=125)
Tribal Girls (N=40)
Non Tribal Girls (N=25)


Comparison of Chinup Between Tribal & Non Tribal Groups
In Numbers
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Tribal Boys (N=150)
Non Tribal Boys (N=150)
Tribal Girls (N=110)
Non Tribal Girls (N=125)

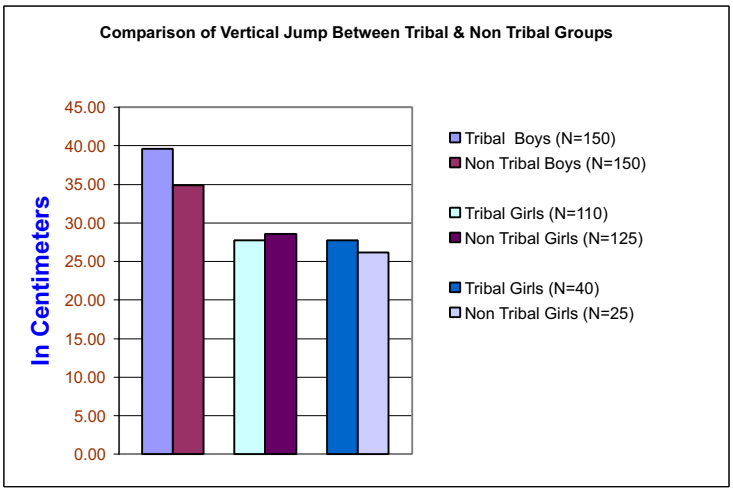

Comparison of Vertical Jump Between Tribal & Non Tribal Groups
In Centimeters
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Tribal Boys (N=150)
Non Tribal Boys (N=150)
Tribal Girls (N=110)
Non Tribal Girls (N=125)
Tribal Girls (N=40)
Non Tribal Girls (N=25)

Fig. 1

and shoulder strength), tribal girls showed more magnitude in speed and agility but no difference was found in vertical jump item (explosive strength). Among the girls who were remaining after eliminating 'zero' scored group, remaining tribal girls showed their superiority in shuttle run. But non-tribal girls were superior in chin up item i.e. arm strength. Tribal and non-tribal girls did not show any difference in vertical jump item in this group.

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DEMONSTRATION OF MALARIA CONTROL BY THE USE OF DELTAMETHRIN TREATE D CURTAINS IN NATIONAL THERMAL POWER CORPORATION, DADRI,GAUTAM BUDH NAGAR, (U. P.)

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Abstract. *A field trial was conducted in selected residential blocks of National Thermal Power corporation (NTPC) Dadri, Gautam Budh Nagar to demonstrate malaria control by using deltamethrin treated curtains @ 100 mg/m$^{2.}$ Results revealed drastic reduction in adult density of An. culicifacies in the experimental block($p<0.05$).Deltamethrin treated curtains also reduced the densities of non -target species such as Mucosa domestica. Gryllus sps. Cx. Quinquefasciatus and also other anopheline mosquitoes. Bioassay results revealed that treated curtains did produce 100% mortality of An. Culicifacies up to 5-6 months followed by sharp decline in successive months. Use of deltamethrin treated curtains resulted a considerable reduction in the slide positivity rate (SPR) and cases /000. The study revealed that insecticide treated curtains provide cost-effective control of malaria in the project area.*

INTRODUCTION

Industrial malaria is a serious problem in India. During the construction phase of the industrial project large number of excavation activities, man-made habitats for water storage, immigration of labour population from malaria endemic areas result in increase of mosquitogenic and malariogenic conditions in and around the project construction area. The parasite load in the community gradually increases with the persistent transmission of malaria and results in epidemics; and also inadequate infrastructure and insufficient mosquito mitigation measures further worsen the situation and results in high morbidity and mortality due to malaria. All these factors contribute to enormous loss in production and also economic loss. Malaria spurge has been reported in industrial townships and project areas especially during the construction phases in National Thermal Power Project at Shakthi Nagar[1], Mathura Oil Refinery, stone quarry areas in Allahabad, U.P. [2], steel plant at Vizag, A.P. [3] and two mining areas in Orissa[4]. National Thermal Power Corporation (NTPC), Dadri located on the command area of upper Ganga canal had also experienced the problem of malaria. This project was

