Chapter 4

REVIEW OF LITERATURE
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4.1. Epidemiology of malaria in children:

The dynamics of malaria depends on the epidemiological condition of the area and drug susceptibility (Snow et al., 1997). It is known that in areas with stable malaria and perennial transmission, the children suffer more than the adults because immunity in elder age class. Malaria infection produces the most severe disease in those who lack immunity and as immunity takes time to develop after repeated exposure to infection, the children bear the most of the burden of the disease. In a study carried out in hyper endemic areas in Koraput district of Orissa state, India, it was observed that the parasite rate in infants was 23.2% and in children varied between 14-23.6% whereas in adults (>15 yrs), it was 8.6% (Rajagopalan et al., 1989). In this study, it was observed that the average enlarged spleen was 2.06. It is understood that the children bear the most of the burden due to malaria because of lack of immunity. In African situation, each child experiences at least one clinical malaria attack each year resulting in 200 million of malaria episodes per annum of which 4-6 million are complicated. It is not clear as to why only some children severe very severe malaria. It is estimated that each malaria episode has a case fatality of 0.5-2% (Taylor and Molineux, 2002). The clinical features are generally classified as uncomplicated malaria and complicated or severe form of malaria. Fever with chill and rigor with periodicity is a classical manifestation of uncomplicated form of malaria. Malaria
is not the only disease that causes fever. In addition, acute respiratory tract infection (ARI) is a common co-morbid condition (Dempsey et al., 1993). However, there is strong relationship between hepato-splenomegaly and malaria (Redd, 1992). There is myriad of clinical manifestations of malaria in children, especially in *P. falciparum* endemic areas. Hyper pyrexia, involvements of central nervous system (CNS), respiratory, gastro-intestinal, renal manifestations are common. Anaemia is a concomitant association with malaria in children. In a hospital study in Manipur, a northeastern state of India, 90.6% of children with *P. falciparum* developed complications, mainly anemia (90.6%) and cerebral malaria (59.4%) (Chisti et al., 2000). In a study, carried out in a tribal area of Sundergarh district of Orissa state (India), haemolytic anaemia was the major complications of malaria in children (Das et al., 1999). In cases from non-endemic areas and imported cases also, anaemia was a major clinical manifestation (Rivera-Matos et al., 1997). Although the complications and severities vary to some extent, the influence of eco-system remains more or less similar on the transmission. For example, in India, the northeastern states, the highest contributor of *P. falciparum* malaria cases in India, the API of forest malaria is 347.9 in contrast to API in plain areas (61.0) (Sharma et al., 2004).

4.2. Malaria in pregnant women:

4.2.1. Pregnancy and susceptibility to malaria:

Women are not intrinsically more susceptible to malaria (Molineaux and Gramicia, 1980). However, Pregnancy increases the susceptibility to malaria
(Brabin, 1991) due to lack of immunity against malaria and thereby increase in morbidity and mortality (McGregor, 1984, Logie et al., 1973, Annon, 1979, Greenwood et al., 1989). This is possibly due to transient immunological suppression needed to allow the development of a foreign allograft. Pregnancy is known to increase the susceptibility to bacterial, parasitic (Brabin, 1991) and viral, especially HIV infections (Stekettee, 2001) infections. There are several studies on malaria during pregnancy and the effect of malaria on foetus available. All these works give information either on epidemiology of malaria during pregnancy based on parasitological observations or on complications (anaemia, low birth weight, pre-term complications, foetal and perinatal mortality, maternal mortality, congenital malaria and general complications of puerperal sepsis, postpartum haemorrhage etc.). The studies focused on P.falciparum infection. Recently, the role of P.vivax during pregnancy has been also described (Sholapurkar et al., 1988, Nosten et al., 1999, Singh et al., 1999).

4.2.2. Epidemiology of Malaria in Pregnancy:

Epidemiology of malaria during pregnancy can be broadly described as (1): Parasitological observations (cross sectional and longitudinal) and (2): Complications of malaria in pregnancy. Maternal anaemia (Van Dongen and Van’t Hof, 1983), low birth weight (Kramer, 1987, McGregor and Avery, 1974 Brabin, 1991, Nosten et al., 2003), pre-term delivery (Jilly, 1969), foetal and perinatal mortality (Sholapurkar et al., 1988, Greenwod, 1989) cerebral malaria and congenital malaria (Covell, 1950) are the major complications. The problem
of malaria infection in pregnant women was first described in 1936-37 in Sri Lanka where the maternal mortality even after quinine therapy was 13% and pregnancy loss was 67% (Wickaramsuriya, 1937). Recently a meta-analysis of compatible 34 studies (from 1985 to 2000) from 25 investigations in 5 sub Saharan African countries have been shown below (Stekette, 2001) (Table 4.1).

Table 4.1. The results of a meta-analysis of compatible 34 studies (from 1985 to 2000)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Prevalence</th>
<th>Risk estimate range</th>
<th>Population attributable risk range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate or severe anaemia</td>
<td>1-20%</td>
<td>1.5-2.5</td>
<td>2-15%</td>
</tr>
<tr>
<td>LBW*</td>
<td>12-20%</td>
<td>1.4-1.8</td>
<td>8-14%</td>
</tr>
<tr>
<td>Pre-term LBW</td>
<td>3-8%</td>
<td>2.2-3.5</td>
<td>8-36%</td>
</tr>
<tr>
<td>IUGR**-LBW</td>
<td>8-15%</td>
<td>1.7-5.5</td>
<td>13-17%</td>
</tr>
<tr>
<td>Infant mortality</td>
<td>50-160/1000 live births</td>
<td>-</td>
<td>3-8%</td>
</tr>
</tbody>
</table>

