



EVALUATION OF THE
LYMPHATIC FILARIASIS CONTROL PROGRAM,
SAMARAI MURUA DISTRICT,
PAPUA NEW GUINEA



Sapak P, University of Papua New Guinea, Papua New Guinea
Melrose W, James Cook University, Australia
Durrheim D, James Cook University, Australia
Pawa F, Milne Bay Provincial Health Department, Papua New Guinea
Wynd S, James Cook University, Australia
Leggat P, James Cook University, Australia
Taufa T, James Cook University, Australia
Bockarie M, Institute of Medical Research, Papua New Guinea

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Authors: Sapak, Peter; Melrose, Wayne; Pawa, Festis; Wynd, Shona; Leggat, Peter; Taufa, Tukatau; Bockarie, Mark

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List of Abbreviations

DEC	Diethylcarbamazine
GSK	Glaxo Smith Kline
JCU	James Cook University
LF	Lymphatic Filariasis
MDA	Mass Drug Administration
PNG	Papua New Guinea
UPNG	University of Papua New Guinea
WHO	World Health Organization
WHO-LFCC	World Health Organization (WHO) Lymphatic Filariasis Collaborating Centre, James Cook University

1. Executive Summary

The prevalence of lymphatic filariasis (LF) in Papua New Guinea (PNG) is among the highest in the world reaching 100% in some locations. A collaboration involving the World Health Organisation Lymphatic Filariasis Collaborating Centre, James Cook University (WHO-LFCC), the University of Papua New Guinea and PNG Health Department evaluated the impact of a community controlled program on LF transmission and prevalence within the Samarai Murua District in rural PNG, with a particular focus on Misima Island. Adopting the Global Filariasis Elimination Program's protocol, the Samarai Murua District LF program used a community-based model to deliver annual mass treatment. In addition, the program trialled the use of an adapted version of a WHO rapid appraisal questionnaire on Misima Island to develop a more refined approach to rapidly obtaining a valid socio-cultural understanding of factors influencing LF transmission and control from a community perspective.

The program was supported and managed by Misima Mines Ltd from its inception. Other participants and contributors included the Papua New Guinea and Milne Bay Departments of Health, James Cook University, Australia, Glaxo Smith Kline, Canada Fund, Toba Motors and local churches. Particular mention should be made of the outstanding leadership of this program, and dedication of, Dr Billy Selve.

Screening of Misima Island mine workers and villagers (2000), and subsequent assessment of blood donors two years after completion of five rounds of MDA (2003), provided convincing evidence of the program's dramatic impact on filarial antigenaemia. Screening of Misima Island school children confirmed the program's success in interrupting transmission of the disease.

Further confirmation that transmission had ceased came from an entomological survey of four villages in the Samarai Murua district. Mosquitoes were collected, dissected and examined for filarial larvae. Of 159 mosquitoes captured, none showed evidence of filarial infection.

Concurrent with the introduction of the Samarai Murua LF control program, a decrease in the proportion of low birth weight infants and childhood stunting was found. The decrease in childhood stunting may be due to the impact of albendazole on intestinal helminth burden, while the extension of primary health care services in the community that occurred as part of the program, may well have had a positive impact on maternal care.

A community survey found that Misima Islanders viewed the LF control program very positively. However, several local misperceptions were identified that could negatively impact on control efforts. Overall LF was no longer considered a key health problem in the area, and reported compliance was encouraging.

Direct costing provided evidence of considerable efficiency of the community based approach and this approach may be of particular relevance in settings similar to rural PNG.

The Samarai Murua District LF control program appears to have had a profound impact on the prevalence and transmission of LF, and provides a potential model for sustainable, cost-effective LF elimination in PNG.



Maternal child health care in rural Samarai Murua

2. Background

Lymphatic filariasis (LF) is the second most common vector-borne disease globally. Its chronic disabling nature and enormous toll in human suffering and health care costs prompted a decision to launch a global program to eliminate this disease. This program, sponsored by the World Health Organization (WHO), non-government organizations, the drug manufacturers Glaxo Smith Kline (GSK) and Merck, and government health departments, is based upon annual mass treatment with diethylcarbamazine (DEC) and albendazole in areas where there is no co-endemicity with onchocerciasis, and ivermectin (Mectizan) and albendazole in areas where onchocerciasis and LF co-exist.

Papua New Guinea (PNG) is the country with the greatest remaining burden of LF in the Western Pacific Region. It is also the only endemic country in the Region that has not yet introduced a countrywide program to eliminate LF. However, on Misima Island and the remainder of Samarai Murua District of Milne Bay Province, government and the private sector have collaborated to implement a pilot control program that relies heavily on community involvement.

Historically, Misima Island experienced a high LF prevalence. This was well documented by the WHO-LFCC (JCU), prior to the initiation of annual mass drug administration (MDA) campaigns, which have achieved annual coverage of at least 70% over a five-year period. This provides a unique opportunity to determine the impact of the WHO recommended regimen utilising a community controlled model in a highly endemic area.

