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## Socio-economic aspects of malaria in India — a literature review

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### Introduction

Spraying insecticide and treating cases of malaria is no longer all that is needed to control malaria. Today this requires a good deal of epidemiological and technical expertise. The epidemiology of malaria differs from place to place and from time to time, and thus a continuous study of the changing situation and development of appropriate technology is required to deal with this (Saigal, 1983). It is gradually realized that human factors, in addition to environmental factors, are responsible for the maintenance of high levels of malaria infection in tropical countries in the world. Hence, the efforts for eradication of malaria have now been focused in this direction. The change in human ecology is emerging as a continuing problem when dealing with the eradication process. The most significant fact is the vicious circle of malaria, namely the relationship between malaria and poverty, ignorance, illiteracy, malnutrition and social deprivation. Not only has malaria contributed to poverty and ill health, but the syndrome of under-development also acts as an antecedent of malaria.

### Malaria — eradication and resurgence

India has experienced both success and failure in controlling malaria in the recent past and currently has modified a strategy of controlling the disease. A fall in morbidity and mortality was achieved, as is evident from the fact that by

1965, the active cases estimated were only 100,000, and no deaths were reported. However, the hopes of eradicating the disease were shattered as resurgence began to appear in 1966 with a rapid and steady rise in cases to over 5 million (Ray, 1977).

The approach for controlling the disease did not yield the desired results in the late 1970s for various reasons. A major reason considered to be responsible for the resurgence of malaria is the problem of vector resistance to insecticides (Mojamdar, 1975; Ray, 1977). There are also some political and situational factors that indirectly contributed to the return of malaria. These include interruption or severe delay in the flow of insecticide from the western countries due to closure of the Suez Canal affected by the Middle East War of 1967 (Ray, 1977). In addition situations peculiar to India have been attributed to this state of affairs of the stream-bed jungle species; resistance was reported in *Anopheles fluviatilis* in Maharashtra, Karnataka, and the hilly states of the northeastern region (Ray, 1977). The exophilious habits of the *A. minimus* and *A. balabacensis* vectors were regarded as a major cause of persistence of endemicity in some pockets, such as Kutch in Gujarat, Bastar in Madhya Pradesh (Dutt *et al.*, 1980), Arunachal Pradesh and Maghalaya, because of peculiar characteristics of the region and the inhabitants of the area.

Among the social and cultural factors, mud plastering of walls on various festivals is very common in rural India, and this proved to be a barrier to effective house-spraying programmes (Agarwal, 1978). Thus, the resurgence of malaria in India seems to be a result of natural and human causes. The World Health Organization, while taking note of resurgence of

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malaria in 1973, observed that "Malaria has re-emerged as a major public health problem in Burma, India and Sri Lanka, and could do so in the near future, unless anti-malaria activities are assessed, revised and intensified". Anti-malaria activities after the resurgence of the disease in India have undergone a change to meet the fresh problem associated with it. In 1977, the modified plan of operation under the National Malaria Eradication Programme (NMEP) was introduced with the objectives of eliminating malaria mortality, reducing morbidity, and consolidating the gaps. With these measures, however, incidence has now declined to 2.16 million during 1982 and 1.15 million by the end of 1983. Further, human factors responsible for resurgence, which are yet to form an integral part of the control programmes, would shed light on some basic issues of scientific investigation.

The basic epidemiological model frequently used to study malaria is based mainly on three factors: host, agent and environment. Among these, environmental factors imply ecological factors as well as human, social and economic conditions, as such a disease is considered to be a result of interaction of these factors. Evidence available from epidemiological investigations suggest that there are some predisposing factors other than environmental that are related to the incidence of malaria. Among these poor hygiene, poverty, illiteracy, poor diet and occupation are more prominent. Poverty coupled with illiteracy aggravates social and economic conditions of the people, and due to those conditions they fall an easy prey to a host of diseases. This phenomenon is very common in the Indian situation.

