Surveillance of lymphatic filariasis after stopping ten years of mass drug administration in rural communities in south India

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Background: While various studies provided insight into the impact of mass drug administration (MDA), information on the dynamics of the post-MDA threshold level lymphatic filariasis (LF) infection facilitates understanding its disappearance pattern and determining the duration of post-MDA monitoring and evaluation.

Methods: The changes in microfilaraemia (Mf) prevalence and vector infection rates were monitored for four (2005–2008) and six years (2005–2010) respectively after stopping ten rounds of annual mass diethylcarbamazine (DEC) administration in a group of five villages located in South India. Four years after stopping MDA, circulating filarial antigenaemia (Ag) status among children and adults was also assessed in two villages.

Results: Overall Mf prevalence (n = 700) and vector infection rates (n = 803–3520) showed a declining trend. Two villages maintained zero Mf status in each of the four years, vector infection rate was zero from the third year onwards and Ag prevalence in adults was 0.4% (n = 226). In two other villages despite persistence of Mf and vector infection there was zero vector infectivity rate during the third to sixth year and Ag prevalence among children (n = 50) was nil. In the fifth village Mf prevailed at <1.0% and Ag prevalence among 1–7 year old children was 4.6% (n = 44) and vector infectivity rate during the sixth year was 0.1% (n = 852).

Conclusion: The incidence of sporadic new infections is evident in highly endemic communities such as the fifth village. However, there is uncertainty on the potential of the Ag positive children to reestablish infection. Six years of post-MDA monitoring and evaluation appears to be adequate to discern the status of transmission interruption and appropriate decision making.

Keywords: Lymphatic filariasis, Mass drug administration, Elimination, Surveillance, DEC, India

Introduction

Lymphatic filariasis (LF) is a debilitating mosquito borne disease widely prevalent in many tropical countries. LF was identified as an eradicable disease by CDC in 1993 and targeted for elimination. A global programme to eliminate the disease as a public health problem was launched in 2000. The programme envisages annual mass administration of a single dose of diethylcarbamazine (DEC) or ivermectin combined with albendazole (ALB) to interrupt transmission and eliminate LF. Several countries have launched the mass drug administration (MDA) programme and are progressing well towards control/elimination of the disease. A number of studies showed that MDA exerts a tremendous impact on LF infection and transmission and five or more rounds were shown to reduce microfilaraemia (Mf) prevalence to <1.0% in a majority of communities. Similar results were also observed under some national programmes. Robust monitoring and evaluation of MDA is necessary to assess its impact and to stop MDA when the indicators of impact – Mf prevalence in the population or vector infection rate or antigenaemia (Ag) prevalence in the children born during the MDA period – fall below the threshold level. It is also necessary to monitor the post-MDA changes in LF infection and transmission, at least for a few years, to be sure that the fall in infection is sustained, transmission interruption is complete and incidence of new infections, if any, is below permissible levels. Such post-MDA monitoring and evaluation is necessary to declare the intervention units as free from LF transmission.

While a number of studies provided insight into the impact of MDA, information is scanty on the dynamics of the post-MDA threshold level LF infection. Such information facilitates understanding its disappearance pattern and determining the duration of post-MDA monitoring and evaluation. We studied the impact of 10 rounds of MDA (using DEC alone) on LF infection and transmission in endemic communities of south India, the results of which were reported earlier. The same communities were monitored and evaluated for 6 years after the overall Mf rate of the study communities was brought down to <1.0%, considered to be the safe and threshold level to stop MDA, by administration...
of 10 rounds of annual mass DEC administration. The monitoring and evaluation had been done using parasitological, entomological and immunological methods and the results are reported here.

**Study area**

The study was carried out in five villages in Villupuram district, Tamil Nadu state, India (Figure 1). The total population of the five study villages was 9889 (739 to 3321) in 1994, when the intervention (MDA) was started under the study. The villages were endemic for bancroftian filariasis, transmitted by the tropical house mosquito, *Culex quinquefasciatus*. Favourable transmission conditions combined with lack of control operations facilitated high prevalence and persistence of the disease in the study communities prior to the intervention. Various other details of the study area were given in an earlier publication.6 In brief, each village is well separated from one another with similar ecological and socio-economic characteristics. Agriculture and weaving are the predominant occupations of the study population. Primary health centres are the major source of health care. The major breeding habitats of the vector species, *Culex quinquefasciatus*, are domestic water collections in and around the households. Transmission reaches peak level during November–March and no LF control measures were carried out prior to the present study.