The program was supported and managed by Misima Mines Ltd from its inception, with leadership provided by Dr Billy Selve. Other participants and contributors included the Papua New Guinea and Milne Bay Departments of Health, WHO-LFCC (JCU), Glaxo Smith Kline (GSK), Canada Fund, Toba Motors and local churches. The PNG Health Department, the University of Papua New Guinea and WHO-LFCC (JCU) collaborated to evaluate the impact of a community controlled program on LF prevalence and transmission in Samarai Murua District of Milne Bay Province with a particular focus on Misima Island.

In addition, a broader understanding of community members' behaviour and attitudes towards the Samarai Murua District LF control program was sought by trialling an adapted version of the WHO sponsored rapid appraisal questionnaire of community knowledge and attitudes towards lymphatic filariasis.

2.1. Samarai Murua District

Samaria Murua district is a predominantly maritime district in Milne Bay Province, Papua New Guinea (PNG) with an area of 92,500 square kilometres. The area extends from mainland PNG into the Solomon Sea, with Misima Island and Sudest Island being the most populous islands, and many other islands that are largely uninhabited.

Figure 1: Map of Samarai Murua district



The People

Samaria Murua inhabitants are of Melanesian extraction but there are certain ethnic differences between the various island inhabitants, occasioned by migration over an extended period of time. For example, Sudest Islanders tend to have curly hair, while Misimans have straight hair. Subsistence farming is the major source of livelihood with local bartering amongst islanders. Skills in canoe building or wood-carving still exist in some areas.

Trading for cash is sporadic, but has become more common where school fees or the price of a bride are required, or where agricultural produce or fish are sold. Small-scale cash crops include copra, cocoa and more recently vanilla. The sale of sea cucumbers serves as an additional source of income for Samaria Murua inhabitants.

Misima Island

Misima Island is the administrative centre of the Samarai Murua district, with a population of approximately 14,000. It is 39km long and at its widest point has a 9km diameter. The central mountainous spine has a highest point of 1,035m. The climate is warm and humid with little seasonal variation. Mean annual temperature fluctuates between 30°C and 32°C, and average relevant humidity is 84%. Rain falls consistently during the year with a slight increase from January to May. The Island lies within the cyclone belt and has experienced eight cyclones since 1922.

Gold deposits were discovered on Misima Island in 1884 and mining operations began four years later. Misima Mines was the second gold mine established in PNG and it took ten years to recover the first 100,000 ounces of gold. Operations continued until the First World War, 1915-1919, when all operations ceased. A syndicate was formed after the war to resume gold mining. Mining ceased again in 1942 when all the miners were evacuated during the Second World War. In 1947 mining again resumed and continued until 1964, despite the destruction of the quartz mountain plant by a cyclone in 1952. There was a pause in gold mining between 1964 and 1971 when copper exploration was active. Misima Mines Ltd is owned by Placer Dome Inc (80%) and the Government of PNG (20%), and employs 750 people from surrounding communities.

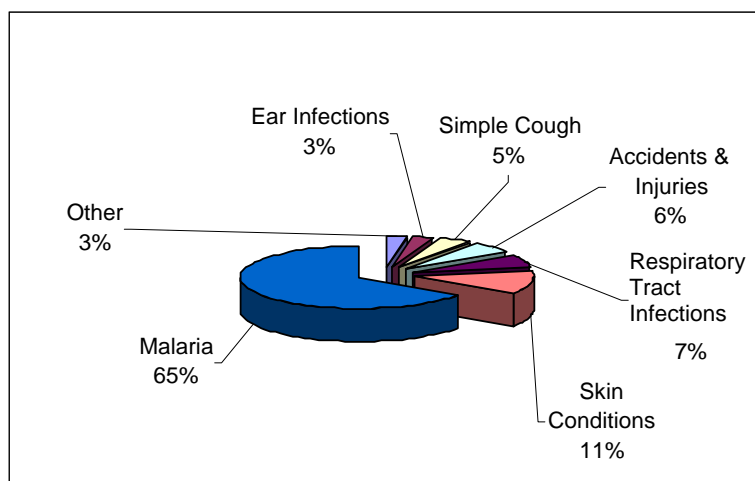
Health Services

A district hospital was opened on Misima Island in 1997. It is staffed by a general practitioner and 40 nursing and ancillary support staff. The hospital has ultrasonography, radiography, dentistry and laboratory facilities, and has the capacity to perform a variety of emergency surgical procedures, including appendectomies, laparotomies and caesarean sections. It has a busy general outpatient service, with antenatal, maternal, child health, and other clinics. Complementing the hospital are health centres, health sub-centres and aid posts scattered throughout the district. These complementary services are administered either directly by the government, or indirectly by church agencies through government grants. The Misima Mines Ltd medical department runs clinics for mine employees and their dependants, and provides a range of outreach medical services to the district, in cooperation with the health department.

