FULL LENGTH RESEARCH ARTICLE

THE IMPACT OF IVERMECTIN MASS TREATMENT ON THE PREVALENCE OF ONCHOCERCIASIS BY RAPID EPIDEMIOLOGICAL ASSESSMENT IN GALADIMAWA, KADUNA STATE, NIGERIA

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ABSTRACT

The impact of repeated mass treatment with ivermectin on the prevalence of onchocerciasis in Galadimawa, Kaduna State, Nigeria, was assessed. The 1988 pre-ivermectin treatment baseline data was compared with the 12 years post-ivermectin mass treatment prevalence of clinical manifestations of the disease (1989-2001) obtained in January 2002. The Rapid Epidemiological Assessment (REA) method was used to determine the prevalence of palpable nodules as an alternative to the more invasive skin snipping. From the 1988 pre-control data, 717 persons were examined of which 176 (24.5 %) had nodules. Parasitological confirmation by skin snipping of the same individuals revealed 346 (48.3 %) persons with Onchocerca volvulus microfilaria. In 2002, 700 persons were examined by REA alone, of which 53 (7.6 %) had nodules. Prevalence reduction post-ivermectin mass treatment was significant for palpable nodules ($p<0.001$) and blindness ($p=0.0014$). Females had insignificant higher prevalences in all the clinical manifestations than males, except for hanging groin which was absent in the females both in1988 and 2002. Nodule prevalence correlated positively and significantly with age ($r=0.91$, $p=0.005$) and was significantly associated with adult females ($p<0.01$), contrary to reported findings in other communities where nodule prevalence was associated with adult males.

Key words: Impact assessment, ivermectin, onchocerciasis, nodules, prevalence.

INTRODUCTION

Onchocerciasis (river blindness) still poses a threat to public health in many tropical regions of Africa and Latin America, despite the concerted effort and high expenditure on control programmes (Basanez *et al*. 2002). So far, the control measures that have been implemented were aimed at interrupting transmission of the *Onchocerca volvulus* (Hougard *et al.* 1997) parasite either by eradicating the vector or the parasite. Davies (1994) made a comprehensive review of 60 years of onchocerciasis control world-wide and the only record of vector eradication was in Kenya where *Simulium neavei* was successfully eradicated by mechanical vegetation removal and chemical larviciding (McMahon *et al*. 1958). The Kenyan situation however, has been faced with the problem of vector reinvasion from adjacent areas not covered by the exercise (Davies 1994).

The advent of ivermectin for the treatment of human onchocerciasis and its suitability for large-scale application were major break-throughs in the control of human onchocerciasis through chemotherapy (Boatin *et al*. 1998). Its effectiveness in controlling the morbidity of the disease has been severally demonstrated (De Sole *et al*. 1989, Remme *et al*. 1989, 1990, Abanobi & Anosike, 2000, Borsboom *et al*. 2003). Perhaps the successes recorded made Winnen *et al.* (2002) to predict that it is possible to eliminate onchocerciasis in Africa using control strategies based exclusively on ivermectin mass treatments requiring a period of at least 25 years in areas with medium to high levels of infection and annual mass treatments with 65% coverage. This has led to the closing down of the Onchocerciasis Control Program (OCP) in West Africa at the end of 2002 and transferring all subsequent control to the participating countries which will almost entirely be based on periodic mass treatment with the drug (Borsboom *et al*. 2003).

The classical method of determining the prevalence and intensity of onchocercal infection is by the demonstration and counting of the O. volvulus microfilariae in biopsies obtained by skin snipping (Boatin *et al.* 1998). This technique is however becoming increasingly unacceptable because of its invasive nature and the risk it poses as a means for the spreading of the Human Acquired Immune Deficiency Syndrome (AIDS) virus. The demonstration of and excellent correlation between the prevalence of palpable nodules in a community and the microfilarial load has led to the development of Rapid Epidemiological Mapping of Onchocerciasis (REMO), which is geographical and the Rapid Epidemiological Assessment (REA), which is community based. These methods are rapid, safe and non-invasive that have enabled the identification of communities for mass treatment with ivermectin (Gemade *et al.* 1998, Esum *et al.* 2001, Anosike *et al.* 2001). The community based REA method involves the physical examination of individuals for the clinical manifestations of the disease, which include palpable nodules, skin depigmentation (leopard skin), hanging groin and blindness. Of these clinical signs, palpable nodules are the most sensitive for the determination of onchocercal infection (Vivas-Martinez *et al.* 2000).

In this paper, the REA method was used to determine the prevalence of onchocerciasis in the study community before and after 12 years of repeated treatment with the drug aimed at assessing the impact of its use in controlling the transmission of the disease in the area.

MATERIALS AND METHODS

Study area: Galadimawa is a village in Kauru Local Government Area of Kaduna State, Nigeria, approximately 65 Km drive westwards from Pambegua off the Kaduna-Jos road ($10^{o}39'N$ $8^{o}30'E$). Its population was estimated at 943 persons by projection from the pre-ivermectin

dosing figure of 907persons of 1988 and Nigeria's population annual growth rate of 4.0% (Encarta Premium 2007). The major occupation of the people in this village is farming, which is a predisposing factor to biting simuliids.

