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Original article

Mass drug administration to eliminate lymphatic filariasis: A population-based coverage and compliance study in Eastern India

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ABSTRACT

Background: Neglected tropical diseases (NTDs) like lymphatic filariasis (LF) affect over 1 billion people globally, with India being a significant hotspot. Challenges persist despite global and national efforts, including the World Health Organization's (WHO) Global Program to Eliminate Lymphatic Filariasis (GPELF) and India's National Filaria Control Programme. We conducted a study to assess the coverage and compliance of mass drug administartion (MDA) to improve LF elimination efforts in the Khordha district of Odisha, India.

Methods: A sample of 2281 participants, including both males and females aged two years or older, was chosen through multistage stratified sampling. These participants were interviewed using a semi-structured questionnaire. Collected data regarding socio-demographic characteristics, knowledge of filariasis, coverage and consumption of MDA drugs were analyzed. Descriptive statistics were applied to determine coverage and compliance, with results presented alongside a 95 % confidence interval.

Results: In our study, coverage and compliance rates were 86.36 % and 91.12 % for Albendazole, while 84.12 % and 90.62 % for DEC respectively. Fear of side effects was the reason for most of the participants' non-consumption. The coverage rate was low in urban areas because of gated communities and a lack of confidence in drug distributors.

Conclusion: This recent round of MDA was effective but still fear of side effects and lack of awareness were major challenges for the compliance of MDA drugs that need to be addressed for the complete eradication of LF.

1. Introduction

Neglected tropical diseases (NTDs) mainly prevalent in tropical areas affect more than 1 billion people globally, caused by a variety of pathogens including viruses, bacteria, parasites, fungi and toxins.[1] Lymphatic filariasis (LF) is one of the NTDs caused by filarial nematodes and transmitted through the bites of infected mosquitos.[2] Due to the disease's effects on the lymphatic system, people may experience discomfort, deformity, severe disability, social stigma, and financial difficulties.[3] Acute dermatolymphangioadenitis, hydrocele, lymphoedema, and elephantiasis are all symptoms of long-term LF. The productive age group experiences job loss, financial loss, and psychological pain as a result of it.[2,4]

70 % of the global LF cases reside in South-East Asia, majorly in India as it is ranked as the second most populous country in the world.[2] 650 million Indians are currently in danger of catching LF, which is endemic in 18 states. According to reports, over 23 million people are impacted by it from 256 districts spread over 21 states and Union territories.[5,6]

The World Health Organization (WHO) established the Global Program to Eliminate Lymphatic Filariasis (GPELF) in the year 2000 to eradicate LF as a public health issue by 2020, later by 2021, and now targeted for elimination by 2030.[7] In 1955, India also started a National Filaria Control Programme to track and control this disease in the country.[3]

To eliminate LF "two-pillars" strategy was adopted mass drug administration (MDA) and morbidity management and disability prevention (MMDP). The MDA program defines the distribution of a single dose of diethylcarbamazine (DEC) and albendazole annually to all

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individuals who are at least two years of age for continuous 5–6 years in LF-endemic regions.[8] In the MDA program, a single dose of these two drugs annually functions against parasites found in infected patients and reduces its density in blood, as a result the burden of LF decreases to the point where additional transmission throughout the population is eventually impossible and avoids new cases. For a successful interruption, it is necessary to have MDA coverage and compliance of >65 % with four to six years of drug rounds.[9]

In spite of multiple rounds of MDA in Odisha, it was found that 13.8 % of participants in the Khordha district had filarial antigens.[10] Despite a high coverage of MDA, the government of Odisha is facing a significant obstacle to reach the final objectives of elimination. Previous evidence suggests that post-MDA coverage review and compliance assessment are important to increase the MDA program's effectiveness.[11–14] Hence, this study was conducted to estimate the coverage and compliance of the recent round of MDA survey in the Khordha district of Odisha, India.