**Details of MDA**

With an objective of evaluating the impact of annual single dose mass treatment on LF infection and transmission, an intervention study was started in 1994 in the study villages. After the collection of baseline data over a one year period, the first round of MDA was given in 1994. A total of 10 rounds of MDA were implemented, the last given in 2004. DEC alone, at the dose of 6 mg/kg body weight, was used in the MDA. Children below 15 kg body weight, pregnant and lactating women and severely ill people were excluded from treatment. No further intervention measures were implemented after the 10th MDA.

In each village, three to four teams of three to four health workers each were constituted to impart the treatment to the study communities. Using the census list prepared for each village, the teams visited every household and gave the tablets according to the weight of each individual.6 Treatment coverage ranged between 49 and 84% at village level and from 53 to 75% in different rounds of treatment. On average an individual consumed the drug six times out of 10 rounds of treatment.

**Material and methods**

We evaluated the impact of 10 rounds of MDA, implemented under the study, by measuring the changes in three parameters: Mf prevalence, vector infection rate and Ag prevalence. The same
parameters were monitored, using the same techniques, during the post-MDA period also to understand the changes in LF infection and transmission.

**Mf prevalence**

Night blood surveys were carried out annually in all five villages for four years (2005–2008) to study the changes in Mf prevalence after stopping the MDA. During the base-line survey complete enumeration was carried out to record number of households and details of individuals (age and gender) residing in each household. All the enumerated households were numbered serially in each village and based on the initial Mf survey sample size was determined with an error margin of 20% and 95% confidence. The required sample size was covering a minimum of 7% of households and in each village these households were selected randomly using Epi-info software 6 (CDC, Atlanta, GA, USA) random number generation. All members of the selected households were blood sampled. From each consenting member, approximately 60mm$^3$ of blood was collected and made into 3 thick smears of 20mm$^2$ each. The blood samples were collected between 20:00 and 24:00 h as the parasitemia was noted. The laboratory and examined for Mf. The number of microfilariae in each positive smear was noted.

**Vector infection rates**

Mosquito surveys were carried out and vector infection rates monitored for six years (2005–2010) after stopping the MDA. Mosquitoes were collected at monthly intervals in all five study villages during the peak seasons of January to March and October to December every year. In each village, mosquitoes were collected through a mechanical aspirator from 12 fixed households, spending about 15 min per household. On collection day, the mosquitoes were transported to the laboratory where they were separated according to species and sex. Specimens of the vector species, *Culex quinquefasciatus*, were dissected and others discarded. Each mosquito was cut into three parts (head, thorax and abdomen) and placed in three separate drops of normal saline. The parts were gently macerated with needles and examined under a compound microscope for the presence of filarial larvae. The number of different stage filarial larvae (Mf/L1/L2/L3) present in each body part was recorded. The vector infection (% of dissected mosquitoes with Mf/L1/L2/L3) and infectivity (% of dissected mosquitoes with L3) rates were computed. The dissection procedure has been described in previous publications.

Mosquito surveys were not carried out in two villages, Muppili and Thenkalavai, in year 5 as during the preceding two years we were not able to detect mosquitoes with infection. However, they were resumed in the sixth and last year of evaluation.

**Ag assessment**

In Alagramam we assessed Ag prevalence both in children (1–7 years) and adult (15–45 years) age-groups; in Thenber village only in children and in Muppili village only in adults. The assessment was done in 2008, four years after stopping the MDA. Ag was assessed using immunochromatographic (ICT) card test, which detects circulating antigen to *Wuchereria bancrofti* following instructions provided by the manufacturer. In Alagramam, about 7% of the households were selected and all the children and adult members of these households were sampled. In Muppili, close to 50% of the adult population was sampled in order to evaluate the proportion of infected people robustly. In Thenber, all the available and willing children were sampled to assess the incidence of new infections.

**Statistical analysis**

Mantel-Haenszel/Woolf test with the fixed effect assumption was carried out for $\chi^2$ – heterogeneity in the reduction of microfilaria infection prevalence among the villages from base-line to post-tenth of MDA periods as done in the earlier study. To see the trend in Mf prevalence, vector infection and infectivity rates during the evaluation period (4–6 years) of post-MDA, $\chi^2$ trend in proportion test was carried out. These analyses were carried out using STATA 9.0 (StataCorp LP, College Station, TX, USA) and IBM SPSS 19.0 (SPSS Inc., Chicago, IL, USA). A probability level of $p < 0.05$ was considered for all statistical significances.