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entrusted to generate about 1200 MW power to cater the need of Delhi and Uttar Pradesh states. The project was become operational in 1991 and the construction phase was started in 1989 and completed in 1992 in Dadri, Gautam Budh Nagar resulting in the congregation of enormous labour foci from malaria endemic states such as Orissa, Tamil Nadu, Assam, Rajasthan etc. Large excavation of land during construction phase has created enormous breeding places of *An. Culicifac*iies since there was no in-built provision for migration measures. Therefore, malaria incidence in migrant population of core project staff and particularly in labour population started increasing sharply and reached to epidemic form. Intervention measures comprising of anti-larval focal spray and ULV fogging did not provide any dent and the annual parasite incidence (API) jumped to more than 300. Project Health authorities have approached us to develop strategic action plan using new technologies to protect core project staff from malaria. In view of this a field trial was carried out in selected blocks of the campus using insecticide treated curtains. Results of this trial are reported in this paper.

MATERIALS AND METHODS

Study site

The thermal power plant is situated in Dadri Primary Health Centre of erstwhile District Gaziabad in 1988. The project is located at about 40 km south east of Delhi in the command area of upper Ganga canal in an area of about 2224.5 acres. The initial population of the project staff was 7000 but increased up to 12000 in 1992. All houses in the campus were concrete structures ranging from one bedroom to 4 bedrooms and drawing and dinning. All inhabitants of houses were using curtains on windows and doors to protect from sunlight and for privacy. The labour population was also migratory and majority of them were from malaria endemic states such as Orissa, Assam, Tamilnadu and Rajasthan who resettled in outskirts of the campus. .Deltamethrin formulation (2.8%EC) used for treatment of curtains was obtained through the courtesy of Hoechst Agro Evo.India Ltd.(Mumbai,India).

The experiment was conducted in A and D types of staff quarters merely comprising Executive Officers. Block A&D comprising 257 quarters (experimental) with a population of 1560. Block B comprising 280 quarters with a population of 1800 was taken as a control where inhabitants used untreated curtains. Temperature and relative humidity were variable in each season. In summer, temperature ranged from 38-44^0 C with 40-60% relative humidity. The temperature was 25-35^0 C during the monsoon season with relative humidity of 80-90%. In winter temperature was extremely low (5-20^{0}C) with 60-70% relative humidity. Inhabitants of both experimental and control blocks were briefed about the new technique and they were also requested to cover their windows and doors with treated curtains for about one hour during the dusk dawn and they were instructed

not to wash curtains. Curtains were treated with deltamethrin @ 100 mg/m^2 on both sides with the help of stirrup pumps from July 25,1994 to 1st August 1994. The total treated area of curtains installed on doors and windows was measured to be about 11692.5 sq. m.

Entomological evaluation

Densities of indoor resting mosquitoes were monitored fortnightly before and after the impregnation of curtains. Target mosquitoes were collected by hand catch and non-target species by aerosol spray. Collected specimens were identified in the laboratory and the percent reduction was calculated by the following formula -

$$\text{Percent reduction} = \frac{\text{Control treated X100}}{\text{Control}}$$

Bioassay test

The efficacy of deltamethrin was tested in the laboratory by exposing groups of laboratory reared *An. culicifacies and Cx. Quinquefasciatus.* Mosquitoes (n=100) were exposed for fifteen minutes and the mortality was recorded after 24 hours as per WHO procedure. Corrected mortality was calculated as per Abbott's formula[5].

