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Measuring impact on filarial infection status in a community study: Role of coverage of mass drug administration (MDA)

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Abstract. Lymphatic filariasis is still endemic in many parts of India. The main strategy to implement mass drug administration with DEC and albendazole was added in 2006 to ensure increased impact on the microfilaria (mf) rate in the community. However, the effective coverage remained low in the community leading to lower than desired impact on the parasite population in human. This paper presents the dynamics of participation in annual repeated rounds of mass drug administration in some villages of Kanpur Nagar district in Uttar Pradesh and its impact over the infection rate. It is revealed that after 6 annual rounds of MDA, mf rate could only be reduced by 17.3% in population subgroups who participated only once in comparison to 88% in those who participated in 6 or all annual rounds.

INTRODUCTION

Lymphatic filariasis has been a major public health problem in India. The disease is reportedly endemic in about 250 districts of India, spread over 20 states and Union territories of India. About 600 million people are at risk of lymphatic filariasis in these districts. The strategy for achieving the goal of elimination of filariasis is by annual Mass Drug Administration (MDA) of anti-filarial drug diethylcarbamazine citrate (DEC) for 5 years or more to the population, excluding children below two years, pregnant women and seriously ill persons in affected areas, to interrupt transmission of disease (NVBDCP, 2013).

However, several studies (El-Southy *et al.*, 2007; Ramzy *et al.*, 2009; Ravish *et al.*, 2011; Sinha *et al.*, 2012; Roy, *et al.*, 2013) had indicated variable drug coverage and compliance to MDA and therefore it is anticipated that the impact over a given infection level may be variable. A simulation based study had clearly suggested that it would take 6 annual rounds to bring down the microfilaria (mf) rate of 10% to 0.5% if MDA coverage is >90%, otherwise it would take several more years (Michael *et al.*, 2004).

This study was conducted to provide the inside dynamics of variable MDA doses and its impact on mf prevalence at the end of 6 years or 7 rounds (baseline and 6 annual rounds).

MATERIALS AND METHODS

The present study reports on MDA coverage, compliance and its impact on mf rate in 4 villages of Ghatampur block in Kanpur Nagar District of Uttar Pradesh in India. The total population in these villages is 3912. The study began in the year 2004 with the first survey (Baseline R0) and concluded in 2010. A volume of 20 µl blood sample was collected on a micro slide in late evening hours after 7 pm and processed to examine for mf using standard procedures (Sasa, 1967). MDA was

given to all after the blood slide was taken and some absentees the next day. All the persons were asked to swallow the DEC tablets in the presence of project team members. Therefore the compliance was nearly 100%. This procedure was repeated every year for 6 years. If a slide reading showed 1 or more mf, this was labeled as positive, otherwise as negative.

RESULTS

Baseline mf rate

In these 4 villages, nearly 2/3 of the population (2499/3912) cooperated in providing blood samples for slide preparation and the mf rate was observed to be 9.96% (249/2499) with mf counts ranging from 1 to 170 per 20 µl blood sample. The inter-village mf rate varied from 9.5% to 10.79%. The infection was due to *Wuchereria bancrofti* parasite.

Possible number of groups at repeated rounds of smear/MDA

It is a practical problem faced in this kind of survey that many persons were either not available (for whatever reasons) at the time when the study team visited the villages or they were unable to ingest DEC/MDA for reasons such as being unwell/pregnant/lactating/asthma/on other medications or just refused to participate. Such a system leads to an individual participating in variable rounds of MDA and a fraction of the population either did not participate at all or participated in all rounds.

The scenario presented in Table 1 reveals that there could be 128 possible combinations in a situation where 6 annual rounds are done after the baseline round at the time of blood sampling. If such a situation is mixed with annual rounds of MDA done simultaneously, then this number increases manifolds from 128. This paper elaborates on the former situation as described in Table 1.

