Estimation of the Socioeconomic Burden of Mosquito Borne Illnesses on Different Income Groups Using the Principles of Health Economics

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Research Article

Abstract: **Introduction:** Mosquito-borne diseases are one of the most serious and complex health problems facing humanity in the 21st Century are making many countries spend billions on health sector. Authentic figures indicated that malaria kills more than one million people each year. **Objectives:** To calculate and compare expenditure on mosquito preventive measures, expenditure on treatment of illnesses and benefit cost ratios, working days lost in three income groups viz. low, middle and high income group, to find out most preferred preventive measures in terms of effectiveness, cost and environmental modification undertaken. **Materials and Method:** A cross sectional study was conducted in 300 families (100 of each low, middle and high income group). All families, which were using mosquito-preventive measures, were included in the study and those which did not were excluded. The study was conducted through a detailed pretested semi-structured questionnaire filling via a door to door survey approach. **Results:** Monthly expenditure on preventive measures were highest and lowest in high and low income group respectively, the no. of persons falling ill due to mosquito-borne illnesses in the past one year were highest and lowest in low and high income group respectively whereas expenditure on treatment of mosquito-borne diseases (per capita) was highest and lowest for middle and high income group respectively. It was found that if expenditure is more on preventive aspect in all income groups, greater is the benefit in terms of greater benefit cost ratio in therapeutic aspect, the cost-effective mosquito control measure of choice was Neem leaves while the most effective mosquito control measure of choice was aerosol. **Conclusion:** Families spent according to their incomes on mosquito-preventive measures i.e. highest by high and lowest by low income group. Families that spent more on preventive measures had lesser no. of people falling ill.

Keywords: benefit cost ratio, mosquito borne illnesses, working days lost.

Introduction

Mosquito borne diseases are one of the most serious and complex health problems faced by humanity in the 21st century. Several countries spend billions on health sector, as the diseases are taking the lives of many. Mosquito borne diseases are prevalent in more than 100 countries of the world, infecting 300-500 million people and causing about 1 million deaths every year [1]. Malaria is mainly present in tropical and sub-tropical countries in Asia, Africa and Latin America. Prevention and cure of these diseases incur large expenses thus affecting the countries' economy. Authentic figures indicate that malaria kills more than one million people each year mainly children under five years and 3000 people die from malaria each day whereas ten new cases are recorded in our health facilities in less than every minute. In India, more than 40 million people suffer from mosquito diseases annually [2]. Malaria, filaria and dengue are the most prevalent diseases spread by mosquitoes in Indian scenario. Presently, about 1.5 million cases of malaria and less than 1000 deaths are reported every year. About 80% of malaria burden is in, Madhya Pradesh, Orissa, Andhra Pradesh, Jharkhand, Maharashtra, Gujarat, Rajasthan, West Bengal, Karnataka, Chhattisgarh and North-eastern (NE) states [3]. The present study was carried out at a major city of Central India trying to assess the financial burden of mosquito borne diseases and its ill effects on economy of the families.

Aim and Objectives

- To calculate and compare total expenditure on mosquito preventive measures and the expenditure on treatment of persons falling ill due to mosquito borne diseases.
- To calculate and compare no. of working days lost and years lost to mosquito borne illnesses.
- To determine and compare benefit cost ratio of expenditure on preventive & therapeutic measures due to mosquito related illnesses.
- To observe and find out most preferred preventive measures to combat mosquito borne illnesses in terms of effectiveness and cost.

- To find out the various measures undertaken for environmental modification to control breeding of mosquitoes.

Material and Methods

A Cross sectional study was carried out at field practice area of Urban Health Centre attached to Department of Community Medicine of M.G.M. Medical College, Indore. The study was conducted in total of 300 families from three different income groups through a detailed questionnaire filling via a door to door survey approach. 100 families from each income group were selected viz. low income group (Modified Kuppuswamy Scale 1 and 2), middle income group (Modified Kuppuswamy Scale 3 and 4) and high income group (Modified Kuppuswamy Scale 5 and above) [4]. Simple random sampling was used to select the sample size from these three different income group families. A pretested semi-structured questionnaire was administered to the head of the family, which was designed to elicit information on demographic and spending aspects of respondents. The demographic profile included details such as name of head of the family, number of family members and address of residence etc. and included the spending variables such as their usage of protective measures for mosquitoes, monthly expenditures on protection measures as well as on the treatment of illnesses occurred in past one year due to mosquito menace, the average days lost from their works due to the same illnesses in past one year, the most suitable measures in terms of effectiveness and in virtue of costing and the environmental modification undertaken by them to control the problem of mosquito borne illnesses. Followed by an interactive education session in the form of group discussion using different lectures and audio visual aids to promote the use of mosquito nets and conservative use of chemical methods of mosquito preventive measures was held in all 3 different income groups study sites. Data was entered into Microsoft excel spread sheet and analysed using SPSS version 20 software.