Disease Profile

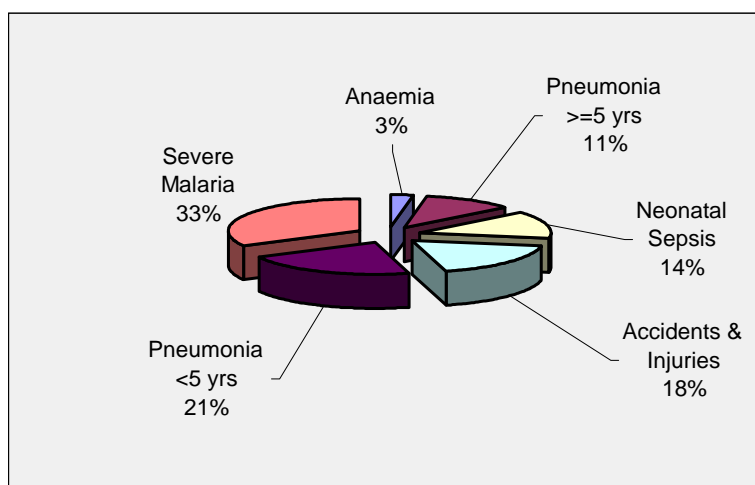
The leading cause of presentations to the Samarai Murua district health facilities is malaria (65%), followed by skin conditions (11%) and respiratory tract infections (7%) (Figure 2). Malaria diagnosis in this setting is generally based on clinical features and thus there is potential for other febrile diseases, including acute lymphatic filariasis episodes and dengue, to be misdiagnosed as malaria.

Figure 2: Causes of Health Centre Presentation, Samarai Murua District, 2000



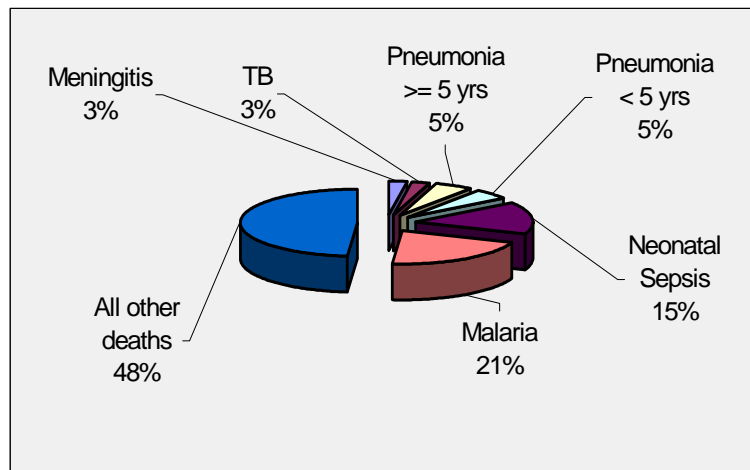
Malaria is also the single most common cause of hospital admissions followed by pneumonia in children less than five years of age. Figure 3 provides further details of hospital admissions for children in the Samarai Murua district.

Figure 3: Leading causes of hospital admissions in children < 5 years, Misima Hospital, 2000



Death certificate data from the Samarai Murua District indicates that approximately one in every five deaths is attributed to malaria (see Figure 4).

Figure 4: Causes of death, Samarai Murua District, 2002



Until the start of the LF control program very little was known about the prevalence of LF in this district, however anecdotal evidence suggests that LF has been a problem for many years. The surveys carried out prior to the commencement of the Samarai Murua District LF control program confirmed high filarial endemicity.



Children from Budibudi

3. The Samarai Murua District Lymphatic Filariasis Control Program

The prevalence of lymphatic filariasis in PNG is amongst the highest in the world reaching 100% in some locations. Over the past two decades in PNG, a small number of localized research programs have explored the efficacy of mass drug administration (MDA) programs, predominantly using diethylcarbamazine (DEC) and ivermectin. The Samarai Murua district LF control program however, differed from these programs in two ways.

Firstly, this LF control program adopted the Global Filariasis Elimination Program's protocol. The Global Filariasis Elimination Program is based upon annual mass treatment with diethylcarbamazine (DEC) and albendazole in areas where there is no co-endemicity with onchocerciasis, and ivermectin (Mectizan) and albendazole in areas where onchocerciasis and LF co-exist. This permitted field assessment of the standard protocol in a highly endemic Pacific environment.

Secondly, the Samarai Murua District LF control program was primarily a community field-based operation delivering MDA's in partnership with the local community rather than a research project exploring drug efficacy.

The LF control program was developed and supported by Misima Mines Ltd, with additional contributions from the Papua New Guinea and Milne Bay Departments of Health, James Cook University, Glaxo Smith Kline, Canada Fund, Toba Motors and local religious organizations.