Baseline data: The study was carried out within two weeks in June 2002. Base-line data for onchocerciasis prevalence during the pre-ivermectin dosing period as well as records of ivermectin distribution activities in the study area were obtained from the National Eye Center and Sight Savers both located in Kaduna. Other relevant information was obtained from the Departments of Biological Sciences, ABU Zaria and the Ophthalmology Unit, Ahmadu Bello University Teaching Hospital ABU, Zaria, Nigeria. These were used in establishing the prevalence of onchocerciasis in the study community before the commencement of the distribution of the drug in 1989.

Collection of main data: A community-based questionnaire was designed and used for the assessment of the prevalence of the disease in the community using REA method (Gemade *et al*. 1998, Esum *et al*. 2001, Anosike *et al*. 2001). The parameters recorded included sex, marital status, and occupation. Five community health workers were used for the examination of members of the community and the administration of the questionnaires. Individuals were examined for clinical manifestations, namely: nodules, leopard skin, hanging groin and blindness.

RESULTS

The 1988 pre-control baseline data showed that a total of 717 persons were examined both by the REA and parasitological (skin snipping) methods. Of these, 340 were males and 377 females. The REA method used showed that 222 (30.96 %) of the total persons examined had at least one of the clinical manifestations known to be prevalent in populations that are endemic for onchocerciasis. Palpable nodules was the most prevalent clinical manifestation found on 176 (24.45 %) persons. 25(3.49 %) persons were blind, 17(2.37 %) had leopard skin and hanging groin was the least prevalent found on only 4 (0.56 %) of the persons. The prevalence of the disease determined parasitologically by the examination of skin snips obtained from the same persons examined by REA showed that 346(48.26%) were positive for *O. volvulus* microfilaria (Table 1). Females had a higher prevalence of 190 (50.40 %) compared to males with 156 (45.88 %), but the difference was not significant (χ^2=1.28, p=0.26)

Twelve years post-ivermectin mass treatment: Of the 700 persons examined in 2002 by REA, 81(11.57%) had at least one of the four physical manifestations of the disease with palpable nodules having the highest prevalence 53(7.57 %). Hanging groin was the least rare and found in only 4 persons (0.57%). The comparisons between the pre- and post-control prevalences as determined by REA are shown in Table 1. Females had higher prevalences than males for all the clinical manifestations except hanging groin which was absent in the females. These differences were not significant for both study periods.

TABLE 1: THE PRE- AND POST-CONTROL PREVALENCES OF THE CLINICAL MANIFESTATIONS DETERMINED BY THE REA METHOD AND OF MICOFILARIA BY SKIN SNIPPING IN GALADIMAWA.

Clinical manifestation	Number (%) of persons positive for each clinical manifestation					
	Pre-ivermectin treatment (1998)			Post-ivermectin treatment (2002)		
	Males n=340	Females n=377	Total n=717	Males n=351	Females n=349	Total n=700
Nodules	63(18.53)	113(29.97)	176(24.55)	15(4.27)	38(10.87)	53(7.57)
Blindness	11(3.24)	14(3.71)	25(3.49)	2(0.57)	4(1.15)	6(0.86)
Leopard skin	5(1.45)	12(3.18)	17(2.37)	6(1.17)	12(3.44)	18(6.61)
Hanging groin	4(1.18)	0(0.00)	4(0.56)	4(1.14)	0(0.00)	4(0.57)
Microfilaria	156(48.88)	190(50.40)	346(48.26)	-	-	-

Prevalence reduction 12 years post ivermectin mass treatment was highly significant for palpable nodules (χ^2=74.08, p<0.001) and blindness (χ^2=10.25, p=0.0014) but no significant change in the prevalences for leopard skin (χ^2=0.01, p=0.94) and hanging groin (χ^2=0.10, p=0.75).

From the 1998 pre-control data, the prevalence of palpable nodules (24.45%) was close to the actual prevalence of infection as determined by microfilarial emergence (48.26%) from skin snips. This was therefore the clinical manifestation used in 2002 to assess the disease burden in the study community as the alternative to skin snipping.

The distribution of nodules in the community, based on the questionnaire showed that females had the highest prevalence (10.89%) of palpable nodules. This group was closely followed by those who were singles (10.36%) and farmers (8.94%) with sexes combined in both categories. The least prevalence of 4.14% was recorded in the married category (Table 2). Also, the Odd's Ratio (OR) analysis showed that prevalence of palpable nodules was significantly associated with the female sex, those who were singles and farmers (OR>1.0, p<0.01). On the other hand, nodule prevalence showed no association (OR<1.0, p>0.05) with the remaining categories of persons.