* LBW-Low birth weight, ** IUGR-Intra uterine growth retardation

The link between malaria and perinatal mortality was explored by systematically reviewing 117 studies published between 1948 and 2002. The mean perinatal mortality rate was higher in malaria endemic countries (61.1/1000, 95% confidence interval, CI=52.1-70.1) than in non-endemic countries (25.8/1000, 95%CI=21.1-30.6)

It has been shown that in endemic countries, especially in African countries, prevalence of malaria, based either on placental infection or parasitaemia varies between 8.8 to 36.2 in multigravidae and between 15.7 to 64.0% in primigravidae
(Archibald, 1956, Cannon, 1958, Spitz 1959, Jelliffe, 1968, Bray and Anderson, 1979, McGregor, 1983, McGregor, 1984, Stekete, 1988). It has also been shown that mean haemoglobin concentration is significantly higher in women with malaria parasite than without. The still birth rates are also higher in primigravidae (1.5%-10.6%) than multigravidae (0.9%-6.9%). However, it is interesting to note that malaria related maternal mortality, which is mostly due to severe anemia, is very low in epidemic situation (1.5-4.1%) (Wickramasuriya, 1937, Fullerton, 1962).

4.3. Control of malaria through community participation:

Malaria control programmes, to be successful need to be tailored according to the local epidemiological characteristics. Community participation, inter-sectoral collaboration, training, operational research and health education are essential components for effective control of malaria (Pattanayak et al., 1994). Community participation in malaria control is not a new idea. Malaria can be eliminated on isolated islands with well-adapted short-term mass drug administration and sustained vector control if there is a high degree of community participation. In a study, weekly mass drug administration either with chloroquine or, pyrimethamine/sulfadoxine and primaquine was carried out on the entire population of 718 inhabitants of Aneityum island for 9 weeks in 1991. Two additional islands of Vanuatu, one with and one without malaria transmission were monitored for comparison. Community involvement as measured by drug
compliance (88.3%) and bed net provision (one net per villager) resulted in sustained interruption of malaria transmission. The surveys showed complete absence of *Plasmodium falciparum* and *P. vivax* after mass drug administration, from 1996 onwards, with the exception of two instances of imported infections (one mixed infection in 1993 and one *P. vivax* infection in 1999 (Kaneko *et al.*, 2000). Community participation has successfully contributed for the control of malaria in the rural areas of Guatemala and Indonesia (Okanurak, 1996). In a study, it was observed that folk healers had more positive attitude towards community based programmes for gaining social recognition and willingness to stay on and the their performance was better (Okanurak, 1992). Control of malaria has also been successful in Ethiopia where a total of 681 volunteers chosen by their communities received malaria training and served a rural population (Ghebreyesus *et al.*, 1996). Women’s participation in the famous Blue Nile Health Project (BNHL) is exemplary, wherein 75% of the health instructors were women and were concerned for the self-protection and home management of malaria (Rahman *et al.*, 1996). In rural areas of Latin America, a network of unpaid village malaria workers, known as volunteer collaborators, who were trained and supervised by national malaria service, carried out malaria surveillance and treatment. These volunteers identified twice as high a percentage (33% vs. 17%) of patients with suspected malaria in their villages and the delay in detection (23 to 11 days) and treatment (21 to 7 days) of malaria cases reduced (Ruebush *et al.*, 1992). Depending upon the epidemiological, social and geographical variations, the strategy per se may not be suitable in all
situations. The Barangay health workers or government trained health volunteers in rural areas of Philippines did not contribute optimally to malaria control activities even in endemic areas because of inadequate training, insufficient logistic support, poorly sustained motivational schemes and lack of community support (Lariosa, 1992). A community based malaria control programme, by providing treatment with chloroquine by village volunteers in Saradidi, Kenya, 40,649 cases were treated in one year. However, about 41.8% of cases did not receive any treatment, 50.5% of cases received multiple treatment and 13.4% of cases received five or more times treatment. Chloroquine consumption pattern was more in women and above 30 years of age. In spite all these, the results demonstrated that volunteer health workers could effectively provide treatment for malaria cases (Spencer et al., 1987). But there is a word of caution, though malaria control was successful in Nicaragua in 1970-80, rebel war in 1990 led to deterioration in malaria control activities, the volunteers took few slides and were less motivated sue to breakdown social life and peace in the area (Garifield, 1999).

In India, community based bioenvironmental control measures has been successful in reducing mosquito larvae and adult vector population (Sharma 1989). In other diseases like lymphatic filariasis, it has been demonstrated that community participation has helped in drastic reduction of infection and disease in India (Rajagopalan and Panicker, 1984). A small-scale trial with insecticide treated bed nets with community participation has resulted in decline in malaria
incidence in a tribal area of Koraput district, India (Das et al., 1993). However, transmission could not be interrupted. Vector control measures also in tribal areas could not yield desirable results because mud plastering habits and low socio economic conditions. Therefore, the only option that remained was to reduce the morbidity and mortality due to malaria in these areas by administering antimalarial drugs in time. This led to the idea of village health guides (VHG) by government. The VHGs, working under primary health centre became defunct due to a variety of reasons including the meager amount ($1) of monthly remuneration and lack of job security. Therefore, there is an urgent need to make antimalarial drugs available at village level through volunteers for reduction of morbidity and mortality due to malaria.

4.4. Measuring burden of malaria:

The conventional instruments for measuring the burden of malaria are malaria mortality, annual blood examination rate (ABER), annual parasite incidence (API), and infant parasite rate and parasite species index. However, a new instrument, called disability adjusted life years (DALY) lost, developed by Murray and Lopez, for measuring the burden, combines the sequale due to malaria (mortality, malarial fever episodes, malarial anaemia and neurological sequale) into a single parameter which helps in comparison across the diseases to help prioritization in disease control.