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MORBIDITY AND MORTALITY ASSOCIATED WITH PLASMODIUM VIVAX AND PLASMODIUM FALCIPARUM INFECTION IN A TERTIARY CARE HOSPITAL IN NAVI MUMBAI, INDIA

Gurjeet Singh, Raksha, A.D. Urhekar

Department of Microbiology

N.C. Medical College and Hospital, Israna, Panipat, Haryana, India-132107

MGM Medical College and Hospital, Kamothe, Sector-1, Navi Mumbai, Maharashtra, India-410209

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Address for correspondence

Dr. Gurjeet Singh
Department of Microbiology
N.C. Medical College and Hospital,
Israna, Panipat, Haryana, India-132107
Email: gurjeetsingh360@gmail.com
Contact no: +91-8693076518

ABSTRACT

Malaria is a major public health problem and causing high morbidity and mortality worldwide especially in India and South Africa. To study the mortality of patients due to malaria. This cross sectional and retrospective study was conducted over a period of one year in a tertiary care hospital. All the patients with fever and chills as major complain who had attended OPD and IPD of Medicine. Patient's clinical history was recorded for comparing the severity of the disease and co-morbidity. Data were analyzed in the computer software Statistical Package for Social Sciences (SPSS) version 17.0.

Slide Positivity Rate (SPR) and Slide Falciparum Rate (SFR) was 16.58% and 8.50% respectively. Plasmodium falciparum was 45.24% of the total positive cases. Mortality analysis- male to female ratio was 3:1.Age wise malaria mortality was recorded maximum in the age group of 21 to 30 years 38.46%), followed by 11 to 20 years 23.08%, 41 to 50 and 50 and above was 15.38% each, lowest was age group 31 to 40 years 7.69%, however no death cases found in the age group of 0 to 10 years. P. falciparum was 73.08% than P. vivax 26.92%. Falciparum to vivax ratio in mortality was 3:1. Complications and causes of death involved in malaria mortality was terminal cardio respiratory arrest in 20 cases, followed by cerebral malaria 4 cases, Acute Respiratory Distress Syndrome (ARDS) 4 cases, multi organ failure 5 cases, dengue (co-infection) 3 cases, Sub Dural Haematoma, Sinus Thrombosis and Myocardial Infarction 1 case each.

The study revealed underreporting of malaria episodes and deaths to the formal health system, with the consequent underestimation of malaria burden. Adult age group had the highest mortality rate, emphasizing the known effect of malaria on this population group. Males lost more than females in all age groups, which altered the picture displayed by the incidence rates alone. Complications and causes of death involved highest in malaria mortality was terminal cardio respiratory arrest. The epidemiological estimates in this study form a basis for comparing interventions that affect mortality and morbidity differently, by comparing the amount of burden averted by them. Apart from P. falciparum, P. vivax infection also tends to severe complications. There is a need to do study on malaria mortality by P. vivax malaria.

KEYWORDS: Malaria mortality, Plasmodium falciparum, Plasmodium vivax, Slide positivity rate, Navi Mumbai.

INTRODUCTION

Malaria is still causes high morbidity and mortality in tropical countries. In 2015, an estimated that 212 million malaria cases occurred worldwide, out of which African Region (90%), followed by the South-East Asia Region (7%) and the Eastern Mediterranean Region (2%). About 4% of estimated cases globally are due to *Plasmodium vivax*, but outside the African continent the proportion of *P. vivax* infections is 41%. According to the data from world health organization (WHO), incidence rate of malaria is estimated to have decreased by 41% globally between 2000 and 2015, and by 21% between 2010 and 2015. In 2015, it was estimated that there were 429 000 deaths from malaria globally. Most deaths in 2015 are estimated to have occurred in the African Region (92%), followed by the South-East Asia Region (6%) and the Eastern Mediterranean Region (2%). The vast majority of deaths (99%) are due to *Plasmodium falciparum* malaria. *P. vivax* is estimated to have been responsible for around 3100 deaths in 2015, with 86% occurring outside Africa (1)

According to the WHO estimates 207 million cases of malaria occurred globally in 2012 and 6,27,000 deaths; about 80 per cent of these cases were found in African countries and 13 per cent in South East Asia Region (SEAR) countries. India contributes to 61 per cent of malaria cases and 41 per cent of malaria deaths in SEAR countries (1).