Epidemiological evaluation

Epidemiological evaluation was carried out by weekly door-to-door surveillance. All blood smears of fever cases were examined for malaria parasites. All malaria positive cases were given radical treatment as per NAMP schedule.

RESULTS

Entomological evaluation

Impact of treated curtains on target species: Month-wise man-hour densities of target mosquito, *An. Culicifacies*, the principal vector in the NTPC campus are depicted in Table 1 and the percent reduction of *An. Culicifacies* is shown in Fig 1. It is clear from the table and graph that before the introduction of treated curtains in the experimental area the man-hour densities were higher than that of the control village. The av. man-hour density of *An. Culicifacies* before treatment was 35.7 as against 28.4 in the control area. The deltamethrin sprayed curtains resulted in drastic reduction in the MHD of An. Culicifacies in successive months and the percent reduction in adult densities were 100% upto 8 months in the experimental area (Fig.1) as against variable degree of MHD of *An. culicificies* recorded in the control area. *An culicificies was* recorded every month in the control area.

Impact of treated curtains on non-target species: The average density per structure of mosquitoes and domestic insects in the control and experimental areas is presented in Table 2. It was interesting to note that considerable reduction in the density per structure of non-vector species was also observed in case of total anophelines. *Cx. Quinquefasciatus,* total mosquitoes, *Musca domestica*

Table 1: Man-hour density in experimental and control blocks

Month/Year	*An.culicifacies*		Total anophelines	
	E	C	E	C
Pre-treatment				
Jan 94	10±1.6	6±1	13±0.5	8±1.2
Feb	15±1.5	12±1	18±1.0	13±1.3
March	30±2	20±2	38±2.2	25±1.3
Apr	56±3	42±3	71±4.5	50±2.2
May	60±5	48±4	82±5.5	63±3.3
Jun	43±1.5	32±4	84±0.2	67±6.1
July	48±4	39±0.5	131±6	72±3.8
Av.	35.7±2	28.4±11.5	62.4±1	42.5±16.6
Post-treatment				
Aug	0	56±2	0	73.5±0.7
Sept	0	58.5±0.7	0	104±2.7
Oct	0	63±3.5	0	102.7±4.4
Nov	0	56±2.5	0	99.5±0.2
Dec	0	42±1	0	64.5±0.2
Av.	0	54.9±4.2	0	88.8±1.4
Jan 95	0	5.5±0.2	0	8.5±0.2
Feb	0	12±1	0	16±1.5
Mar	0	22±1	0	27±0.5
Apr	13.5±0	48±4	23.5±0	78±6
Av.	**3.37±0**	**21.8±1.7**	**5.8±0**	**32.3±4.1**

PS :Date of Spray 25.7.94 to 1.8.94;BlockA&D(Experimental);BlockB(Control)