Main source of transport in the Samarai Murua District are sailing canoes

3.1. Key events in the Samarai Murua District LF Control Program

The Samarai Murua District LF control program was developed after an initial survey (1995) found a high prevalence of filarial antigenaemia in the community. MDA's were conducted over a period of five years. Below is a timeline cataloguing some of the key events that occurred during this period.

1995	An initial small scale survey in three selected communities on Misima Island by JCU found a prevalence of filarial antigenaemia of 93%.
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1996	Larger-scale survey on Misima Island by JCU confirmed a high prevalence of filarial antigenaemia of 63% in the general community.
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1996	An initial Misima Island MDA was conducted by Misima Mines Ltd and JCU using DEC and ivermectin. Filarial antigenaemia at three sentinel sites fell to 2.8% after 12 months.
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1997	Initiation of the LF control program on Misima Island using DEC and albendazole, as recommended by the WHO Global Lymphatic Filariasis Elimination Program.
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1997/8	LF control program extended to include the whole of Samarai Murua District with initiation of MDA's on remaining islands in the District.
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2001	Five rounds of MDA completed on Misima Island.
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2002	Five rounds of MDA completed on other islands in the Samarai Murua District.
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2003	Assessment of the impact of the Samarai Murua District LF Control Program by the JCU/UPNG team with financial support from GSK.
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3.2. MDA Coverage in Samarai Murua District

MDA coverage was maintained at >70% throughout Samarai Murua District for the duration of the program. Current knowledge suggests that this level of coverage would be effective in interrupting transmission in an area where anopheline vectors are responsible for the *Wuchereria bancrofti* transmission. Table 1 provides further details.

Table 1: MDA coverage, Samarai Murua District, 1998-2002.

Year	Total Treated	Projected Population	% Treated
1998	29,658	40,735	73
1999	28,965	41,631	70
2000	29,883	42,547	70
2001	34,672	43,483	80
2002	17,243	26,240*	70

*Does not include population of Misima Island who had concluded their 5th MDA in 2001

4. Impact of the LF Control Program on Misima Island

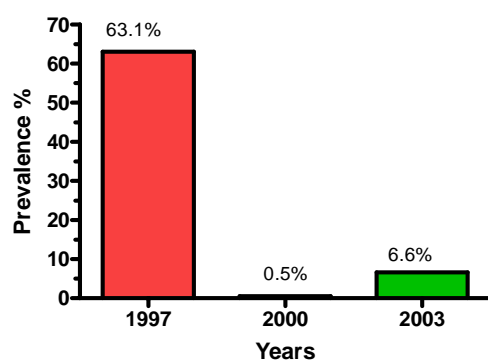
Misima Island was selected as the focus for assessing the impact of the LF control program as a number of the surveys were conducted on Misima Island: baseline (1997), mid-term (2000) and two years after the last round of MDA on Misima Island (2003). Surveys and screening tests used are summarised in Table 2.

Table 2: Misima Island LF Prevalence Surveys; 1997, 2000 and 2003.

Year	Number tested	Source	Test used
1997	778	Nine villages	Og4C3 ELISA
2000	882	Mine site workers	ICT
	200	Three villages	Og4C3 ELISA
2003	167	Adult blood donors	ICT
	484	Elementary school children	Og4C3 ELISA
	450	Elementary school children	IgG1 and IgG4 antibodies

The five rounds of MDA appear to have had a dramatic effect on the overall prevalence of filarial antigenaemia on Misima Island as reflected in Figure 5.

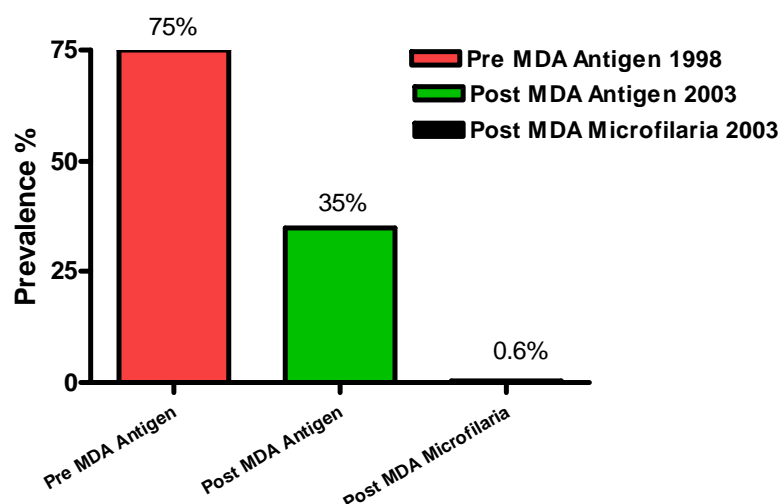
Figure 5: Filarial antigenaemia prevalence on Misima Island: pre MDA (1997) and mid-MDA (2000) and post MDA (2003)



The slight rise in filarial antigenaemia between 2000 and 2003 is difficult to interpret. It may reflect a chance finding, variation due to sampling of different sub-populations, the unstable decay of population-based serological assays, or a combination of these factors. A blood survey for microfilaria may have assisted interpretation but resistance from the community to further blood surveys precluded this possibility.