2. Materials and methods

2.1. Study design, setting, and population

We conducted a cross-sectional study in the Khordha district of Odisha, India where the MDA drive was recently conducted in February 2024. The study covered all five Community Health Centers (CHC) that are also the implementation units for MDA: Baramunda, Begunia (Botaloma), IRC-Village, Mukundaprasad, and Pokhariput under the Khordha district. The participants aged 2 years and above were included in the survey while severely ill personnel and pregnant women were excluded from the study as per the instructions of MDA distribution in India.

2.2. Sample size and sampling technique

To obtain the final unit of observation, we performed a multistage cluster random sampling. In the first round, we choose all five Implementation units (IU) of the Khordha district following which we chose three mohallas from the urban area and one village (representing the rural region) from every CHC/IU followed by integrating 30 households from each of the selected sub-centers. We included 20 sub-centers (mohallas/village) from the five CHCs.

To get the targeted numbers (30) of households in a sub-centre, a probability proportionate sampling method was adopted with an aim to select 30 households from each sub-centre. The successive households were selected with a gap of quotient value by employing direction-based systematic random sampling. Every eligible member of the household was interviewed. In the end, 2281 participants were enrolled in the analysis.

2.3. Data collection

The coverage and compliance for the MDA round in February 2024 were evaluated. The study's data collection took place in March and April 2024, one month following the MDA round, therefore it was assumed there would be less recall bias. Data was collected with the help of a pre-validated questionnaire modified from WHO-validated MDA coverage tools to conduct the household-level survey. We investigated the socio-demographic data of participants like age, sex, place of residence, and educational attainment. The participants were questioned about the number of tablets received, the drugs taken, any side effects encountered, previous knowledge of filariasis and MDA, and the reasons for compliance or non-compliance. Knowledge-related questions were not posed to children younger than ten years old. However, for children under the age of ten, information about MDA drug intake was obtained by asking their parents if they had taken the medications or not.

2.4. Data analysis

After collection of the data in tablet from the household survey it was transferred to Microsoft Excel spreadsheet and analyzed using STATA v. 17.0 (Stata Corp, Texas) software. We calculated the coverage and compliance in percentages and expressed the population estimates in terms of the Fleiss quadratic 95 % confidence interval (CI). Graphical representations and proportions were used to determine coverage and compliance along with a 95 % CI. Coverage was defined as the percentage of the eligible population that received MDA drugs supplied in February 2024, while compliance was defined as the percentage of the population that self-reported drug consumption among those who received the MDA drugs.

2.5. Ethical considerations

This study was approved by the Institutional Human Ethics Committee of ICMR-Regional Medical Research Centre, Bhubaneswar. Informed written consent was taken from all paricipants prior to participation.

3. Results

3.1. Background information

Among all (2281) study participants, 1164 (51.03 %) were males and 1117 (48.96 %) were females. Most of the participants were 16–45 years of age (57.78 %). 12.31 % of the participants had no formal education. Our study consisted of more individuals from urban (76.54 %) than from rural (23.45 %) areas (Table 1).

3.2. Coverage and compliance

During the MDA program, Albendazole and DEC reached a total of 86.36 % and 84.12 % of individuals while 91.12 % and 90.62 % of the coverage population claimed they consumed those drugs respectively. The coverage and consumption of Albendazole (95.70 %, 97.85 %) and DEC (91.02 %, 97.94 %) was higher in rural areas than in urban. A

Table 1
Socio-demographic characteristics of the study participants.