**Informed Consent**

Written consent of all the participants and consent of the parents for children <15 years was obtained to collect the finger prick blood sample for Mf and Ag assessment. Confidentiality of the results was maintained and only family members of the positive households were informed of the Mf and/or Ag positive result.

**Treatment**

The individuals found positive for Mf and/or Ag were treated with a single dose of DEC, the drug used by the national filarial control programme in India prior to revised strategy (DEC 6mg/Kg body weight + Albendazole 400mg) for elimination programme.

**Results**

**Mf prevalence**

The baseline overall Mf prevalence in the study villages was 13.2% (94/711) (range 6.8% [3/44] to 17.2% [41/238]; 95% CI 10.73–15.71). Following 10 rounds of mass DEC administration, it declined to 0.9% (6/697) (range 0% [0/76] to 1.7% [4/231]; 95% CI 0.2–1.6) by the end of one year after stopping the last and 10th MDA (Mantel-Haenszel $\chi^2 = 56.3; p < 0.05$). During the following three years, the Mf rate remained stable ($\chi^2$ trend in proportion $=0.319; p = 0.5723$) at $<0.9%$ (range 0% [0/108] to 1.7% [4/239]). While two villages showed 0% (sample size ranged between 54 and 83) Mf rate during the entire post-MDA period, another village showed no Mf (n = 108) from post-MDA third year onwards. In the other two villages (Alagramam and Thenber), residual Mf carriers continued to persist (Figure 2).
The median age of these carriers was 50 years (range 13–64); the youngest was 13 years.

Vector infection rates

During the six year evaluation period, we collected and dissected a total of 10,842 mosquitoes to assess the changes in vector infection rates. Following 10 rounds of MDA in the study villages, the overall vector infection rate declined from the baseline level of 18.4% (649/3520) (range 8.9% [82/917] to 29.2% [257/881]; 95% CI 17.2–19.7) to 1.7% (32/1871) (range 0% [0/61] to 2.7% [18/655]; 95% CI 1.1–2.3). During the next five years after stopping MDA, it fluctuated between 0.5% (11/2390) (range 0% [0/426] to 0.8% [7/852]) and 1.9% (24/1289) (range 0% [0/366] to 4.7% [16/339]). Two of the five study villages (Muppili and Thenkalavai) remained free from infected mosquitoes for 4 years, i.e., the post-MDA period of the third to sixth year. Podirappillyur showed no infected mosquitoes for three years, i.e., fourth to sixth year post-MDA. However, Alagramam and Thenber showed infected mosquitoes almost throughout the 6 year evaluation period. Of these Thenber mostly showed <1.0% infection rate. Alagramam consistently showed infected mosquitoes, with the infection rate ranging from 0.8% (7/852) to 2.7% (18/655) (Table 1).

As a result of 10 years of MDA, the overall vector infectivity rate fell from the base-line level of 1.0% (35/3520) (range 0.2% [2/917] to 1.9% [8/427]; 95% CI 0.7–1.3) to 0.1% (2/1871) (range 0% [0/417] to 0.2% [1/428]; 95% CI 0.0–0.3). During the next six years, the rate fluctuated between 0% (0/2049) and 0.2% (5/2440) (range 0% [0/449] to 0.6% [3/518]). During the last five years of the evaluation, i.e., during the second to sixth year after cessation of MDA, no infective mosquitoes were found in four of the five study villages. However, infective mosquitoes were found, although not consistently, in Alagramam, in which infected mosquitoes were also seen frequently (Table 1).

The \( \chi^2 \) trend in proportion test showed that both the infection rate (\( \chi^2 = 7.84; \ p = 0.0051 \)) and infectivity rate (\( \chi^2 \) trend in proportion = 5.58; \( p = 0.0182 \)) exhibit declining trend during the evaluation period of six years.

Ag prevalence

Four years after the cessation of MDA, the adult population, evaluated in two villages, Alagramam and Muppili, showed an overall Ag prevalence of 1.2% (4/321) (95% CI 0.0–2.5). The prevalence rate in children, also assessed in two villages, Alagramam and Thenber, was 2.1% (2/94) (95% CI 0.0–5.0). These rates were 96% and 88% respectively, less than the rates observed in children and adults after the sixth round of MDA (Table 2).