Several studies have demonstrated that filarial antigen can persist for years after microfilaria have cleared and transmission of disease has stopped. We were also able to demonstrate this phenomenon on Basalaki Island at the western end of the Samarai Murua District. Figure 6 shows pre-MDA antigen prevalence, and antigen and microfilaria prevalence after completion of five rounds of MDA. The data from Basalaki Island suggests a greater than 30-fold difference in positivity between filarial antigenaemia and microfilaraemia soon after the MDA program. Thus, although there was persistent filarial antigenaemia, the lack of microfilaraemia provides reassurance that transmission had ceased.

Figure 6: Laboratory evidence of Filarial infection on Basalaki Island, Samarai Murua District, 1998 and 2003



During 2003, filarial antigen and antibody (IgG1+ IgG4) tests were conducted on 484 elementary school children at five schools on Misima Island. Only one child was antigen positive (0.2%), while 4 (0.8%) and 5 children (10%) were IgG1 and IgG4 antibody positive, respectively. Two children (0.4%) were positive for both IgG1 and IgG4.

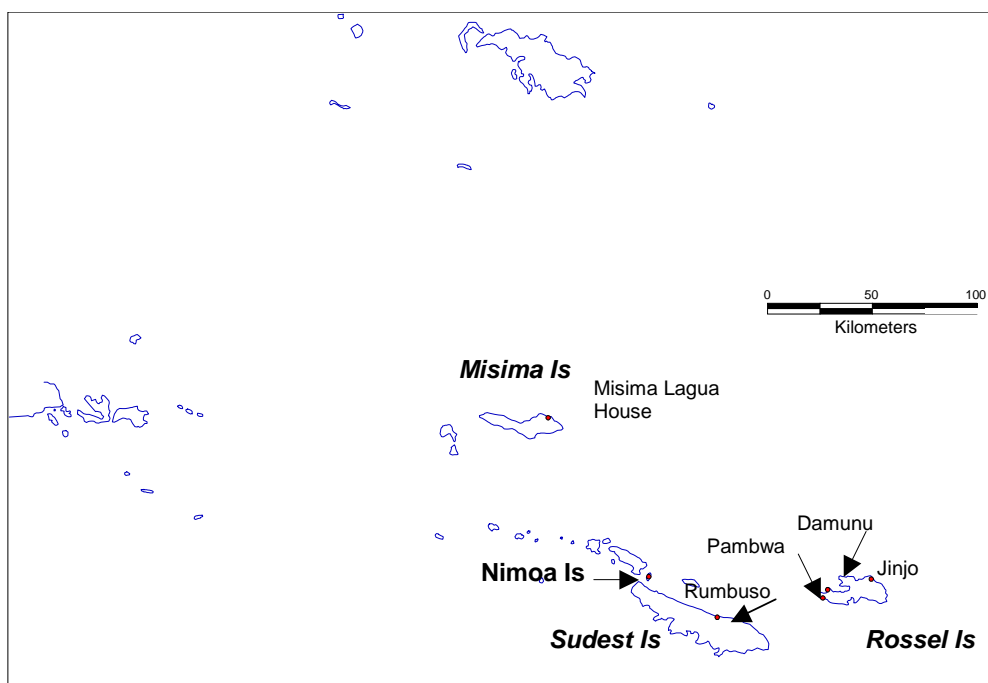
Previous studies have shown that filarial antibodies develop early in life where there is active transmission of the parasite. The very low levels of antibody positivity detected, in addition to detecting only two filarial antigen positive children, provides additional evidence that transmission is likely to have ceased.

4.1. Entomological Assessment

In order to confirm that transmission had ceased, mosquitoes were collected by night-biting catches, dissected and examined for filarial larvae. These surveys, conducted by PNG Institute of Medical Research, collected *Anopheles* mosquitoes, the main carriers of malaria and lymphatic filariasis in Papua New Guinea in Jinjo, Damunu, Rambuso and Nimoa Islands (Figure 7). In total 159 mosquitoes were collected; Jinjo-83, Rambuso-60, Damanu-11, and Nimoa-5. The size of catches was constrained by imperfect climatic conditions.

All of the mosquitoes collected were morphologically identified as *Anopheles farauti*. Further DNA analysis demonstrated all specimens to be *Anopheles farauti* s.s. or *Anopheles farauti* No. 1.

Figure 7: Map of Islands where entomological assessments were performed



All mosquitoes collected were dissected. There was no evidence of filarial infection.

