Rev. Biol. Trop., 45(2): 871-876, 1997

Comparison of two sample survey methods for hyperendemic onchocerciasis and a new focus in Dakka, Nigeria

O. B. Akogun[1], Akoh J. I[2]., and Okolo A[3].
[1] Parasite and Tropical Health Research Department of Biological Sciences Federal University of Technology, Yola, Nigeria.
[2.] Department of Biological Sciences University of Agriculture, Makurdi, Nigeria
[3.] Department of Mathematics, Statistics and Operations Research, Federal University of Technology, Yola, Nigeria.

(Received 25-VIII-1995. Corrected 10-IX-1996. Accepted 10-IX-1996.)

Abstract: Most researchers rely only on large samples for the assessment of onchocerciasis prevalence in communities where it is endemic . However, because of the large population that must be included in the sample and the cost of surveys, several alternative methods are being explored. One is the selection of a small "at risk" sample of 30 persons from each community to determine the level of onchocercal endemicity. In this study both the Small Sample Survey (SSS) and the Complete Enumeration Survey (CES) techniques were used to determine the prevalence and intensity of onchocerciasis infection in sixteen communities in Dakka district, Nigeria, using conventional epidemiological procedures. The SSS showed that 82.3% of 390 at risk persons were microfilarial positive with a mean microfilaria density (MFD) of 90.9 microfilaria per skinsnip (MF/SS) and six communities were classified as hyperendemic (prevalence beyond 59.9%). The CES of 1529 persons produced a count of 78.2% positivity and a MFD of 88.44 MF/SS. For each of the physical symptoms of the disease and the MFD, computed T-test values showed that the SSS gives an estimate that is impressively close to the CES in the estimation of the prevalence of onchocerciasis in a community despite its low cost.

Key words: Onchocerciasis, Nigeria, comparison, methods, survey cost reduction.

Nigeria is one of the endemic countries for the river blindness disease caused by *Onchocerca volvulus* and transmitted by *Simulium damnosum* S.I.

Since the pioneering work in the Taraba river valley Nigeria, (Akogun and Onwuliri 1991) studies have continued to reveal that the prevalence of onchocerciasis reaches hyperendemic levels in the Fan-Manga headwaters of the Taraba river.

Gongola State has some of the worst onchocerciasis foci in Nigeria with prevalence rates reaching 100% in some communities (Akogun and Onwuliri 1991). The high endemicity of onchocerciasis in the Hawal river valley in Borno State has already been established (Budden 1956, Bradley 1976). The development of ivermectin as a drug of choice for mass chemotherapy and the Nigerian National Onchocerciasis Control Programme has made the collation of baseline data within a short period necessary for selecting communities for ivermectin delivery.

The merits and demerits of various methods of diagnosis of community prevalence of onchocerciasis have been reviewed (Akogun *et al.* 1992) and a comparative testing of each method in different ecological settings have been suggested. On this basis a model which is built on a number of confounding factors for the selection of communities for ivermectin distribution was designed (Kelly and Akogun, in press). The model showed that the value of clinical symptoms for the prediction of infection rate is extremely limited when mathematically expressed.

Large-scale surveys using large samples continue to be the most favoured method of determining the rate of infection in the communities. However, the large areas involved and the cost of surveys during the present economic depression are major impediments to the continued use of large samples. Recently the selection of a small (less than 30) at-risk-group persons for parasitological examination and the use of the result for estimating the prevalence of infection in the community has become a convention. However, it is yet to be established if small samples give similar estimations as large samples.

Consequently the present investigation was designed to achieve two objectives: determine the prevalence and distribution of onchocerciasis in Dakka District of Gongola State and compare the results of surveys based on small samples with those based on large samples. The main aim is to determine if small samples give as good an estimate of endemicity as large samples.

MATERIALS AND METHODS

Area: Dakka is an important district in central Gongola State, Nigeria. The district is situated between 8°00-8°45'N and 11°20-11°50'E. Many streams and rivulets which feed rivers Fan-Manga and Kam take source from this hilly district. Fan-Manga and Kam are the two major rivers which take source from Dakka and which appear to provide suitable habitats for *Simulium* breeding. While Fan-Manga flows westward into the south bound Benue, Kam-Manga flows south into the Taraba river. The high altitude of the Dakka district reaches about 2,042m on the Shebshi heights. The Chamba, are the main inhabitants of the Dakka district. The common occupation of the people is the cultivation of guinea corn and rice in the valleys and hillsides.