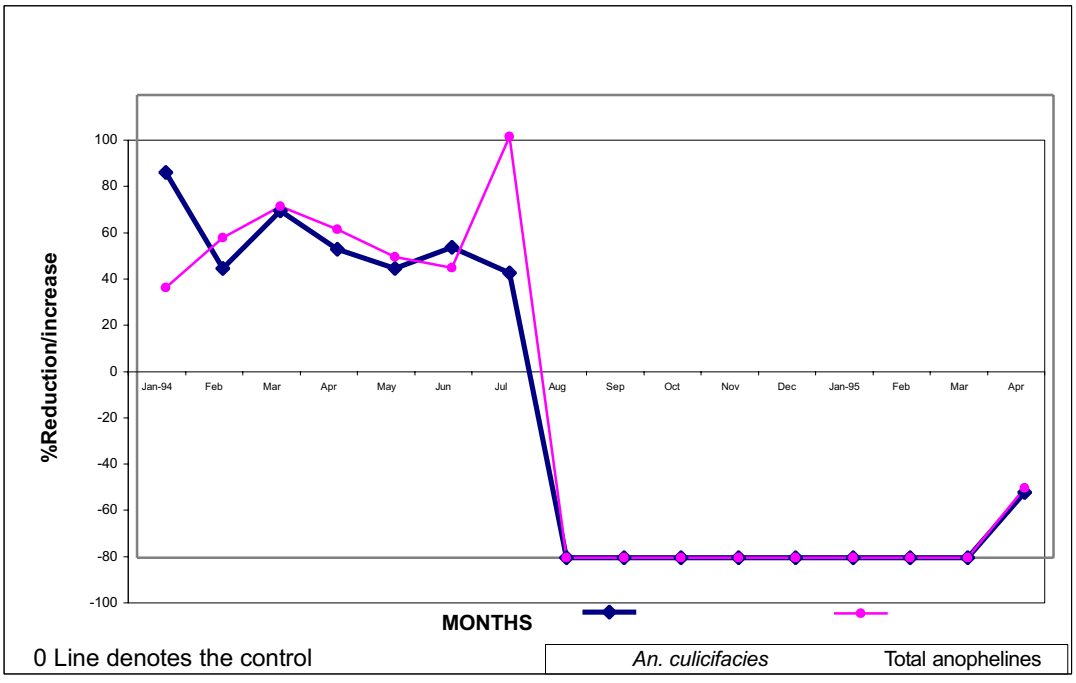

Fig. 1: Percent reduction/ Increase in the density of *An. culicifacies* and total *anophelines* in the experimental area.

and Gryllus species. The percent reduction in total anophelines is 100% up to 8 months in the experimental area after the introduction of treated curtains, which clearly denotes the efficacy of curtains on non-target species also. Further the density per structure of *Musca domestica* declined drastically showing 100% reduction up to 4 months after the introduction of treated curtains, whereas in case of *Cx. Quinquefasciatus, Gryllus* species and total mosquitoes 80-90% reduction were observed after introduction of treated curtains. This clearly denotes the effect of deltamethrin on non-target species also.

Persistence of deltamethrin on curtains: The results of bioassay tests conducted on *An.culicifacies* and *Cx. Quiquefasciatus* with deltamethrin @ 100 mg/m^2 are presented in Table 3. The results revealed that deltamethrin @ 100 mg/m^2 could produce 100% corrected mortality in *An. Culicifacies* because Table 3 shows 100% mortality up to 10 weeks in both species and *Cx quinquefasciatus* up to a period of 10 weeks. Later the effect diluted gradually in case of *An. culicifacies and* drastically in case of *Cx. quinquefasciatus* .

Epidemiological evaluation

Results of epidemiological parameters such as SPR, SfR, cases/000 and *Pf*/000 are presented in Table-4 and the percent reduction of SPR and SfR in the experimental area in Fig.2. The average monthly SPR during pre-treatment was 36.4 in the experimental area as against 29.2 in the control area. The SPR declined significantly in the experimental area after introduction of treated curtains whereas in the control area the SPR increased in successive months ($P<0.05$). Similarly cases /000 also decreased in the experimental area after the introduction of curtains. *Pf* incidence was recorded nil up to 9 months post-treatment in the experimental area but the *Pf* transmission continued in the control area. The results denote that treated curtains could control malaria transmission.

DISCUSSION

The results of the present study revealed that deltamethrin impregnated curtains reduced the density of *An culicifacies* in the houses where the treated curtains were used. *An. culicifacies* densities substantially reduced in the experimental area after the introduction of deltamethrin treated curtains and the effect persisted for about 8 months post treatment. This was also focused in the epide - miological indicators, whereas in the control area malaria transmission continued throughout the study period. The impregnated curtains might have prevented the mosquito entry and also rested mosquitoes on the curtains might have prevented the mosquito entry and also rested mosquitoes on the curtains might have been killed which resulted in 100% reduction of the vector mosquito- *An culicifacies*. In addition, reduction was also observed in the densities of non-target