5. Efficiency of Community Delivered LF Control Program

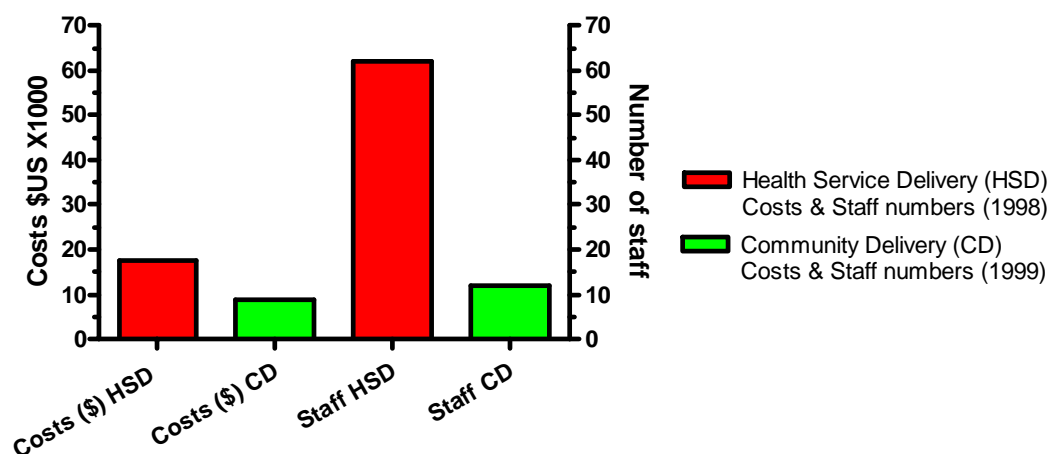
With the dramatic reductions in lymphatic filariasis prevalence that followed limited preliminary community studies of MDA with combination therapy in Samarai Murua District, a district-wide control program was launched during 1998 by Misima mine officials and government health services. Although acceptable coverage was achieved, a decision was made to adopt a strategy encouraging community participation for MDA delivery.

In 1999, a village health worker was selected from all four district council areas. These four health workers were trained on lymphatic filariasis and its control, including calculation of treatment doses on the basis of age, program surveillance, and management principles. The training sessions were conducted as three-day intensive workshops. Practical supervised field sessions were then conducted before the health workers were delegated specific villages for delivering MDA.

The initiative was successful with similar MDA coverage achieved during 1998 and 1999 being 73% and 70% of the Samarai Murua district population, respectively. However, the composition of the MDA delivery teams differed markedly between the two years. In 1998, 62 health staff participated in the campaign, including 10 externally hired drug distributors and 52 professional health workers from government, church agencies, UPNG and Misima mines. These personnel all participated in outreach MDA activities. In 1999, only 12 staff were involved, including 4 village health workers and 8 professional health staff (Figure 8). The latter were almost exclusively involved in training village health workers.

The 81% reduction in absolute staff numbers and shift from professional to community MDA delivery resulted in a halving of the total direct cost of the 1999 MDA campaign from \$US 17,388.00 (56,000Kina) to \$US 8,694.00 (28,000 Kina) (Figure 8). This translates into a remarkably low cost of less than \$US 0.31 (1 Kina) per person treated by the community MDA delivery team. These positive findings resulted in a decision to complete the remaining three years of MDA campaigns by means of the community delivery model.

Figure 8: Comparison of direct expenditure and staff involved: Formal Health Service delivery versus Community delivery approaches



This community delivery mechanism was concurrently used to distribute bed nets, predominantly for malaria prevention; an HIV/AIDS prevention program; family planning; and first aid training (14 graduates).



First Aid Training

6. Community Perceptions

A qualitative research approach was used to provide a broad understanding of community members' behaviour and attitudes towards the Samarai Murua District LF control program. Four Misima Island villages were selected for this study using purposive sampling, taking into account the remoteness of the village, proximity to the mine, and level of health facilities available.

The study used an adaptation of a questionnaire developed by the World Health Organisation for rapid appraisal of community knowledge and attitudes regarding lymphatic filariasis in affected areas.

Focus group discussions were also conducted to explore a number of open-ended questions broadly grouped into: perceptions of health; knowledge of etiology and symptoms of filariasis, elephantiasis, and hydrocoele; and attitudes towards the filariasis and MDA's.

Misima islanders did not spontaneously identify lymphatic filariasis as an important current health concern. Direct probing as to whether filariasis (*"pom"*) was a health problem in the villages, resulted consistently in a negative response. When questioned about the prevalence of filariasis, one key informant stated: *"I think a long, long time ago, yes. But I do not see pom nowadays"*. Only one respondent mentioned filariasis as a serious health condition, recalling a *"death due to filariasis"*, while another recalled someone with a big swollen leg.

Focus group participants placed greater importance on access to adequate health facilities and on life-threatening infectious diseases such as malaria. These findings mirror those found in other LF endemic areas where effective control has been introduced.

When questioned about the source of filariasis, only three of 16 focus groups identified mosquitoes as the source of illness. Mosquito nets were not frequently used nor were mosquito-breeding sites controlled, either for malaria or LF control. Particular clinical presentations were associated with supernatural forces. In certain villages chronic hydrocoele was considered to be the result of a curse placed on individuals who stole from betelnut plantations. A key informant indicated that many community members believed that *"sorcery and witchcraft are the cause for elephantiasis"*.