Discussion

Ten rounds of MDA in the study villages reduced the Mf prevalence by 93% and vector infection and infectivity rates by 91% and 89% respectively. At the end of one year after the cessation of the tenth MDA, the overall Mf rate of the villages stood at <1.0% (Figure 2) and the vector infection and infectivity rates remained at 1.7% and 0.1% respectively (Table 1). After the cessation of MDA, we continued monitoring the changes in the Mf rate and vector infection rates for four and six years respectively to assess whether the impact of the MDA was sustained and if there was any threat of reestablishment of infection.

The parasitological, entomological and immunological evaluation suggests that, overall, the impact of the MDA was well sustained and the impact indicators showed a declining trend after the cessation of MDA, which coincided with the fall of the overall Mf prevalence of the five villages to <1.0% level. The Mf rate of <1.0%, in 60mm³ of blood smears, is the threshold level recommended by WHO to provisionally stop MDA. MDA can definitely be stopped and post-MDA surveillance instituted if the transmission assessment surveys (TAS) show an Ag prevalence of <2% in 6–7 year old children in an intervention unit. Repeated TAS or longitudinal surveillance of special population groups such as military recruits and university students is recommended for post-MDA surveillance. However, this study was started in
2005 and 2006, when there were no clear guidelines for post-MDA surveillance. Hence, we relied upon measurement of changes in Mf prevalence and vector infection rates and Ag prevalence in children.

In two study villages, Thenkalavai and Muppili, the Mf prevalence fell to zero level after the sixth and tenth MDA respectively. This status continued throughout the parasitological evaluation period of four years after the cessation of MDA. Due to zero level Mf prevalence no mosquito was found with filarial larvae during the third to sixth year of entomological evaluation. Encouraged by the absence of Mf in the human population and parasite stages in mosquitoes, we assessed the Ag status of the adult population in Muppili to find out if the infection had totally disappeared. The adult population was assessed because it harbours the highest worm burden\(^\text{12}\) in typical endemic situations and will have a high probability of residual infection. Surprisingly, only one of the 244 sampled people (0.4%) was found positive for Ag. Even in this person, the circulating Ag was found positive for Ag. Even in this person, the circulating Ag may not necessarily be an indication of living and reproductively active adult worms,\(^\text{13}\) they may be decaying. These two villages, with the best results, are the smallest of the five with a population of 739 and 1074 and with moderate baseline Mf and vector infection rates. Thus, an effective MDA has the potential to decimate the *Wuchereria bancrofti* infection, which could be several decades old, in a proportion of endemic villages. The parasite may never get reestablished in these villages because they are small with hardly any immigration.

In two more villages, Thenber and Padirappuliyur, the Mf prevalence fell to <1.0% after the ninth round of MDA.\(^\text{8}\) In Thenber, the Mf rate further declined and reached 0% level by the third year after the cessation of MDA and remained so during the fourth year (Figure 2). Yet we detected close to 1.0% of mosquitoes with infection during all years, with the exception of year 4 when the rate was much higher at 4.7% (16/339) in the fourth year (Figure 2). However, no mosquitoes with infection were found during the second to sixth years of entomological evaluation (Table 1). In both the villages, we failed to detect any mosquito with infective stage larvae, suggesting that the residual microfilariae in either village is not able to cause transmission. Absence of transmission is further confirmed by the absence of Ag in children, evaluated in Thenber. Thus, the evidence from all the impact indicators suggests that both villages are able to sustain the reduced levels of microfilariae and transmission, with a trend towards the gradual disappearance of infection. We, however, are uncertain about the higher vector infection rate and Mf rate, observed only once during the six year evaluation period in these two villages. It might be due to residual microfilaria carriers in a few households during the sampling process and collection of mosquitoes in households where the frequency of mosquitoes is higher. Also, notably, no concordance was seen between Mf prevalence and vector infection levels suggesting that an individual level relationship between Mf level and ingestion of parasites by mosquitoes\(^\text{14–16}\) appears to get diluted at household and community level. As observed in the earlier studies\(^\text{17,18}\) it might be due to complex feeding behaviour and movement of mosquitoes among households. Similarly, at village level, the variation in sampling process involved in the collection of blood smears for Mf assessment and the collection of mosquitoes for infection assessment may obviate concordance between human Mf and vector infection rates. The other limitations of comparing the vector infection and Mf rate are the limited number of mosquitoes dissected and the relatively less sensitive technique of thick blood smear examination for Mf assessment. We dissected a maximum of 852 mosquitoes per village per year. It has been suggested that about 1000 mosquitoes should be assessed per village for robust estimation of infection rates prior to MDA\(^\text{19}\) and a higher number of them should be assessed in post-MDA situation, when the infection rates fall to lower levels.\(^\text{19–21}\)