TABLE 2: THE 2002 DISTRIBUTION OF PALPABLE NODULES AMONG VARIOUS CATEGORIES OF PERSONS IN GALADIMAWA

Category	Number examined	Number with Nodules	Prevalence (%)	Odds Ratio	p-value
Males	351	15	4.27	0.37	0.9985
Females	349	38	10.59	2.74	0.0016
*Married	314	13	4.14	0.37	0.9969
*Singles	386	40	10.36	2.68	0.0032
*Farmers	369	36	9.68	1.96	0.0358
*Civil servants	32	2	6.25	0.81	0.9579
*Pupils	154	9	5.84	0.71	0.4563

*Both sexes combined.

There was a significant positive correlation (r=0.9075, p=0.005) in the prevalence of nodules with age (Fig. 1) indicating that the prevalence of nodules increased with the ages of individuals examined. A slight insignificant decrease (χ^2=0.04, p=0.85) in prevalence was observed only in the age group 45-54 years (class mark = 49.5 years).

DISCUSSION

The observed significant reduction in the prevalence of palpable nodules after the intervention with ivermectin was an indication of the efficacy of the drug in curbing the spread of onchocerciasis in the community. Such significant reduction in nodule prevalence has been

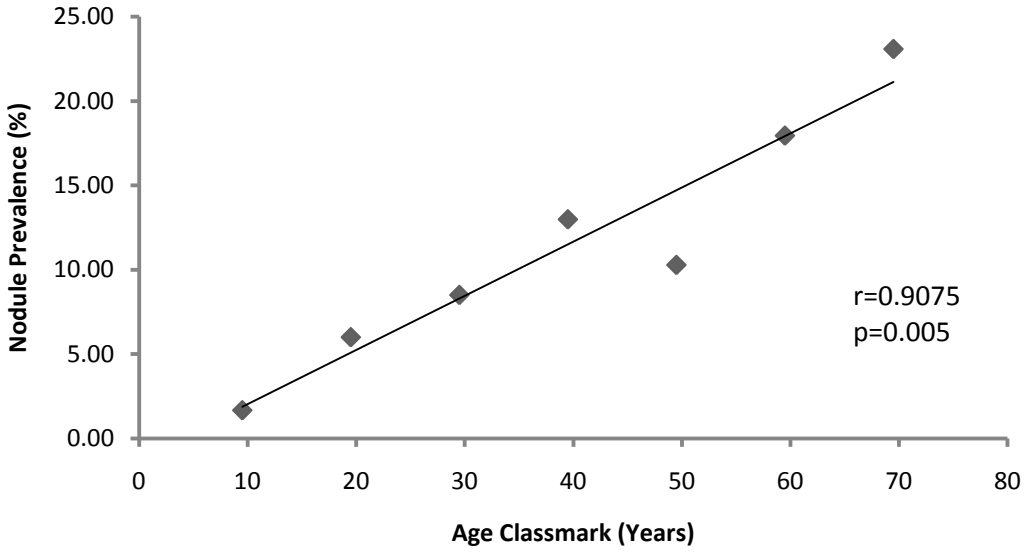

FIG. 1: AGE CORRELATION WITH NODULE PREVALENCE IN GALADIMAWA AS DETERMINED BY REA METHOD IN 2002

reported earlier (Emuka *et al.* 2004, Ndyonmugyenyi *et al.* 2004). Although palpable nodules is a clinical condition that has been confirmed to be a valid rapid assessment tool for the community diagnosis of the disease for urgent distribution of ivermectin (Kipp & Bamhuhiiga 2002), it may not be absolutely adequate in the assessment of the efficacy of the drug in the control of onchocerciasis in some communities. This is because Emukah *et al.* (2004), in assessing the impact of repeated mass ivermectin treatment on the clinical manifestations of onchocerciasis in Imo state, Nigeria, found that nodule prevalence in one community did not change at all seven years post commencement of ivermectin treatment.

The females in the study community were more disposed to infection with the disease than their male counterpart. This is because the women are involved in farming activities that span long hours daily, thereby exposing them to the repeated bites of the flies. This explains why nodule prevalence was significantly associated with farming being the main occupation in the study area. Therefore, the use of the prevalence of palpable nodules in adult males as a rapid method for the identification of communities that are hyperendemic for onchocerciasis as determined by earlier workers (Law *et al.* 1998, Whitworth & Gemade 1999, Kipp & Bamhuhiiga 2002) may not be suitable for application in this study community. Adult females in this case will be the most suitable. We also suggest that the cultural and agricultural practices of each community should be taken into consideration during pre-ivermectin treatment surveys.

Although the prevalence of nodule reduced significantly post-ivermectin repeated mass treatment, it still correlated strongly and positively with age. Higher nodule prevalences in the adult population agree with previous works (Anosike *et al*. 2001).

Previous reports (Winnen *et al.* 2002) showed that the efficacy of ivermectin in controlling the disease burden of any community depends on the consistency of the treatment regimen. Osei-Atweneboana *et al.* (2007) demonstrated in Ghana that skin microfilaria repopulation commenced in 12-90% of treated individuals in the various communities they studied. Therefore, intervals between treatment regimens beyond 90 days (3 months) may still allow the effective transmission of the parasite by the simuliid vector.

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