The majority of participants did not consider themselves at risk of LF because they had taken medication during the MDA's. There was a common misperception that taking the drugs

provided long-term immunity. It was stated in one focus group that: *“The benefits of the drug distribution is people are now in good health and they believe that they will never get sick with filariasis again in times to come”*.

While community members generally viewed the aims and logistics of MDA campaigns positively, the frequency of drug-associated adverse events was identified by focus groups as a potentially important factor that could negatively affect compliance. One young woman indicated: *“We are not willing to take them again because of the sick side effects and the tablets are too many to take at one time”*.

While beliefs in the supernatural origin of LF were widespread, few villagers appeared to understand the role of vectors in disease transmission.

An additional misperception that could negatively impact on community assessment of program success is the inclusion of a number of dermatological conditions under the same descriptive term *“Pom”*. It is clear that where individuals comply strictly with a drug regime and the symptoms or signs incorrectly attributed to LF do not resolve, the resulting dissonance can have a detrimental effect on compliance. The importance of effective community consultation and education programs cannot be overemphasised.

A number of shortcomings were identified in the questionnaire during field use. This has allowed refinement of the qualitative approach to understanding important socio-cultural beliefs and behaviour.

7. Additional Benefits of the Samarai Murua Lymphatic Filariasis Control Program

The Samarai Murua District LF control program provided additional benefits besides controlling LF. A survey of children on Rossel Island, before and after the MDA program, demonstrated changes in childhood growth, while a comparison of birth-weights on Misima Island and the remote Paneati Island, before and after the MDA program, demonstrated a decrease in the proportion of low birth weight babies.

7.1. Childhood growth

A number of studies in various parts of the world have found an association between stunting of childhood growth and burden of intestinal worm infestation. Anti-helminthic treatment may have a beneficial effect on child growth. Intestinal worms are extremely common in PNG. For example, a cross-sectional survey conducted on Rossel Island, a remote and rural island at the eastern limit of the Samarai Murua district in 1998 prior to the first MDA with DEC and albendazole, found a high prevalence of *Ascaris lumbricoides*, Hookworm, and *Trichuris trichiura*.

To explore the possible effects of annual MDA therapy on child growth a cross-sectional anthropometric and parasitological survey was repeated in 2003 to determine the height and weight of Rossel Island children. Despite minimal changes in the mean weight of children (Figure 9), there was a notable increase across all ages from 10-17 years (Figure 10) in mean height following the MDA program. Although it is difficult to conclusively attribute this improvement to the control program alone, it is likely that annual deworming contributed to this improvement in child growth.

Figure 9: Weight of Rossel Island children: Pre (1998) and post (2003) MDA program

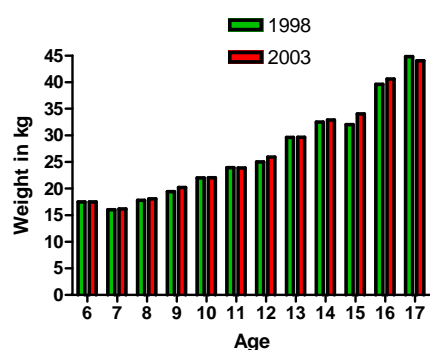
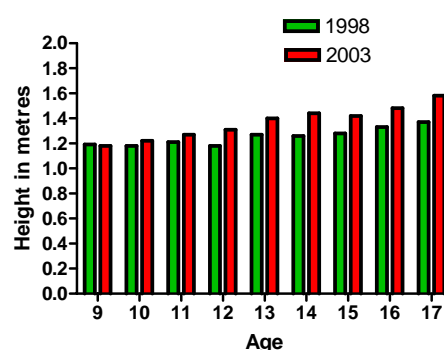


Figure 10: Height of Rossel Island children: Pre (1998) and post (2003) MDA program