Inclusion Criteria - All the families using mosquito preventive measures and who gave an informed written consent to participate in the present study.

Exclusion Criteria - All the families which were not using any mosquito preventive measure and/or who have not given written consent to participate in the present study.

Observation and Result

Socio-Demographic profile

The pretested semi-structured questionnaire was administered to the head of the family to get the required data. Among the study population, most of the families were headed by male (86%) and remaining families (14%) were headed by female; maximum respondents were in the age group 61-70 years (42%) and lowest percentage was found in 71-80 years age group (3%); most of the respondents (55%) were from the 21-60 years age group; about 73% of respondents studied upto 8th standard and above.

Monthly expenditure on various mosquito-preventive measures and treatment of illnesses

The sum total of monthly expenditure of all the families on various mosquito preventive measures was ₹14320.00 (12.15%) for low income group whereas it was ₹ 37995.00 (32.25%) for middle income group and ₹ 65470.00 (55.58%) for high income group. It was observed that families spent according to their incomes on mosquito preventive measures i.e. highest expenditure was done by high and lowest by low income group. Monthly expenditure on the treatment of illnesses caused by mosquito menace by low, middle, high income group was ₹7850.00, ₹9990.00 and ₹3955.00 respectively.

Illnesses caused by mosquito menace and working days lost in past one year

The total no. of persons falling ill due to mosquito borne illnesses in the past 1 year were maximum (49% of total) from low income group then secondly from middle income group which were 31% of total and the least from the high income group which were 20% of total. The families that spent more on preventive measures had lesser no. of people falling ill. The total working days lost due to mosquito borne illnesses in the past 1 year for various income groups were similar to the illness trend and was observed as maximum 1236 days (100 families) for low income group, it was a total of 876 days (100 families) work lost for middle income group and 482 days (100 families) lost for high income group. The average per capita working days lost in past 1 year was maximum for low income group i.e. 9 days; it was 6.7 days for middle income group and was minimum for high income group i.e. 3.5 days. Investigators observed that the families spending less on mosquito preventive measures lost more no. of working days.

Calculation of years lost to illnesses and actual life expectancy at birth.

The average life expectancy at birth in India as per UNDP technical report is 65.4 years [5], thus the expected days of life of an average Indian comes out to be 23871 days (65.4 X 365). In the present study the average per capita working days lost due to mosquito related illnesses in low income group is 9 days per annum. Thus for a life expectancy of 65.4 years, the days lost due to illnesses are 588.6 (65.4 X 9) and the years lost to illnesses comes out to be 1.61 years. The health adjusted life expectancy in low income group due to mosquito borne illnesses comes out to be 23282 days (23871-588.6), thus the actual life

expectancy at birth comes out to be 63.79 years. In the similar way, considering the average per capita working days lost due to mosquito related illnesses for middle and high income group were 6.7 and 3.5 days per annum respectively; the years lost to illnesses calculated for middle and high income group came out to be 1.2 and 0.63 years respectively, thus the actual life expectancy at birth for middle income group is 64.20 years and for high income group it is 64.77 years.

Benefit cost ratio of expenditure on preventive & therapeutic measures

To get benefit cost ratio, the average monthly income of each of the group was calculated by set criteria of monthly income, Ministry of Housing and Urban Poverty Alleviation, Government of India [6]. Based on the findings of present study the average monthly expenditure incurred per family on both preventive and therapeutic measures was obtained independently from 100 families of each group [Table 1]. The benefit cost ratio based on cost benefit analysis was applied. The benefit was calculated on monetary basis on the principle of the "lesser the expenditure more the benefit". The benefit cost ratio on preventive measures was compared with benefit cost ratio on therapeutic measures applying the same formula. It was observed that more the expenditure on preventive measures less is the benefit cost ratio and lesser the expenditure on therapeutic measures, more is the benefit cost ratio. The bottom line thus, is that if expenditure is more on preventive aspect in all the income groups, greater is the benefit in terms of greater benefit cost ratio in therapeutic aspect.