### Socio-economic and cultural factors

#### Poor hygiene

Poor hygiene, either within the house or in the community, is an important factor. Houses that are congested, crowded, damp, dark, ill-ventilated and dirty are favoured by mosquitoes (Heir, 1927). According to Tiber Lepes, the then Director of malaria control division of the WHO, high incidence of leishmaniasis (one of the common tropical diseases) was associated with poor housing in India (cf. Agarwal, 1978). In a rural study in Tamil Nadu that examined

the reappearance of malaria, Hyma and Ramesh (1980) concluded that dwelling types, irrigation, agriculture and other social and economic activities contribute to the increase of rural malaria. In northern India, Mukherjee (1980) found that the clustered settlements where houses are built with common walls and a single sewer that is open and flows into pits scattered throughout the settlement, make an ideal breeding ground for flies and mosquitoes as well as for other pernicious vectors.

#### Poverty and illiteracy

Poverty, coupled with little or no education, aggravates social and health conditions of the people. Due to illiteracy, people do not acquire even basic information on sanitation, personal hygiene, etc.; they are not even aware of the causes and spread of diseases, including malaria, and the preventive measures to be taken against other common diseases. Hyma and Ramesh (1980) indicate a positive correlation between poverty and high incidence of malaria in rural populations. It is true that poor people are malnourished, ill-sheltered and ill-clothed, resulting in a weakened resistance to the disease; thus, they are never protected from the mosquito bites (Heir, 1927). An historical account of malaria in pre-independence India given by Christophers (1935) records that the heaviest mortality was among the poorest section of the population and those dwelling in squalid surroundings. One study in the rural area of Tamil Nadu, in the post-independence period, does not consider that poverty and illiteracy are antecedents of malaria in the river-side village but concludes instead that these factors hinder control measures (Hyma and Ramesh, 1980).

#### Occupation and nutrition

There apparently exists a relationship between incidence of malaria and type of occupation, but there is neither convincing nor conclusive evidence to show a relationship between these variables, at least pertaining to India (Bhatt *et al.*, 1962; Neogy & Sen, 1962). People pursuing occupations that require manual labour, but who are not supported by a nutritious diet, have reduced resistance to diseases, and so are more

prone to frequent attacks of malaria. The labourers working on road and railway line construction and irrigation projects have no proper shelter to protect them from mosquito bites. Heir (1927) observed that the workers engaged in occupations such as excavating soil, or construction of railway lines and roads in malarious areas were more prone to the disease. However, he suggested that these factors were not directly related; instead, hard work, exposure to the vectors and a defective diet were predisposing factors.

Quality of diet is a determining factor of resistance power or level of immunity. Heir (1927), whose observations refer to the pre-independence period, noted that in rural India where poor nutrition coincided with hyperendemicity, the people had the largest number of greatly hypertrophied spleens in children and malaria cachexy in adults.

Mukherjee (1980) reported the association between an unbalanced diet and disease in the Dun where principal sources of carbohydrates are wheat and maize. Consumption of many kinds of vegetables and fruits is almost unknown. These dietary habits result in deficiencies of protein, vitamins and minerals.

### Agriculture and irrigation

The agricultural activities with irrigation facilities have led to a change in cultivation pattern and process, resulting in a resurgence of malaria in the country. Rao (1945) found that the introduction of Caverry river-water into the almost arid area of Mysore State (now Karnataka), which in the first few years was hailed as a godsend, soon turned out to be a mixed blessing. The land became saturated with all the evils of waterlogging, and fertile lands originally under tank irrigation and adjacent to valleys became overgrown with weeds and, thus, were rendered unfit for cultivation. An epidemic of malaria was followed by the establishment of hyperendemic conditions in the course of a few years, paralysing the village economy and the entire area. As the canal services were extended to cover all the villages and the area affected by the malaria epidemic increased with the extension of irrigation, the relationship between irrigation and malaria was reinforced (Rao, 1945). While studying the