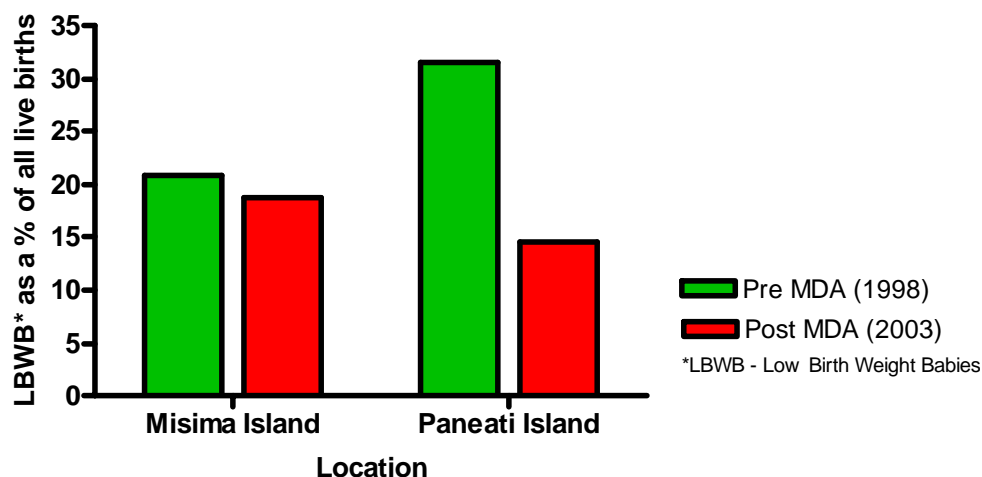


7.2. Birth weight

Although women acknowledging pregnancy are excluded from MDA campaigns, many pregnant women are inadvertently included in annual MDA campaigns with DEC and albendazole, particularly during early pregnancy. Thus it is likely that a considerable number of pregnant women have taken annual MDA treatment in recent years.

A comparison of birth-weights on Misima Island and the remote Paneati Island, before and after the MDA program, showed a decrease in the proportion of low birth weight babies on Misima Island and a striking decrease on Paneati Island (see Figure 11). Although it is not possible to conclude from the data that this decrease in low birth weight children is causally linked to the MDA program, it an important finding that should be explored further using a prospective study design.

Figure 11: Birth-weights on Misima and Paneati Islands, pre (1998) and post (2003) the LF control program.



8. Conclusions

This evaluation of a unique community-delivered filariasis program in rural PNG provides important findings. Most significantly it confirms that the current MDA strategy advocated by the WHO with DEC and albendazole effectively interrupted transmission of LF in a previously highly endemic area where Anopheline vectors were responsible for transmission. Screening of mine workers and villagers at mid-term and subsequent assessment of blood donors two years after completion of five rounds of MDA provided convincing evidence of a dramatic impact on filarial antigenaemia. Screening of school children and an entomological survey confirmed the program's success in interrupting transmission.

Benefits that occurred concurrently with the introduction of the Samarai Murua LF control program were a decrease in the proportion of low birth weight infants and childhood stunting, the former possibly due to the impact of albendazole on intestinal helminth burden, while the latter most likely resulted from an extension of primary health care services in the community with a positive impact on maternal care.

A community survey found that Misima Islanders viewed the LF control program very positively. LF was no longer considered a key health problem in the area, and reported compliance was encouraging. Direct costing provided evidence of considerable efficiency of the community based approach and thus may be of particular relevance in settings similar to rural PNG.

The Samarai Murua District LF control program has had a profound impact on the prevalence and transmission of LF and provides a potential model for sustainable, cost-effective LF elimination in PNG.



The locally built boat "MV Diakonos" sails into Damanu Bay late afternoon

9. Publications arising from, or utilizing material from Samarai Murua project

Leggat PA, Melrose W, and Durrheim DN. Could it be lymphatic filariasis. *Journal of Travel Medicine* 2004; 11: 56-60.

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Melrose WD. Lymphatic filariasis – new insights into an old disease (review article). *International Journal for Parasitology* 2002; 32: 947-960.

Melrose WD, Selve B, Usurup J, and Turner PF. Filarial antibodies in a group of expatriate miners exposed to filariasis. *Transactions of Royal Society of the Royal Society of Tropical Medicine Hygiene* 2000; 94: 706-707.

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Selve BP, Bwadua S, Misa M, James K, Usurup JP, Turner P, Melrose WD, Yad W, Samuel R, and Eddie C. Community empowerment and control of lymphatic filariasis in Misima, Milne Bay province using diethylcarbamazine in combination with albendazole. *Papua New Guinea Medical Journal* 2000; 43: 183-186.

10. Presentations arising from, or utilizing material from Samarai Murua project

Melrose W. (2002). Bancroftian Filariasis, is it a threat to expatriates? Evidence from a mine-site in Papua New Guinea. Paper presented at the Annual Meeting of the New Institute of Medical Scientists Annual Meeting, Rotorua.

Melrose W. (2003). Update of filariasis diagnosis and control. Paper presented at the Annual Seminar for Laboratory Managers, Port Moresby, Papua New Guinea.

Melrose W. (2003). Report on Samarai-Morua filariasis control project. American Society of Tropical Medicine and Hygiene 52nd Annual Meeting, Philadelphia, USA, 3-7 December 2003.

Melrose W. (2003). Lymphatic Filariasis, new understandings of an old disease. Paper presented at the Seminar, College of Allied Health Science, University of Texas.

Wynd S, Carron J, Dürrheim DN, Melrose W, Leggat P, Chaine JP, Selve B and Canyon D. (2003). Using the multiple perspective approach to understanding local issues regarding lymphatic filariasis in the pacific region. American Society of Tropical Medicine and Hygiene 52nd Annual Meeting, Philadelphia, USA, 3-7 December 2003.