According to National Vector Borne Disease Control Programme (NVBDCP) India contributes 70% of malaria cases and 69% of malaria deaths in the South-East Asia Region. However, a WHO projection showed an impact in terms of a decrease of 50–75% in the number of malaria cases by 2015 in India, which showed that the country has been on track to decrease case incidence 2000–2015 [2] According to NVBDCP In Maharashtra state in 2014, total cases were detected 53,385 and P. falciparum was 25,770 and death were 68 (2).

However worldwide and regional estimation of malaria mortality has been difficult due to three reasons. First, the recorded case-mortality rate from malaria may be misleadingly low even in populations that still have high malaria mortality rates because the disease can be cured easily if treated promptly, so those episodes that are diagnosed properly will not be those that cause most of the deaths (3). Second, where health care facilities are limited, severe malaria in people who die of it without any medical attention is easily mistaken in retrospective enquiries for some other life-threatening fever; conversely, other febrile causes of death can be mistaken retrospectively for malaria. Lastly, in most rural areas where death from malaria is common, proper medical attention at the time of death is uncommon (4-5).

Malaria transmission depends on two primary factors: 1) location of mosquito breeding sites and 2) clustering of human habitations where people serve as reservoirs of parasites for mosquito infection. Previous successes in malaria control for example in India and Sri Lanka were primarily attributed to the effects of residual insecticide spraying which severely reduced Anopheline population (6). A typical attack of malaria comprises three distinct stages: Cold stage, hot stage and sweating stage. The clinical features of malaria vary from mild to severe, and complicated, according to the species of parasite present, the patient's state of immunity, the intensity of infection and also the presence of concomitant conditions such as malnutrition and other diseases (6) Navi Mumbai is a planned township of Mumbai off the west coast of the Indian state of Maharashtra in Konkan division. Mumbai has a population of 1,119,477 as per the 2011 provisional census (7).

MATERIALS AND METHODS

This cross sectional and retrospective study was conducted in teaching Hospital, Navi Mumbai, India over a period of one year. All the patients with fever and chills as major complain who had attended OPD and IPD of Medicine. Patient's clinical history was recorded for comparing the severity of the disease and co-morbidity.

The following formula was used to calculate SPR, SFR and Pf.

1. Slide Positivity Rate (SPR) = Total positive x 100 / Total slides examined.
2. Slide Falciparum Rate (SFR) = Total positive PF x 100 / Slides examined.
3. P. falciparum Percentage (PF %) = Total positive for P. falciparum x 100 / Total positive for MP

Ethical Clearance: Ethical clearance was obtained from the Institutional Ethical committee of MGM Institute of Health Sciences (Deemed University), Navi Mumbai before starting the project.

Statistical Test: Chi-square test and SPSS (version 17) software was used for statistical analysis.

RESULTS

Slide Positivity Rate (SPR) and Slide Falciparum Rate (SFR) was 16.58% and 8.50% respectively. Plasmodium falciparum was 45.24% of the total positive cases.

Total slide positivity rate (SPR) was 16.58%, slide falciparum rate (SFR) was 7.50% and Plasmodium falciparum was 45.24%. Month wise SPR, SFR and Pf % was seen maximum in the month of July to November peak in October i.e. SPR 23.68%, SFR 13.45% and Pf 56.79%.

Mortality analysis- was sex wise distribution males were predominant i.e. 19/26 (73.08%) than females 7/26 (26.92%). Male to female ratio was 3:1.