In Alagramam, the results were subdued. This village had the highest baseline Mf rate of 17.2% (41/238) and vector infection rate of 29.2% (257/881).\(^\text{22}\) Many studies surmised that highly endemic villages take a long time and require more rounds of MDA to get rid of the infection.\(^\text{6,22}\) We discussed the reasons for the prolonged persistence of infection in this highly endemic village in an earlier publication.\(^\text{22}\) While the Mf prevalence was 1.7% (4/231) during the first year after the cessation of MDA, it remained at <1.0% during the subsequent three years, with the lowest Mf rate of 0.4% (1/235) during the

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**Table 1. Vector infection rates (%) during base-line and post-10th MDA periods**

<table>
<thead>
<tr>
<th>Village</th>
<th>Number of mosquitoes dissected</th>
<th>Baseline</th>
<th>Post-10th MDA period</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muppili</td>
<td>Number dissected</td>
<td></td>
<td></td>
<td>435</td>
<td>310</td>
<td>561</td>
<td>455</td>
<td>366</td>
<td>ND</td>
</tr>
<tr>
<td>Thenber</td>
<td></td>
<td></td>
<td></td>
<td>917</td>
<td>428</td>
<td>518</td>
<td>561</td>
<td>339</td>
<td>134</td>
</tr>
<tr>
<td>Thenkalavai</td>
<td></td>
<td></td>
<td></td>
<td>860</td>
<td>61</td>
<td>237</td>
<td>121</td>
<td>33</td>
<td>ND</td>
</tr>
<tr>
<td>Alagramam</td>
<td></td>
<td></td>
<td></td>
<td>881</td>
<td>655</td>
<td>675</td>
<td>600</td>
<td>361</td>
<td>619</td>
</tr>
<tr>
<td>Padirappuliyur</td>
<td></td>
<td></td>
<td></td>
<td>427</td>
<td>417</td>
<td>449</td>
<td>312</td>
<td>190</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>3520</td>
<td>1871</td>
<td>2440</td>
<td>2049</td>
<td>1289</td>
<td>803</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Village</th>
<th>Infection rate (%)</th>
<th>Insectivity rate (%)</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muppili</td>
<td>17.7</td>
<td>1.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>ND</td>
<td>0.0</td>
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</tr>
<tr>
<td>Thenber</td>
<td>8.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td>4.7</td>
<td>0.0</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>Thenkalavai</td>
<td>21.2</td>
<td>0.0</td>
<td>0.4</td>
<td>0.0</td>
<td>0.0</td>
<td>ND</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Alagramam</td>
<td>29.2</td>
<td>2.7</td>
<td>1.8</td>
<td>2.7</td>
<td>2.2</td>
<td>1.1</td>
<td>0.8</td>
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<tr>
<td>Padirappuliyur</td>
<td>11.9</td>
<td>1.7</td>
<td>0.5</td>
<td>0.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>18.4</td>
<td>1.7</td>
<td>0.8</td>
<td>1.1</td>
<td>1.9</td>
<td>0.9</td>
<td>0.5</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Village</th>
<th>Infection rate (%)</th>
<th>Insectivity rate (%)</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muppili</td>
<td>1.4</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>ND</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Thenber</td>
<td>0.2</td>
<td>0.2</td>
<td>0.6</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
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<tr>
<td>Thenkalavai</td>
<td>1.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>ND</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Alagramam</td>
<td>1.1</td>
<td>0.0</td>
<td>0.1</td>
<td>0.0</td>
<td>0.6</td>
<td>0.0</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Padirappuliyur</td>
<td>1.9</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>1.0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.0</td>
<td>0.2</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
</tr>
</tbody>
</table>