Sampling methods: Sixteen communities were surveyed for onchocerciasis. The surveyed communities are: Dakusun (8°37'N, 11°22'E), Shina (8°10'N, 11°18'E), Dadinkowa (8°10'N, 11°10'E), Jaro-Aku (8°12'N, 11°9'E), Dakka (8°28'N, 11°22'E), Gangdambana (8°32'N, 11°22'E), Kwamsa (8°10'N, 11°18'E), Danaba (8°10'N, 11°10'E), Gangwonjida (8°10'N, 11°21'E), Gangiren (8°22'N, 11°19'E), Timku (8°19'N, 11°17'E), Gangpotenu (8°23'N, 11°15'E), Abiola Farm (8°30'N, 11°10'E), Befori (8°13'N, 11°28'E), Nyikusun (8°12'N, 11°18'E), Yam-Allah-Yayi (8°16'N, 11°22'E). The simple random sampling technique was used to select the communities. Each community was visited twice. During the first visit which was unannounced, small sample survey of not more than forty adult male farmers who were the at-risk group were examined for microfilariae in skin and clinical symptoms of onchocerciasis.

A second preannounced visit was made to each village and all social groups from both sexes were examined for microfilariae in skin and clinical symptoms during a house to house survey (complete enumeration). Some houses were visited three times before all the members could be completely examined.

Physical and parasitological investigation: Physical examination for clinical symptoms of onchocerciasis was done in a hut or room with enough light with the individual stripped to maximum extent that modesty permits in the circumstances. The presence and degree of pruritis, lizard skin, leopard skin, nodule presence and load and hymphadenopathy (hanging groin and scrotal enlargement) were recorded on an epidemiology form specifically designed for this investigation. Visual acuity and eye involvement were not determined.

Skin biopsies were taken from both sides of the hip of the individual. The site for biopsy was first cleaned with cotton swab moistened in 70% ethanol then a German-made corneoscleral punch with 1.5 mm bite was used to take a skin fragment. The fragment was placed in microtitre plates with U-shaped wells containing two drops of normal saline. The wells of completely filled plates were covered with adhesive tape to prevent evaporation and spilling of contents during transportation. Each well was examined for the microfilariae (mf) of *O. volvulus* with a binocular lens (x 50 magnification) within 24 hours. The number of mf was recorded.

During the physical examination and parasitological investigations the same epidemiological assistant performed the same function during both small sample survey (sss) and complete enumeration survey (ces) in order to maintain the same level of standard. It was therefore not necessary to weigh each skin fragment before the mean microfilarial density (mfd) could be calculated.

Data analysis: The two sets of data were derived from normal populations with a common variance. The common variance was estimated (Gupta 1982) and the null hypothesis tested at 0.05 level.

RESULTS

Using the Small Sample Survey (SSS) method the sixteen villages were investigated in 13 days while 172 days were spent during the complete enumeration survey (CES) when all the villages were completely covered.

Small Sample Survey (SSS): A total of 390 adult male farmers from sixteen communities were examined during the SSS (Table 1). The sample sizes ranged between 5 and 37 in any one community.

Table 1

Prevalence of infection and clinical symptoms (small sample survey)

				Prevalence (%)			
Community	No. Exam	Prevalence	Intensity *	Lizard skin	Leopard skin	Nodule rate	Lymphatic involvement
Dakusun	31	83.8	60.4	2.7	0.0	29.7	0.0
Shina	32	100.0	94.8	40.7	6.3	90.6	12.5
DadinKowa	26	100.0	115.4	30.8	15.4	69.2	7.7
Jaro-Aku	30	100.0	121.5	10.0	20.0	70.0	10.0
Dakka	21	100.0	93.0	0.0	19.0	42.9	0.0
Gangdambana	32	90.6	75.4	15.6	21.9	71.9	12.5
Kwamsa	26	100.0	60.2	30.8	23.1	100.0	19.2
Danaba	28	100.0	118.0	39.3	17.9	42.9	7.1
Gangwonjida	30	86.7	106.2	13.3	26.7	70.0	20.0
Gangiren	5	100.0	133.0	20.0	60.0	100.0	20.0
Timku	30	100.0	59.5	13.3	30.0	36.7	16.7
Gangpotenu	12	100.0	116.4	16.7	25.0	100.0	16.7
AbiolaFarm	33	33.3	62.4	0.0	0.0	9.0	0.0
Befori	10	100.0	87.4	10.0	30.0	60.0	0.0
Nyikusun	8	100.0	94.3	0.0	0.0	100.0	25.0
Yam-Allah-Yayi	30	20.0	56.5	3.3	0.0	6.7	0.0
TOTAL	390	82.3	90.9	15.9	15.4	55.6	9.2