Variable	Category	Total (N = 2281), n, % (95 % CI)	Male (N = 1164), n, % (95 % CI)	Female (N = 1117), n, % (95 % CI)
Age (years)	2–10	209, 9.16 (8.0–10.42)	118, 10.13 (8.46–12.01)	91, 8.14 (6.60–9.90)
	11–15	191, 8.37 (7.26–9.58)	102, 8.76 (7.20–10.53)	89, 7.96 (6.44–9.71)
	16–45	1318, 57.78 (55.72–59.81)	639, 54.89 (51.98–57.78)	679, 60.78 (57.85–63.66)
	>45	563, 24.68 (22.92–26.50)	305, 26.20 (23.69–28.82)	258, 23.09 (20.65–25.68)
Education	No formal Education	281, 12.31 (10.99–13.73)	109, 9.36 (7.75–11.18)	172, 15.39 (13.3–17.65)
	Primary (1–4 std)	256, 11.22 (9.95–12.59)	120, 10.30 (8.62–12.20)	136, 12.17 (10.31–14.23)
	Secondary (5–10 std)	1154, 50.59 (48.51–52.66)	588, 50.51 (47.60–53.42)	566, 50.67 (47.69–53.64)
	Higher Secondary (11–12 std)	316, 13.85 (12.46–15.33)	183, 15.72 (13.67–17.94)	133, 11.9 (10.06–13.95)
	Graduation	237, 10.39 (9.16–11.71)	141, 12.11 (10.29–14.12)	96, 8.59 (7.01–10.39)
	Post Graduation	37, 1.62 (1.14–2.22)	23, 1.97 (1.25–2.95)	14, 1.25 (0.68–2.09)
Area	Rural	535, 23.45 (21.72–25.24)	275, 23.62 (21.21–26.17)	260, 23.27 (20.82–25.86)
	Urban	1746, 76.54 (74.75–78.27)	889, 76.37 (73.82–78.78)	857, 76.72 (74.13–79.17)

significantly greater rate of consumption of 96.47 % for albendazole and 96.15 % for DEC was observed among the participants aged 11–15 years. The MDA drug compliance rates were higher for those with secondary or higher secondary levels of education. The compliance rate was a little higher among males than females (Table 2).

3.3. Awareness about lymphatic filariasis

About 2070 participants were interviewed including males (1046) and females (1024) on the basis of eligibility to inquire their level of awareness of filariasis. 44.92 % of participants claimed that they hadn't heard about Lymphatic Filariasis previously. More than half of the individuals from the study had no idea about the mode of transmission. Only 43.52 % of the responders were aware that mosquito bites can spread disease. A higher portion of participants (60.28 %) weren't using mosquito nets. About 51.06 % of respondents knew the major symptoms (swelling of limbs, and fever) of the infection. 42.07 % of individuals believed that this disease can be treated by medicine and 40.04 % of the individuals knew that anti-filarial tablets were given for prevention. 25.07 % of participants thought they might be infected (Table 3).

8.88 % and 9.38 % of the participants among the covered population did not consume MDA drugs Albendazole and DEC respectively for several reasons like fear of side effects, bad taste, participants felt that they were healthy and not sick; not enough information was given; and lots of tablets (numbers) (Fig. 1A and B).

4. Discussion

In this study, we noticed a low coverage and high compliance rate compared to other studies.[3,15] In our study, the coverage rate was 86.36 % and 84.12 % (for both MDA drugs) which is lower than studies conducted in the Dhenkanal district of Odisha in February 2022 that is 99.28 %, and in the Cuttack district of Odisha in February 2021 at 93.2 %. Nonetheless, the compliance rate was 91.12 % and 90.62 % for both the drugs which is higher than both of the studies conducted in Dhenkanal (85.87 %) and Cuttack (87.3 %).[3,7]

This may be because of multi-disciplinary teams encouraged participants to take medicines in front of them, they did not provide medicines for those not present on the day of drug distribution rather a follow-up visit was made so that directly observed drug distribution can be followed for each individual, which resulted in the effective utilization of MDA medicines. Mathematical models suggest that to eliminate LF, MDA should be conducted for four to six years, considering that the lifespan of *Wuchereria bancrofti* is about five years and a coverage rate of 65 % is required. Based on these predictions and previous study data, it can be concluded that our study achieved successful coverage and compliance that may help in halting the transmission of LF.[16,17]