Table 2: Average density per structure of mosquitoes and domestic insects in different blocks

Month/ Year	An.culicifacies		Total Anopohelines		Cx.quinquefasciatus		Total mosquitoes		Musca domestica		*Gryllus* Sps	
Pre - treatment	E	C	E	C	E	C	E	C	E	C	E	C
Jan-94	6.2±0.6	4.6±0.3	11.0±0.5	8±1	44±1	40±2	61.2±0.6	52±1	2±0.2	1±0.1	1±0.1	1±0.1
Feb	13.4±0.2	9.4±0.2	22.4±0.2	14.5±0.5	92±1	81±0.5	127.8±0.9	104.9±0.5	3±0.1	2±0.2	2±0.2	0
Mar	20.5±0.2	13.8±0.4	37±0.5	22.4±0.8	148±2	129±0.5	20.5±0.7	165..2±0.6	6±0.5	3±0.2	4±0.2	1±0.1
Apr	44.5±0.2	32.3±0.1	56±1	37.0±0.5	260±2	240±2	320.4±2.2	309.3±1.3	7±0.5	5±0.5	8±0.5	5±0.5
May	69.2±0.4	46.4±0.2	71±0.5	50.5±0.7	244±±2	210±2	384.2±1.1	306.9±1.5	5±0.3	4±0.2	7±0.5	6±0.5
Jun	52.4±0.2	37.8±0.3	59.5±0.2	42.0±1	203±1.5	190±5	314.9±1.5	269.8±0.9	4±0.2	3±0.1	5±0.5	7±0.5
July	61.3±0.3	52.6±0.3	72±1	60±2	162±1	138±1	295.3±2.6	250.6±1.3	3±01	2±0.2	4±0.2	6±0.5
Av.	38.2±1.4	28.1±2.4	46.9±2	33.5±3.3	164.7±10.5	146.8±13	244.2±9.6	208.4±7.1	4.3±0.5	2.8±0.4	4.4±2	3.7±1.2
Aug	0	14.2±0.1	0.5±0.05	29.5±0.2	1.0±0.1	79.1±0.5	1.5±0.05	108.6±1.7	0.6±0.1	1.5±0.05	0.2±0	0.5±0.5
Sep	0	11.6±0.2	0.4±0.1	27.3±0.6	1.3±0.15	88.5±1.2	3.7±0.15	115.8±1.9	0	4.0±0.2	0.7±0.05	4±0.2
Oct	0	12±1	0	27.4±0.7	2.1±0.05	87.5±0.7	2.1±0.15	114.9±1.5	0	6.7±0.3	1±0.2	7.7±0.1
Nov	0	8.5±0.2	0.2±0	25.7±0.8	2.0±0.2	90.5±1.2	2.2±0.1	116.2±1.1	0	8.5±0.2	2±0.2	7.7±0.1
Dec	0	6.5±0.2	0	19.5±0.2	8.5±0.2	86.0±1	8.5±0.2	105.2±0.6	0	5.5±0.2	2±0.2	11.7±0.1
Av.	0	10.5±1.8	0.22±0.2	25.8±0.6	2.9±0.3	86.3±3.7	3.6±0.1	112.1±6.7	0.1±0.1	5.2±0.4	1.1±0.05	6.3±0.1
Jan-95	0	3.2±0.1	0	4.5±0.2	4.8±0.4	29±0.5	4.8±0.4	33.6±08	0	2.2±0.1	0.1±0.04	4.0±0.2
Feb	0	1.5±0.05	0	1.5±0.05	6.5±0.2	41.8±0.9	6.5±0.2	43.5±0.7	0	0	0	0.5±0.5
Mar	0	0.5±0.05	0	0.5±0.05	24.7±0.3	6.5±0.2	24.7±0.3	61.5±0.7	5.5±0.2	12.5±0.7	0	0
Apr	0	15.0±0.5	10.0±1	27.5±0.7	13.5±0.7	24.7±0.3	23±0.5	149±1.5	17±0.5	34.5±0.7	0	0
Av.	0	5.0±0.4	2.5±1.0	8.5±1.6	12.3±0.9	25.5±1.5	14.7±0	71.9±3.8	5.6±0.7	12.3±1.4	0.2±0.1	.1±0.15