* Microfilarial density

This method showed an onchocerciasis prevalence of 82.3% with eleven communities recording 100% prevalence. Microfilarial density (mfd) averaged 90.9% per skin snip (mf/ss) for the entire district (with a range of 56.5 - 133 mf/ss. Six communities had mfd in excess of 100 mf/ss. Lizard skin was recorded in 15.9% of the district's population. Leopard skin was seen in 15.4% cases but was not observed in Dakusum, Abiola farms, Nyikusun and Yam-Allah-Yayi. The nodule carrier rate was 55.6% of those examined while lymphatic involvement was 9.2%. The commonest form of involvement was scrotal enlargement.

Complete Enumeration Survey (CES): During the CES, 1 529 persons were examined (Table 2) and an onchocerciasis prevalence of 78.2% was recorded. Ten communities were hyperendemic and the mean microfilarial density was 88.4 mf/ss which was similar to that obtained during SSS. Five communities has Mfd in excess of 100 mf/ss. Lizard skin was seen in 15.6% of the population thus showing very little difference with that obtained during the SSS (χ^2, P>0.001). Lizard skin was observed in all communities. Leopard skin was not recorded in 8.5% of those examined. The overall nodule carrier rate was 43.7% but was as high as 93.8% in Nyikusun. Lymphatic involvement occurred in 8.5% and the commonest form of involvement was scrotal enlargement.

Table 2

Prevalence of infection and clinical symptoms (Complete Enumeration Survey)

Community	No. Exam	Prevalence	Intensity *	Prevalence (%) Lizard skin	Leopard skin	Nodule rate	Lymphatic involvement
Dakusun	139	43.2	57.4	5.8	2.9	19.4	2.2
Shina	130	92.3	62.0	4.6	1.5	28.5	3.1
DadinKowa	203	65.5	48.0	7.4	3.0	35.0	2.0
Jaro-Aku	129	96.9	69.2	19.4	7.8	21.7	6.2
Dakka	92	45.7	27.0	8.7	2.2	13.0	4.3
Gangdambana	43	95.3	117.8	30.2	18.6	83.7	11.6
Kwamsa	118	100.0	149.0	27.1	14.4	76.3	15.3
Danaba	80	100.0	180.6	25.0	15.0	81.3	11.3
Gangwonjida	200	80.0	124.6	21.0	15.5	57.5	14.5
Gangiren	18	66.7	70.1	11.1	5.5	22.2	5.5
Timku	180	94.4	92.0	27.2	13.9	62.8	17.8
Gangpotenu	31	96.8	87.5	22.6	19.4	77.4	19.4
AbiolaFarm	64	57.8	30.7	1.6	0.0	12.5	0.0
Befori	20	85.0	93.1	20.0	10.0	20.0	10.0
Nyikusun	32	100.0	159.0	15.6	12.5	93.8	15.6
Yam-Allah-Yayi	50	36.0	45.6	2.0	0.0	8.0	0.0
TOTAL	1529	78.2	88.4	15.6	8.5	43.7	8.5

Table 3

Descriptive Statistics of Sample Groups

Measure of Comparison	Small Sample Survey Sample means	Sample variances	Complete Enumeration Survey Sample mean	Sample variances
Prevalence (microfilaria positive)	20.686	101.430	74.686	2958.763
Intensity of infection (mfd)	90.900	671.051	88.350	2152.861
Lizard skin	3.875	16.783	14.875	221.850
Leopard skin	3.750	8.600	8.125	82.917
Nodule	13.563	70.530	41.750	1425.400
Lymphatic involvement	2.250	4.200	8.125	95.050

Comparison between SSS and CES: Descriptive statistics of sample groups is shown in Table 2 while the computed T-values are shown in Table 3. The sample means and variances were 30.688 and 101.430 respectively for microfilarial positive SSS while in CES they were 74.686 and 2958.763 respectively. Mfd sample means and variances were similar for SSS (χ^2: 90.900, σ^2: 671.051) and CES (χ^2: 88: 2152.861). Thus there was no significant difference between the CES and SSS when the information required is on the Mfd.

The prevalence of Onchocerciasis, lizard skin, leopard skin, nodule rate and lymphatic involvement differed significantly between the two methods.