As can be observed, an individual can participate annually every time (7 rounds including baseline) or 6 times or 5 times or 4 times or 3 times or 2 times or once only or never. In such cases, there are options like when to participate in two rounds, one could have done so in the following ways: R0R1, R0R2, R0R3,R0R4,R0R5, R0R6 and so on ……R5R6 (21 groups). Similarly, an option to participate in 3 rounds gave rise to 35 groups (R0R1R2, R0R1R3, R0R1R4, R0R1R5, R0R1R6 and so on ……R4R5R6).

Coverage of mass drug administration by rounds

At the baseline round, only 61.5% population ingested DEC. At round 1, 21.9% never ingested, 40.1% ingested once and 38% ingested twice. Similarly, at the end of round 2, 14.9% never ingested, 29.4% once, 27.7% twice and 28% ingested DEC thrice and so on. At the end of round 6, 2.1% 'remained untouched' by MDA, 16.5% ingested once, 10% twice, 9.2% thrice, 11.3% 4 times, 15.6% 5 times, 18.4% 6 times and 16.9% every time the MDA was given. It can therefore be said that 97.9% of the population ingested DEC

Table 1. Possible number of groups at repeated rounds of blood smear

Rr	Smear								Possible Groups
R0	Yes				No				2^{r+1} = 2 for r=0
R1	Yes		No		Yes		No		2^{r+1} = 4 for r=1
R2	Yes	No	Yes	No	Yes	No	Yes	No	2^{r+1} = 8 for r=2
R3									2^{r+1} = 16 for r=3
R4									2^{r+1} = 32 for r=4
R5									2^{r+1} = 64 for r=5
R6									2^{r+1} = 128 for r=6

at least once during the time of the study (Table 2).

Decline in mf prevalence over the annual rounds

Interestingly, 7.8% of the population participated in all MDA rounds and 3.2% never participated, 26% participated only once, 16% only twice, 13.8% only thrice, 11.8% participated in 4 rounds, 11.2% in 5 rounds and 10.1% in 6 rounds.

The mf rate from initial level to the end of 6th round declined by 17.3% among those who participated only once during the study; 78.8% among those who participated twice; 84.4% among those who participated thrice; 71% in those who participated 4 times; 73% in those who participated 5 times; 87.8% among those who participated 6 times and the highest 88.7% in those who participated every time (Table 3). It is notable that the mf rate decline was lower in persons who participated in 2 to 5 rounds of MDA compared to those who participated in 6 or all rounds, despite the fact that the initial mf rates were much lower in the former group (5.3% to 8.4%) as compared to the latter group (10.3% to 11.5%). This clearly reveals the inside dynamics as to why elimination of lymphatic filariasis is difficult unless coverage of MDA increases to >90% in the filarial endemic communities.

DISCUSSION

This paper aims to analyze the dynamics of MDA use in the community and its impact on

Table 2. Compliance with mass drug administration(MDA) for lymphatic filariasis in villages of Ghatampur, Kanpur, India

Round	Cumulative (%) MDA doses taken (N=3912)							
	0	1	2	3	4	5	6	7
0	38.5	61.5						
1	21.9	40.1	38.0					
2	14.9	29.4	27.7	28.0				
3	10.6	21.4	19.1	23.8	25.1			
4	7.3	18.6	12.2	16.5	22.7	22.7		
5	3.8	18.5	10.3	11.3	16.4	20.9	18.8	
6	2.1	16.5	10.0	9.2	11.3	15.6	18.4	16.9

Table 3. Summary of mf rate at examination in variable rounds (N=3912)