Age wise malaria mortality was recorded maximum in the age group of 21 to 30 years i.e. 10/26 (38.46%), followed by 11 to 20 years 6/26 (23.08%), 41 to 50 and 50 and above was 4/26 (15.38%) each, lowest was age group 31 to 40 years i.e. 2/26 (7.69%), however no death cases found in the age group of 0 to 10 years.

Malaria mortality due to Plasmodium species was recorded maximum due to P. falciparum i.e. 19/26 (73.08%) than P. vivax 7/26 (26.92%). Falciparum to vivax ratio in mortality was 3:1.

Complications and causes of death involved in malaria mortality was terminal cardio respiratory arrest in 20 cases, followed by cerebral malaria 4 cases, Acute Respiratory Distress Syndrome (ARDS) 4 cases, multi organ failure 5 cases, dengue (co-infection) 3 cases, Sub Dural Haematoma, Sinus Thrombosis and Myocardial Infarction 1 case each.

Month wise	No. of samples	Malaria Positive	SPR (%)	SFR (%)	Pf (%)
January	379	41	10.82	4.75	43.90
February	369	24	6.50	4.34	66.67
March	209	24	11.48	7.18	62.50
April	234	32	13.68	5.98	43.75
May	208	41	19.71	5.77	29.27
June	215	41	19.07	6.05	31.71
July	381	97	25.46	8.40	32.99
August	576	105	18.23	7.29	40.00

Table 1: Shows Month Distribution of Malaria

September	623	97	15.57	9.79	62.89
October	684	162	23.68	13.45	56.79
November	568	105	18.49	5.63	30.48
December	432	40	9.26	4.40	47.50
Total	4878	809	16.58	7.50	45.24

Cont. Table 1: Shows Month Distribution of Malaria

Sex wise	Total death	Percentages
Male	19	73.08%
Female	07	26.92%
Total	26	100%

Table 2: Showing Sex Wise Mortality Of Malaria

Age group (Years)	Total death	Percentages
0-10	0	0%
11-20	6	23.08%
21-30	10	38.46%
31-40	2	7.69%
41-50	4	15.38%
50 and above	4	15.38%
Total	26	100%

Table 3: Showing Age Wise Mortality Of Malaria

Species wise	Total death	Percentages
P. falciparum	19	73.08%
P. vivax	7	26.92%
Total	26	100%

Table 4: Showing Type Of Malaria

Sr. No.	Complications and Causes of death	Number
1	Terminal Cardio Respiratory Arrest	20
2	Cerebral Malaria	4
3	Acute Respiratory Distress Syndrome	4
4	Multi Organ Failure	5
5	Dengue (Co-infection)	3
6	Sub Dural Haematoma	1
7	Sinus Thrombosis	1
8	Myocardial Infarction	1

Table 5: Analysis Of Causes Of Death In Malaria Cases

DISCUSSION

Even a century after the discovery of malaria transmission through mosquitoes in India by Sir, Ronald Ross in 1897, malaria continues to be one of India's leading pubic health problems. In the 1930s, a treatise written by Sinton (1935) on 'what malaria costs India' recorded that the problem of the very existence in many parts of India was in fact the problem of malaria. In those days, 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. In 1935, it was estimated that 100 million malaria cases and 1 million deaths occurred in India. Another estimate in 1947 suggests that 75 million cases (21.8% population) occurred in the post independence population of 334 million with some 800,000 deaths. From this point, India achieved spectacular gains in malaria control during the 'Eradication Era' in the 1950s till the mid 1960s when reported cases were reduced to 64,000. In the post resurgence phase, for many decades reported cases of malaria fluctuated between 1.5 and 3.0 million against the backdrop of rising population of India (8).