ND: Not done.
of Ag is an indication of adult worms. The dramatic reduction in Mf rate respectively, equivalent to 90 and 98% reduction. Presence of Ag prevalence declined to 0.4% (1/226) and 3.2% (3/95) in Muppili and Alagramam cycles of MDA and 4 years post-MDA, the Ag prevalence was not able to substantially reduce the Ag prevalence. These rates were among the highest Ag prevalence of 25.0% (4/16) and 31.6% (35/111) in Muppili and Alagramam, who harbour the highest load of infection. An interesting outcome of the study was the tremendous reduction of Ag prevalence after the sixth MDA revealed a prevalence level from post-sixth to 4 years after the sixth MDA 24 Muppili ND - - 16 4 25.0
Thenber 11 2 18.2
Alagramam 23 4 17.4
Total 34 6 17.6

Fourth year after stopping the last and 10th MDA
Muppili ND - -
Thenber 50 0 0.0
Alagramam 44 2 4.6
Total 94 2 2.1

% reduction in Ag prevalence from post-sixth to 4 years after the 10th MDA
87.9

+ve: Positive; ND: Not done.

Table 2. Ag prevalence in children and adults in the study villages

<table>
<thead>
<tr>
<th>Evaluation period</th>
<th>Village</th>
<th>Children aged 1–7 years</th>
<th>Adult population groups aged 15–45 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. sampled</td>
<td>No. +ve</td>
<td>Ag prevalence (%)</td>
</tr>
<tr>
<td>Post-sixth MDA 24</td>
<td>Muppili</td>
<td>ND</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Thenber</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Alagramam</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>34</td>
<td>6</td>
</tr>
<tr>
<td>Fourth year after stopping the last and 10th MDA</td>
<td>Muppili</td>
<td>ND</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Thenber</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Alagramam</td>
<td>44</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>94</td>
<td>2</td>
</tr>
</tbody>
</table>

It is recommended (http://www.who.int/lymphatic_filariasis/disease/en/), and many studies have demonstrated, that five to six rounds of MDA, using DEC + ALB, will reduce Mf prevalence to <1.0% in a majority of the villages. Empirical evidence for the robustness of the 1.0% microfilaria rate, observed at 60mm3, as threshold level is scarce. The present study shows that from the post MDA 1.0% Mf prevalence level, reestablishment and/or resurgence of infection is unlikely, at least over a period of 6 years. It was observed also in Papua New Guinea, endemic for Anopheles transmitted LF, the Mf and Ag prevalence continue to decline over a period of 5 years after cessation of MDA. However, prevalence of Ag in children in Alagramam, suggests that even at <1.0% Mf prevalence level new infections can occur in highly endemic villages, though the epidemiological importance of the new infections (Ag positive children) is not clear. Albeit, Alagramam, with a base-line vector infection rate of 29.2%, is exceptionally highly endemic and such villages constitute only a tiny proportion of total endemic villages.

The positive result of this study – that post-MDA reestablishment of infection is difficult if Mf prevalence falls to <1.0% – could be attributed to prolonged MDA of 10 years. Such a prolonged MDA was necessary because we administered DEC alone in this study, which is slightly less effective than DEC + ALB combination therapy, and the study villages were relatively more endemic. The better impact of combination therapy...
than single drug therapy, when used in MDA programmes, makes reestablishment of infection more difficult.

Four to six years of parasitological and entomological monitoring, supported by Ag assessment, after the cessation of MDA provided insights into the changes in and the trend of LF infection and transmission in the study villages. We were able to clearly see a declining pattern of infection in all villages. While the (declining) trend is clear and there was no evidence for LF transmission in 4 out of 5 villages after the cessation of MDA, it may not be safe to leave the fifth village, Alagramam, without further intervention, in view of the incidence of new infections. It may be safe to implement at least two more rounds of MDA. The study also suggests that about 6 years of post-MDA monitoring and evaluation appears to be adequate to understand the trend of LF infection and transmission and aid decision making as to further requirement of intervention measures or declaring areas free from LF.

Authors’ contributions: KDR coordinated the project for 4 years and PV for the remaining period. KDR carried out parasitological, entomological and immunological work. PV managed the data and carried out statistical analyses. The manuscript was written and the results interpreted by KDR and PV. KDR is the guarantor of the paper.

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Competing interests: None declared

Ethical approval: The study design was reviewed and recommended by the Scientific Advisory Committee of the Vector Control Research Centre. Based on the recommendation Ethical approval was granted by the Ethical Committee of the Vector Control Research Centre, Indian Council of Medical Research.

References