Frequency of participation (n)	Mass Drug Administration rounds from baseline (R0) to Sixth (R6)								% Decline in Mf rate
	R0	R1	R2	R3	R4	R5	R6	% (N)	
NEVER(126)	X	X	X	X	X	X	X	3.2	N/A
ONCE(1012)	7.5	14.6	19.4	4.2	5.6	8.6	6.2	26.0	17.3
TWICE(628)	5.3	3.2	1.8	1.4	1.0	1.4	1.1	16.0	78.8
THRICE(545)	5.9	4.4	2.4	2.0	2.4	1.3	0.9	13.8	84.4
4 Times(460)	6.7	5.9	3.5	1.7	2.0	1.5	2.0	11.8	71.0
5 Times (440)	8.4	5.2	5.0	3.0	2.5	2.1	2.3	11.2	73.0
6 Times (397)	10.3	6.1	4.8	3.0	2.8	1.3	1.3	10.1	87.8
All the time(304)	11.5	7.9	6.3	2.0	2.0	2.6	1.3	7.8	88.7

X – indicate absence in that round of smear/MDA

Table 4. Trends of mf rate and MDA coverage

Round	Mf rate	Mf counts		MDA coverage (%)
		Highest	Average	
R0-Baseline	10.0	170	2.03	61.5
R1	8.4	176	1.58	54.6
R2	6.5	100	0.69	52.8
R3	4.0	100	0.45	62.6
R4	4.2	90	0.52	65.6
R5	3.3	91	0.31	59.5
R6	3.2	110	0.33	59.7

elimination of lymphatic filariasis as measured by mf rates over the years. In this population, the initial (baseline) mf rate was about 10%. The trend of MDA coverage and mf rate from baseline to 6th round revealed that mf rate over the years declined by 68% (from 10% to 3.2%) and highest mf density per slide averaged 170 mf at baseline to 176 mf the following year and declined to 90 mf, then remained at ~100 mf. The average mf counts during these rounds declined from 2.03 at baseline to 0.33 at 6th rounds. This is in relation to MDA coverage from 61.5% to 52.8% in second round and thereafter maintained at ~60% (Table 4).

The higher impact on mf rate achieved in those who participated in 2 or 3 rounds could be due to lower initial mf rate in the subgroups (5.3% or 5.9%) (Table 3). This is in contrast to the high mf rate of ~11% in those participated in 6 or all the rounds and achieved ~88% elimination of initial mf rates. A study done in Egypt also showed that residual infection rate declined by >50% from baseline among those who participated only once in MDA (El-Southy *et al.*, 2007) and about 98.1% with 3 round of MDA in Papua New Guinea (Weil *et al.*, 2008) and another study revealed 79% decline in mf rate in another island after 5 rounds (Mitja *et al.*, 2011).

The main purpose of MDA is that it could help to clear parasite population in humans and in vectors simultaneously. However such an outcome is a function of a high drug coverage and compliance. A study conducted in Burdwan, West Bengal, India (Roy *et al.*, 2013) showed an effective coverage of 34.16% (coverage 48.76%, compliance 70.1%). In another study (Ravish *et al.*, 2011) in Bijapur (Karnataka, India) showed that although there was fairly high coverage of 86%, the compliance was only 46%, therefore the effective coverage was only below 40%. Similarly, in the district of Midnapur in West Bengal where coverage was 84.1% but compliance rate was 70.5%, the effective coverage was 59.3% (Sinha *et al.*, 2012). Such a situation cannot effectively work to eliminate filariasis. However in the present study, people were asked to consume drugs in the presence of project team members and therefore, the coverage is also the effective coverage and could have led to better effect on mf rates in the community. However, effective coverage remained below 2/3 of the target population.

Although MDA with DEC alone or with DEC and albendazole have the potential to achieve the target goal if effective coverage reaches >75% in the community, most elimination programmes are not able to reach this level due to poor community participation. One of the reasons observed in our study is that some asymptomatic mf carriers developed fever soon after consuming DEC and this had sent a wrong message to the community and led to decline in the participation rate. However, it was noted that this negative impact slowly diminished and MDA coverage increased when the community's confidence returned, leading to the increased coverage by 10 to 20% after 3rd round of annual MDA.

The data presented in this study clearly suggested that to achieve lymphatic filariasis

elimination, MDA needs to be continued for several years in the future, along with increase in community participation.

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