disease ecology of Chandigarh Dun in Northern India, Mukherjee (1980) identified four disease ecological areas where 40% of all patients treated in hospital were suffering from malaria. Besides highly varied climatic conditions, geographic conditions of the Dun were responsible for this disease hazard. The area is dominated by three alluvial fans, two interfluvial areas and terraces of the Kaushilla and Sirsa rivers and their tributaries. Sandy loams are found in cultivated lands near settlements. These soils often receive a maximum amount of irrigation usage and human excreta, and most of the fields are cultivated throughout the year. Predominantly sandy soil occurs in the upper parts of the alluvial fans and the lower terraces leading to major streams. Hard clay sub-soil occurs in scattered patches, and these soils are associated with clay sub-soil that makes drainage extremely difficult. Water remains stagnant for longer periods of time in the area of clay soils.

### Migration

The importance of migration of infected people to immune areas resulting in the spread of malaria has been cited in few studies. Heir (1927) considers the immigration of a non-immune population into an epidemic area as being the most important cause of epidemics of malaria in India. A constant flow of a large number of freshly infected persons into an endemic area intensifies malaria in the indigenous population, in that the resident individuals who were previously relatively immune, are no longer able to protect themselves against the number of parasites introduced by anophelens. The study in Punjab by Christophers (1935) demonstrated that a flow of susceptible persons into an endemic malarious area was one of the major factors sustaining malaria in that area. Russell *et al.* (1938), in the study in Madras (now Tamil Nadu), found that the labourers in Pattukkotti, who lived in Malaya to work in rubber plantations prior to returning to their villages, were likely to be carriers of the disease. There were only four studies in the post-independence period, the focus of which was not to study migration and its relevance to malaria, but to show that migration is related to a spread of the disease. Roy *et al.* (1976) observed in Tamil Nadu that the rural area, which was free from malaria, was infected by



the movement of about 25% of the infected cases of non-complete drug treatment. Conversely, another study in the same area (Roy *et al.*, 1979) suggested that both rural to urban and vice versa migration was responsible for the spread of the disease. Patel and Ambawani (1961) studied issues related to epidemics during the eradication of malaria in the forest area of Gujarat. From the history of the patients, they concluded that all the patients were labourers by occupation who were infected while on road construction work in the forest area. Russel *et al.* (1938) and Hyma and Ramesh (1980) present similar findings in other studies in Tamil Nadu.

The fragmentary studies cited in the preceding discussion confirm the fact that important areas such as socio-economic aspects of malaria still remain unstudied in India. Considering the human, social and economic factors that act as antecedents of malaria, there arises a need for systematic research in this field in view of changing ecological and socio-economic conditions leading to a 'man-made' malaria problem. In the past two decades, the proportion of agricultural production generating from irrigated lands has been increasing in most parts of the country. Due to the shift from subsistence agricultural production to commercial production, there is a marked geographical mobility of the labour force to seek seasonal work. Such intra- and inter-state migration of the labour force has been contributing to the high incidence of malaria, and specific regions may be malaria endemic areas. The agricultural development activities with irrigation facilities have led to a change in cultivation patterns and processes that might be related to malaria in the country.

Surprisingly, no systematic study, either at a micro or macro level, to examine the interactions between various social and economic factors and incidence of malaria has been done so far in India and, therefore, the relationships are unknown. The studies that are available, and cited in the preceding discussion, predominantly concentrate on describing measures and the role of insecticides, without referring to human social and economic factors seemingly related to malaria. Ray (1981), the then Director of the National malaria eradication programme for the Government of India, admitted that the studies covering "sociological, health

economics and management aspects under various political and administrative set-up did not receive due importance". He further suggested that the health planners, particularly those dealing with preventable diseases, should consider socio-economic aspects.

In view of the major significance of malaria as a public health problem in India after resurgence, and as a result of insufficient scientific studies related to social and economic aspects of the disease, it is necessary to use available empirical investigations, conducted in other tropical countries facing similar kinds of problems. Thus, it may not be difficult to postulate some hypotheses in order to study relationships between socio-economic and ecological factors and the incidence of malaria that will help to modify the strategy of malaria control programmes to suit the Indian situation.

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