Our study revealed that there was no variation in the compliance between males and females, as well as across different age groups for both the drugs which is a positive indicator for program's success. We found that urban areas had a lesser compliance of MDA drugs which aligns with the findings from a study conducted by Babu and Kar, 2004.[18] This could be due to gated communities where it is challenging to enter without the approval of resident welfare associations and dispense drugs. People with no formal education had both lower coverage and lower compliance rates for MDA drugs that indicates a need for strengthening the information, education and communication activities so that awareness can be created among masses. The current study has highlighted specific areas where awareness and education are necessary that includes respondents' thoughts that the disease only presents as elephantiasis, and only a few respondents being aware that LF can be transmitted from mother to child. This further indicates a need for awareness.[19]

We found that about 60 % of study participants did not use mosquito nets, a result that totally unaligned with earlier research showing usage rates between 57.9 % and 90.2 % in two malaria-endemic districts of Odisha.[16] Most of the participants reported that in summer it was difficult to sleep in a net which prohibits the flow of air.

The frequency of MDA side effects in India was projected to be between 25.4 % and 82.1 %, with the majority being minor and uncommon.[20–22] Each succeeding cycle of MDA showed a decrease in adverse effects. Consistent with earlier research findings, fear of side effects persisted as a significant concern despite adequate coverage. To tackle this issue, an educational campaign should be run that emphasizes the mild nature of frequent side effects and provides management strategies.

To raise awareness and inspire healthcare professionals to

Table 2
Coverage and compliance of MDA drugs.

Variable	Category	Frequency	Albendazole		DEC	
			Offered (N), n, % (95 % CI)	Consumed (N), n, % (95 % CI)	Offered (N), n, % (95 % CI)	Consumed (N), n, % (95 % CI)
Total	Total	2281	1970, 86.36 (84.88–87.74)	1795, 91.12 (89.77–92.33)	1919, 84.12 (82.56–85.60)	1739, 90.62 (89.22–91.88)
Age (years)	2–10	209	173, 82.77 (76.95–87.63)	158, 91.32 (86.10–95.06)	135, 64.59 (57.69–71.06)	119, 88.14 (81.46–93.07)
	11–15	191	170, 89.00 (83.68–93.06)	164, 96.47 (92.47–98.69)	156, 81.67 (75.44–86.89)	150, 96.15 (91.81–98.57)
	16–45	1318	1130, 85.73 (83.73–87.58)	1037, 91.76 (90.01–93.30)	1131, 85.81 (83.81–87.65)	1037, 91.68 (89.92–93.23)
	>45	563	497, 88.27 (85.32–90.81)	436, 87.72 (84.51–90.48)	497, 0.88.27 (85.32–90.81)	433, 87.12 (83.85–89.93)
Education	No formal Education	281	226, 80.42 (75.29–0.84.90)	191, 84.51 (79.12–88.96)	222, 79.00 (73.76–83.61)	192, 86.48 (81.27–90.69)
	Primary (1–4 std)	256	222, 86.71 (81.93–90.62)	201, 90.54 (85.90–94.04)	199, 0.77.73 (72.13–82.67)	179, 89.94 (84.90–93.75)
	Secondary (5–10 std)	1154	1026, 88.90 (86.95–90.66)	951, 92.69 (90.92–94.20)	1001, 86.74 (84.64–88.64)	921, 92.00 (90.15–93.61)
	Higher Secondary (11–12 std)	316	274, 86.70 (82.46–90.25)	254, 92.70 (88.95–95.48)	275, 87.02 (82.81–90.52)	252, 91.63 (87.71–94.62)
	Graduation	237	197, 83.12 (77.73–87.66)	178, 90.35 (85.34–94.09)	197, 83.12 (77.73–87.66)	174, 88.32 (82.99–92.45)
	Post Graduation	37	25, 67.56 (50.21–81.98)	20, 80.00 (59.29–93.16)	25, 67.56 (50.21–81.98)	21, 84.00 (63.91–95.46)
Area	Rural	535	512, 95.70 (93.61–97.25)	501, 97.85 (96.18–98.92)	487, 91.02 (88.28–93.31)	477, 97.94 (96.25–99.01)
	Urban	1746	1458, 83.50 (81.67–85.21)	1294, 88.75 (87.01–90.32)	1432, 82.01 (80.13–83.79)	1262, 88.12 (86.33–89.75)
Gender	Male	1164	976, 83.84 (81.60–85.91)	892, 91.39 (89.45–93.07)	947, 81.35 (78.99–83.55)	861, 90.91 (88.90–92.67)
	Female	1117	994, 88.98 (87.00–90.76)	903, 90.84 (88.87–92.56)	972, 87.01 (84.90–88.93)	878, 90.32 (88.29–92.11)

Table 3
Knowledge about lymphatic filariasis in the community.