About 95% population in the country resides in malaria endemic areas and 80% of malaria reported in the country is confined to areas consisting 20% of population residing in tribal, hilly, difficult and inaccessible areas. National Vector Borne Disease Control Programme (NVBDCP) has framed a number of well-structured National Disease Control/Elimination Programs was implemented by the state governments in India. Indian government is given priority to health care system in three different ways (1. primary health care system of primary health centers and subcenters in rural areas, urban health centers and dispensaries in the towns, 2.

Year	Population in thousand	Blood Smear Examined	Positive cases	Pf Cases	ABER	API	SPR	SFR	Deaths
2001	984579	90,389,019	2,085,484	1,005,236	9.18	2.12	2.31	1.11	1005
2002	1013942	91,617,725	1,841,229	897,446	9.04	1.82	2.01	0.98	973
2003	1027157	99,136,143	1,869,403	857,101	9.65	1.82	1.89	0.86	1006
2004	1040939	97,111,526	1,915,363	890,152	9.33	1.84	1.97	0.92	949
2005	1082882	104,143,806	1,816,569	805,077	9.62	1.68	1.74	0.77	963
2006	1072713	106,725,851	1,785,129	840,360	9.95	1.66	1.67	0.79	1707
2007	1087582	94,928,090	1,508,927	741,076	8.73	1.39	1.59	0.78	1311
2008	1119624	97,316,158	1,526,210	775,523	8.69	1.36	1.57	0.80	1055
2009	1150113	103396076	1563,574	839,877	8.99	1.36	1.51	0.81	1144
2010	1167360	106040223	1495817	779549	9.21	1.37	1.41	0.74	1018
2011	1194901	109313294	1310656	665004	9.12	1.10	1.20	0.61	754
2012	1211580	109048884	1067824	533695	9.00	0.88	0.98	0.49	519
2013	1221640	113445106	881730	463846	9.26	0.72	0.78	0.41	440
2014*	1234995	124066331	1102205	722546	10.05	0.89	0.89	0.58	561

Table 6: Epidemiological Indicators For Malaria In India (2001-14*) (Source: Ref. 11)

BSE: Blood Smear Examined *Prov.

ABER: Annual Blood Smear Examination Rate (percentage of blood smears examined in a year of total population)

district hospitals for secondary care; and 3. medical colleges and hospitals for tertiary care). Tertiary care hospitals are also operated by large public sector industrial units and a large private sector industry. Apart from that, ASHA- a village volunteer is involved in the programme to provide diagnostic and treatment services at the village level as a part of introduction of intervention like Rapid Diagnostic Tests and use of Artemisinin Combination Therapy (ACT) for the treatment of Pf cases (9-10).

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Total slide positivity rate (SPR) was 16.58%, slide falciparum rate (SFR) was 7.50% and Plasmodium falciparum was 45.24%. Month wise SPR, SFR and Pf % was seen maximum in the month of July to November peak in October i.e. SPR 23.68%, SFR 13.45% and Pf 56.79%.

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Talsania N et al. studied on 17 deaths due to malaria. 5 patients died due to complications of *P. vivax* infection and 12 patients died due to *P. falciparum*. Maximum patients (88.2%) presented with fever (Intermittent and Continuous). Immediate cause of death due to complication was maximum with Acute Renal Failure (29.4%) followed by Acute Respiratory Distress Syndrome (23.5%) and Septicemia (23.5%) (11).

CONCLUSION

The study revealed underreporting of malaria episodes and deaths to the formal health system, with the consequent underestimation of malaria burden. Adult between 21 to 30 years of age had the highest mortality rate, emphasizing the known effect of malaria on this population group. Males lost more than females in all age groups, which altered the picture displayed by the incidence rates alone. Complications and causes of death involved highest in malaria mortality was terminal cardio respiratory arrest. The epidemiological estimates in this study form a basis for comparing interventions that affect mortality and morbidity differently, by comparing the amount of burden averted by them. Apart from P. falciparum, P. vivax infection also tends to severe complications. There is a need to do study on malaria mortality by P. vivax malaria.

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