DISCUSSION

Irrespective of survey method used, the Dakka district is a hyperendemic onchocerciasis zone with a high prevalence of physical symptoms of the disease. This district is probably continuous with the Taraba area focus which was reported to be one of the worst onchocerciasis zones in Nigeria (Akogun and Onwuliri, 1991). The results of this study seem to have confirmed that the entire area between latitude 6°N and 9°N and longitude 10°30'E and 12°30'E has the worst foci of onchocerciasis in Nigeria. Surveys in other parts of the state yielded much lower rates of infection (Akogun 1991, 1991b). The geology of the area provides many numerous breeding sites for the *Simulium* vector and since almost everyone engages in farming, the exposure to fly bites is much higher than those in other areas of the state.

The epidemiological factors which are associated with transmission are similar to those reported in other parts of the state and have been elaborately discussed in previous publications (Akogun 1991a, 1991b). The Dakka district should be included in the first phase of the ongoing ivermectin distribution exercise.

Comparison between SSS and CES indicates wide differences except with respect to microfilarial load where both methods yielded similar results. The computed T-values for each parasitological and clinical parameter falls in the right tail of the distribution thus showing that the CES is a superior method to the SSS in the estimation of the prevalence of onchocerciasis in a community.

The implication of this is that SSS may not be a very suitable method of selecting communities for ivermectin delivery. Several communities may be bypassed by distribution teams. Communities such as Yam-Allah-Yayi will not qualify for ivermectin distribution on the basis of the current survey methods. The CES should continue to be used to assess the community level of endemicity and for ivermectin distribution despite its enormous cost until an alternative method is developed.

A few studies have concentrated on the development of a more rapid and effective method of assessing a community's need for ivermectin. Clinical onchocercal lesions such as nodules, leopard skin and lizard skin which are pathognomonic for onchocercal infections are diagnostic features whose relationship with the prevalence and intensity of *Onchocerca volvulus* can be exploited (Edungbola *et al.* 1983).

These symptoms may be a more useful value than any other form of diagnosis if they reflect the extent of infection in a quantitative manner. Kelly & Akogun (in press) have formulated a simple model and have suggested that a data set from a large geographical region with many variables is required before a quantitative method can be derived.

It is believed that the advantages of such a relationship are many, especially since it will avoid the contamination of body fluids with deadly disease agents such as the HIV virus which the taking of skin snips is in danger of spreading during mass surveys. Fortunately, however, a lot of surveys have been carried out by different groups and by individual scientists. The collation of these into a comprehensive dataset for the determination of the relationship between symptoms and the presence of *O. volvulus* in skin will improve the present method of identifying communities for ivermectin distribution. The long term effectiveness of ivermectin delivery is dependent on how soon an alternative diagnostic method is developed.

ACKNOWLEDGMENTS

We thank Peter Bazza Teru for technical assistance.

REFERENCES

Akogun, O. B. 1991a. Filariasis in Gongola State Nigeria I. Clinical and Parasitological Studies in Mutumbiyu district. J. Hyg. Epid. Microbiol. Immunol. 35: 1 - 7

Akogun, O. B. 1991b. Yaws in the Garkida area of Gongola State with a note on syphilis and Filariasis. Ann. Univer. Sci. Sante (Cameroun) 8: (in press).

Akogun, O. B. & C.O.E. Onwuliri. 1991. Hyperendemic onchocerciasis in the Taraba river valley of Gongola State (old Adamawa province), Nigeria. Ann. Parasitol. Humaine Comparee 66: 22 - 26.

Akogun, O.B. J.I. Akoh & H. Hellandendu. 1992. Studies on Non-ocular clinical onchocerciasis in the Taraba River Valley Nigeria. J. Hyg. Epidem., Microb. Immunol. 36: 368 - 383.

Bradley, A.K. 1976. Effects of Onchocerciasis on settlement in the middle Hawal valley, Nigeria. Trans. Roy. Soc. Trop. Med. Hyg. 70: 225 - 229.

Budden, F.H. 1956. The Epidemiology of onchocerciasis in Northern. Nigeria. Trans. Roy. Soc. Trop. Med. Hyp. 50: 366 - 378.

Edungbola, L. D. B.A. Oni & B.A Aiyedun. 1983. Babana Parasitic Diseases Project I. the study area and a preliminary assessment of onchocercal endemicity based on the prevalence of leopard skin. Trans. Roy. Soc. Trop. Med. Hyp. 77: 303 - 309

Gupta, C.B. 1982 An introduction to Statistical Methods. Vikas, New Dehli. p. 669 - 733

Kelly, M.G. & O.B. Akogun. 1996. The rapid assessment of onchocerciasis prevalence and a model for selecting communities for ivermectin distribution in West Africa. Bull. W.H.O. (in press).