Table 1: Monthly expenditure on various mosquito-preventive measures and treatment of illnesses and their benefit cost ratio

S.No.	Income Group	Average monthly income (₹)*	ME (P)	ME (T)	BCR (P)#	BCR (T)#
1	LIG	5300	143.20	78.50	97.29	98.52
2	MIG	10900	379.95	99.90	96.51	99.08
3	HIG	14500	654.70	39.55	95.48	99.72

*= Income groups criteria based on Ministry of Housing and Urban Poverty Alleviation, Govt. of India.
LIG- Low Income Group, MIG- Middle Income Group, HIG- High Income Group
ME (P) = Average monthly expenditure on various mosquito-preventive measures (₹)/family
ME (T)= Average monthly expenditure on treatment of illnesses (₹)/family
BCR (P)= Benefit cost ratio of preventive measure
BCR (T)= Benefit cost ratio of treatment of illnesses
#= result expressed in percentage

Most suitable measures in terms of effectiveness and cost

On the question of the most effective mosquito control measure, a total of 138 families responded aerosols as the method of choice, 31% families from low income group, 42% from middle income group & 65% families from high income group rated aerosols as the best measure in virtue of effectiveness while, the least effective method observed among the study population was outdoor insecticide spray. As far as the cost is concerned, 73% respondents from low income group rated Neem leaves as the most cost effective measure, the mosquito net was the most cost effective method in case of middle income group (63% families) and Aerosols (75% families) was rated best cost effective method by people in high income group. Overall only 2 % respondents rated mosquito creams, which is on the whole the least cost effective measure observed in this study.

Environmental modification undertaken by different income groups

To prevent the breeding of mosquito, a total of 70 families filled pits with soil and cleaned drainage. The method of choice for middle income group was application of mosquito proof mesh for windows and doors whereas insecticide spraying (professional pest control) was the method adopted by high income group, kerosene spraying on puddles and introduction of fish into ponds (e.g. Gambusia) was also observed but it was practiced only in 7 and 3 families respectively. Astonishing fact observed was that a total of 82 families did not undertake any method of the environmental modification to prevent the breeding of mosquito in their surroundings, in spite of being aware and diseased of the illnesses caused by them.

Discussion

The burden of mosquito menace on economy is a major crisis especially in the developing countries of the world. In the affected part of globe, a considerable part of the earned income is spent either on prevention or on treatment of the disease caused by mosquito bite. In the South-East Asia region, India, being a tropical country, faces the problem of mosquito borne illnesses since the ancient times. A total of 76% malaria cases in the South-East Asia region (11 countries) are contributed by India alone [7], which leads to a substantial amount of working days lost and resultant monetary loss incurred every year, inspite of extensive control measures on prevention of transmission of various diseases caused by mosquitoes. It constituted one of the most important causes of economic misfortune, engendering poverty which lowered the

physical and intellectual standards of the nation, and hampered prosperity and economic progress in every way. The present study tried to find out the financial burden and related benefit cost ratio in a major city of central India. Families spent according to their incomes on mosquito-preventive measures i.e. highest by high income group and lowest by low income group. Families that spent more on preventive measures had lesser no. of people falling ill i.e. highest in low income group and lowest in high income group. Families spending less on mosquito-preventive measures lost more no. of working days i.e. highest in low income group and lowest in high income group. Families spending less on mosquito-preventive measures lost more no. of per capita working days as well as years lost due to disability or illnesses i.e. highest in low income group and lowest in high income group. High income group families spent least on treatment of mosquito borne illnesses due to highest expenditure on preventive measures**.** Low income group families spent next due to lack of money. The cost benefit analysis in present study showed that more the expenditure on preventive measures less is the benefit cost ratio and lesser the expenditure on therapeutic measures, more is the benefit cost ratio. The investigator came to know that aerosol was the most preferred mosquito preventive measures according to the people in terms of effectiveness and cost. Inspite of suffering from the disease, most of the families still did not consider environmental modification as an important measure for reduction of breeding places of mosquitoes. There is a need of a well-organized sensitization for the same.

Conclusion

The present study showed that inspite of a large expenditure on mosquito control measure, an effective National Vector Borne Disease Control Programme and the influence of bigger political commitment there is still a large amount of economic losses and morbidity due to mosquito borne illnesses are importunate. The study recommends that we need to concentrate more on the repeated sensitization of community using spirited education intervention campaign related to the mosquito menace and its impact on the economy and implication of determined environmental modification during the transmission season as well as throughout the year to overcome this problem.

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