Table 3: Bioassay test on curtain impregnated with Deltamethrin (2.8% EC @ 100 mg/m^2) in different blocks

Day / Week	% Corrected Mortality	
	An. culicifacies	Cx. quinquefasciatus
0 day	100	100
2nd week	100	100
4th week	100	100
6th week	100	100
8th week	100	100
10th week	100	100
12th week	42	20
14th week	20	12
16th week	26	8
18th week	4	1

Table 4: Epidemiological incidence of Malaria in block A& D (experimental) and Block B (Control)

Month	BER		SPR		SfR		Cases/000		Pf/000	
	E	C	E	C	E	C	E	C	E	C
Pre-treatment										
Jan-94	2.8	1.5	27.2±6.6	25.9±8.3	2.2±0	0	7.6±1.3	3.8±0.8	0.6±0	0
Feb	3.7	2.6	37.2±1	29.1±0.7	0	0	14.1±1.6	7.7±0.5	0	0
Mar	4.8	2.8	40.7±3.4	36.5±2.9	2.6±0.2	1.9±0	19.8±1.6	10.5±0.8	1.2±0	0.5±0
Apr	5.1	3.5	32.5±1.7	35.9±1.3	0	0	16.6±1.3	12.7±0.8	0	0
May	5.8	4.2	39.9±1.1	36.6±3.8	0	1.2±0	21.7±1.2	15.5±1.1	0	0.5±0
Jun	6.9	4.5	50.9±2.7	40.7±2.2	3.7±0.3	2.4±0.1	35.2±2.2	18.3±1.3	2.5±0	1.1±0
July	13.3	14	30.2±3.1	20.5±1.3	1.9±0.1	0.7±0.05	40.3±2.8	28.8±1.7	2.5±0	1.1±0
Total	42.7	33.4	36.4±2.6	29.2±2	1.6±0	0.99±0.3	155.7±11.2	97.7±6.6	7±.03	3.3±0.5
Post Treatment										
Aug	8.9	11.9	10.7±2.6	27.9±2.7	0	0	9.6±0.9	33.3±5.6	0	0
Sep	3.1	9	10.2±1	27.6±1.9	0	3.6±0	3.2±0.3	25.0±0.3	0	3.3±0
Oct	0.89	2.1	7.1±0	89.4±1.4	0	21±0.2	0.64±0	18.8±0.5	0	4.4±0
Nov	0.64	2.5	0	69.5±10.8	0	26±0.6	0	17.7±0.5	0	6.6±0
Dec	1.1	2	0	64.8±2.4	0	27±0	0	13.3±0.5	0	5.5±0
Av.	14.7	27.7	9.1±0.3	39±0.6	0	7.2±0.1	13.4±0.9	108.3±2.5	0	2±0.1
Jan-95	0.19	1.3	0	41.6±5.7	0	25±0	0	5.5±0.5	0	3.3±0
Feb	0.57	1.3	11.1±0	33.3±4.2	0	8.3±0	0.64±0	4.4±0.5	0	1.1±0
Mar	0.64	1.3	60.0±8.3	75.0±0.7	0	4.1±0	3.8±0.6	10.0±0.8	0	0.5±0
Apr	0.76	2.3	66.6±5.7	73.8±1.1	0	0	5.1±0.6	17.2±0.2	0	0
Av.	2.1	6.3	44.1±7.1	58.7±0.7	0	7.8±0.5	9.6±1.6	37.2±2.2	0	5.5±0

P.S.:Date of spray –25-7-94 to 1-8-94, Block A&D – Population (1560), Block B-Population (1800).