Variable	Response	Total (N = 2070), n, % (95 % CI)	Male (N = 1046), n, % (95 % CI)	Female (N = 1024), n, % (95 % CI)
Heard about Lymphatic Filariasis	Yes	1140, 55.07 (52.89–57.23)	566, 54.11 (51.03–57.16)	574, 56.05 (52.95–59.12)
	No	930, 44.92 (42.76–47.10)	480, 45.88 (42.83–48.96)	450, 43.94 (40.87–47.04)
Mode of transmission	Mosquito bite	665, 32.12 (30.11–34.18)	327, 31.26 (28.46–34.16)	338, 33.00 (30.13–35.98)
	Hereditary/ Genetic	85, 4.10 (3.29–5.05)	50, 4.78 (3.56–6.25)	35, 3.41 (2.39–4.72)
	Both	236, 11.40 (10.06–12.84)	119, 11.37 (9.51–13.45)	117, 11.42 (9.54–13.53)
	Don't know	1084, 52.36 (50.18–54.53)	550, 52.58 (49.50–55.64)	534, 52.14 (49.03–55.24)
Most common symptoms	Swelling of limbs	634, 30.62 (28.64–32.66)	330, 31.54 (28.73–34.46)	304, 29.68 (26.90–32.59)
	Fever and swelling	173, 8.35 (7.20–9.63)	80, 7.64 (6.11–9.42)	93, 9.08 (7.39–11.01)
	Both	249, 12.09 (10.65–13.50)	116, 11.08 (9.25–13.15)	133, 12.98 (10.98–15.20)
	Don't know	1014, 48.98 (46.81–51.16)	520, 49.71 (46.63–52.78)	494, 48.24 (45.14–51.35)
Do you know the treatment of Filariasis?	By Medicine	871, 42.07 % (39.93–44.23)	432, 41.30 (38.29–44.35)	439, 42.87 (39.81–45.96)
	Not curable	10, 0.48 (0.23–0.88)	4, 0.38 (0.10–0.97)	6, 0.58 (0.21–1.27)
	Don't know	1189, 57.43 (55.27–59.58)	610, 58.31 (55.26–61.32)	579, 56.54 (53.44–59.60)
Do you know that anti-filarial tablets are given for prevention?	Yes	829, 40.04 (37.92–42.19)	418, 39.96 (36.97–43.00)	411, 40.13 (37.11–43.21)
	No	1241, 59.95 (57.80–62.07)	628, 60.03 (56.99–63.02)	613, 59.86 (56.78–62.88)
Do you consider yourself at risk?	Yes	519, 25.07 (23.21–26.99)	263, 25.14 (22.53–27.88)	256, 25.00 (22.37–27.77)
	No	606, 29.27 (27.32–31.28)	295, 28.20 (25.49–31.03)	311, 30.37 (27.56–33.29)
	Don't know	945, 45.65 (43.48–47.82)	488, 46.65 % (43.59–49.73)	457, 44.62 (41.55–47.73)
Practice				
Do you use mosquito nets while sleeping?	Yes	822, 39.71 (37.59–41.85)	412, 39.38 (36.41–42.42)	410, 40.03 (37.02–43.11)
	No	1248, 60.28 (58.14–62.40)	634, 60.61 (57.57–63.58)	614, 59.96 (56.88–62.97)

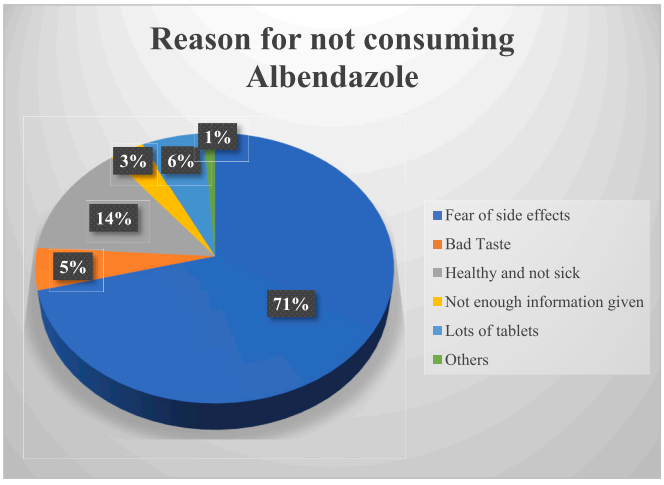

Fig. 1A. Reasons for the non-consumption of Albendazole.

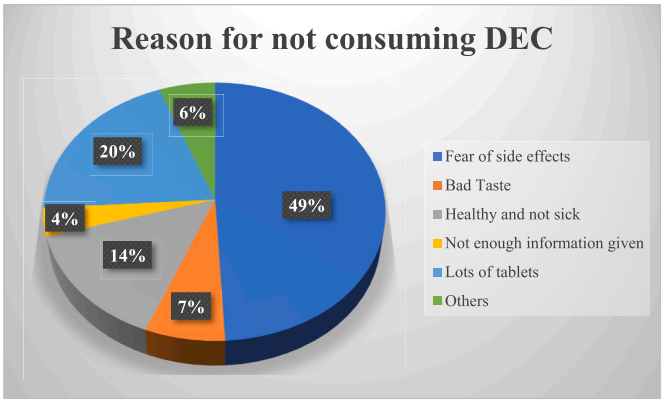

Fig. 1B. Reasons for the non-consumption of DEC.

participate in MDA efforts, multidisciplinary teams of non-governmental organizations (NGOs), WHO, women self-help group (SHG), and state and district officials were essential. In line with the conclusions of Babu and Kar (2004),[18] who emphasized the advantages of integrating district health authorities in enhancing coverage and compliance, this cooperative approach boosted pre-MDA operations.

In the future, we can employ Artificial Intelligence (AI) to help in the complete eradication of LF by analysing vast amounts of patient data, including genetic information, medical records, and treatment results, in order to identify trends and connections. By using AI algorithms and data analysis, researchers and medical professionals can detect adverse drug effects, develop prediction models, and improve patient safety results.[23]

5. Strengths and limitations

This study ensured the representativeness of the population, as participants were selected randomly. However, this study was conducted in only one district of Odisha, which reduces its generalizability.

6. Conclusion

Despite progress in MDA coverage and compliance, urban areas need community involvement, improved surveillance, and focused initiatives to make the program successful. Although tremendous progress has been made since the beginning of GPELF, efforts must be accelerated in order to meet elimination targets. India needs to tackle LF with better health education, and community involvement. To achieve national LF elimination, MDA improvements in additional endemic locations should be guided by the lessons learned from existing evaluations.

Consent to publish

Informed written consent was obtained from all the participants to publish the data.

Ethics approval and consent to participate

This study was approved by the Institutional Human Ethics Committee of ICMR-Regional Medical Research Centre, Bhubaneswar.

Availability of data and materials

The dataset analyzed during the current study will be made available upon reasonable request to the corresponding author.

Authors' contributions

Concept and design: SM, PKS and BB. Acquisition, statistical analysis, or interpretation of data: BB, AS, PKS and SP. Drafting of the manuscript: AS, BB, MB, and PKS. Monitored analysis and critical revision of the manuscript for important intellectual content: BB, PKS, MB and SP. Administrative and technical support: PKS and SP. Supervision: PKS. All authors reviewed the manuscript.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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