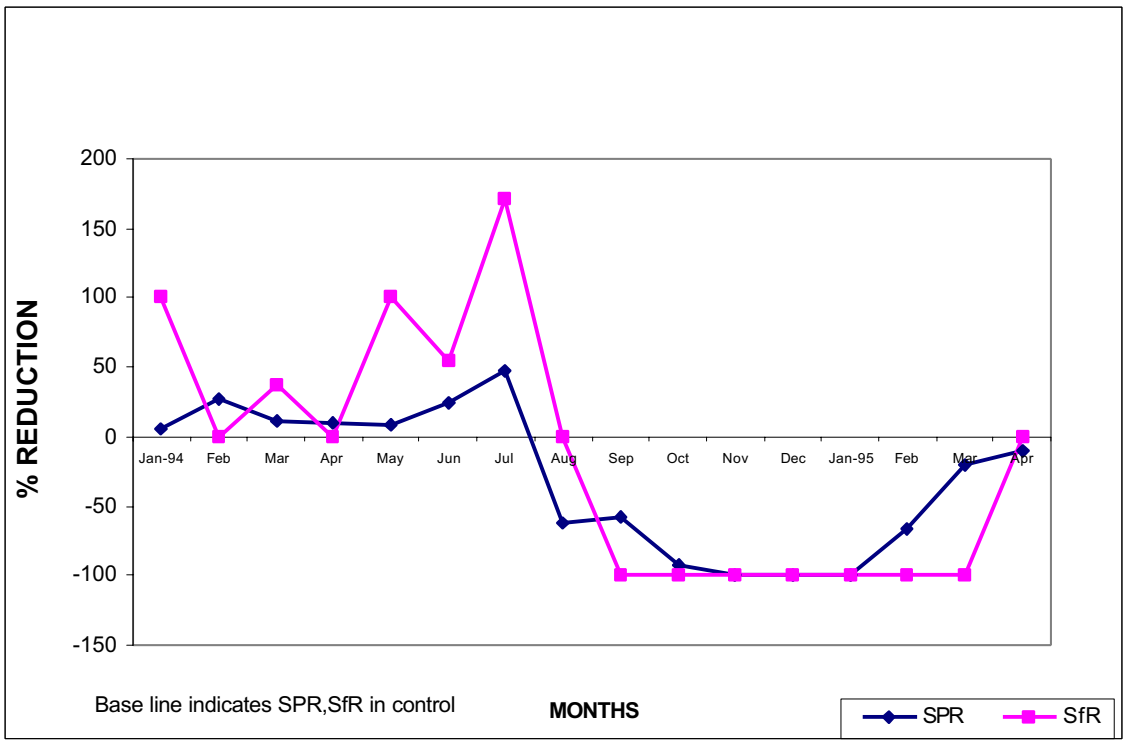

Fig. 2: Percent reduction in SPR and SFR sprayed with Deltamethrin.

species such as *Cx. Quinquefasciatus*, total mosquitoes, *Musca domestica, Gryllus* sps. etc. which transmits other diseases in the experimental area when compared to that of the control area. It can be inferred from the present study that insecticide impregnated curtains are highly effective in controlling mosquito populations. The results of the present study are in conformity with the earlier studies[6-10]. The efficacy of insecticide-impregnated curtains and bed nets in controlling mosquitoes in both laboratory and field conditions had already been demonstrated by Curtis et al (1996), Ansari et al (1998) and Rozendaal (1989)[11-13]. Insecticide impregnated curtains are well accepted by the community as these are not hazardous and the human contact is also less and requires only minor operation during dusk and dawn. Insecti cide impregnated curtains is one of the most appropriate vector control methods in industrial settlements provided two impregnations are required in a year for complete protection. From the present study it can be safely concluded that the strategic action plan prepared and implemented in the NTPC campus, Dadri provided the desired result in reducing the malaria incidence in successive year.

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