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Ivermectin-based control of onchocerciasis in northern Cameroon: individual factors influencing participation in community treatment

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Abstract

A study aimed at determining individual factors associated with participation in community treatment with ivermectin was conducted in a village hyperendemic for onchocerciasis in northern Cameroon. The respective influences of sex, age, place of residence, distance between the compound and the dosing point, compound size, and participation in treatment by authoritative individuals in the compound was evaluated using univariate and multivariate analysis. Participation in treatment was closely associated with the attitude of the compound heads. Participation of compound heads in treatment increased as the household size increased, and as the distance to the distribution point diminished. This may be explained by the fact that getting information on health programmes is easier in large households whose members are involved in various social activities, and in compounds located near the village centre. Staff involved in health education should take this issue into account, and try to ensure circulation of information particularly to those living in small or remote compounds.

Keywords: onchocerciasis, *Onchocerca volvulus*, ivermectin, community treatment, Cameroon

Introduction

In 1987, ivermectin was registered for human use under the trade name Mectizan®, and Merck & Company Laboratories decided to donate it, without charge, to treat onchocerciasis throughout the world for as long as required. As a consequence of this decision, large scale distribution programmes have been developed in many countries. In hyperendemic areas it is recommended that ivermectin be delivered through community-based distribution systems. The success of such programmes depends upon community participation, which is related to various factors, such as the method of drug distribution, health education, and cultural perception regarding infection or treatment. The present study was aimed at identifying individual factors that influenced participation during the first ivermectin distribution carried out by the non-governmental organization River Blindness Foundation (RBF) in northern Cameroon. The final objective was to develop guidelines to improve drug coverage during subsequent treatments, and to ensure sustainability of community participation. The factors considered were sex, age, participation of authoritative persons in the compounds, place of residence, and distance between the compounds and the dosing point.

Materials and Methods

The ivermectin distribution programme in northern Cameroon

A large scale ivermectin distribution programme was launched in 1992 by RBF and the Cameroonian Ministry of Public Health (MOPH) in the Northern Province of Cameroon, where some 200 000 people live in meso- or hyperendemic onchocerciasis areas. Training sessions for the nurses responsible for the treatment, KAP (knowledge, attitude and perception) surveys, and development of health education material were organized in 1992, and the first ivermectin distribution was carried out in March 1993. The programme is integrated into the Primary Health Care system currently developed by the MOPH with the support of the French *Fond d'Aide à la Coopération.* Distribution includes a cost recovery system to cover expenses of distribution, such as motorcycle fuel, maintenance, nurses' allowance, and health committee members' incentive. Every person above 15 years old was asked to pay 75 CFA* (US$ 0·15), an amount considered acceptable by the population, as shown by the preliminary KAP survey. In the study area, ivermectin was available only through the outreach strategy distribution carried out by MOPH and RBF.

Study area

The study was carried out in Konglé (8° 27′ N, 13° 10′ E), a village located in a medio-Sudan savanna area of Cameroon. This village was selected based on the results of preliminary surveys, which gave evidence of a high level of endemicity for onchocerciasis (see below), and because of its representative nature regarding sociological and geographical organization. The village chief is a traditional *lamido.* Konglé includes 3 districts: Konglé-Centre, controlled by the *lamido* himself, and Wakiri and Kpah, which are contiguous and located several kilometres away on the north side of Mount Pangoul (Fig.1); each is controlled by a minor chief (*jauro*). The population belongs to the Dowayo ethnic group; most of the residents are Muslim, and their major occupation is subsistence farming. Six months before treatment 2 skin snips (one at each iliac crest) had been taken with a 2 mm Holth type corneoscleral punch from a sample of 188 people over 5 years of age. After incubation for 24 h in saline, the emerged *Onchocerca volvulus* microfilariae were counted under a microscope. Prevalence of microfilarodermia was 80·3% (76·1% in Konglé-Centre, and 87·3% in Wakiri-Kpah), and the arithmetic mean microfilarial load was 86·1 microfilariae per skin snip (67·1 in Konglé-Centre and 117·4 in Wakiri-Kpah).

Health education and treatment schedule

Health education material, including booklets and charts, created in 1992 following a KAP survey, was aimed at explaining how onchocerciasis is transmitted and emphasizing the risk of blindness if ivermectin is not taken annually. In each village, preparatory health education sessions were organized by a nurse just before ivermectin distribution, with the assistance of the village health committee.

In Konglé, the first ivermectin distribution was carried out by a nurse on 24 May 1993. The target population was clearly identified as the people living in the *lamido*'s area of influence. The drug distribution was carried out in the *lamido*'s home. Before treatment, information was given on the exclusion criteria. The people were also informed that mild and transient reactions might occur after treatment, and that the distributors would manage them during the 2 d after treatment. Before dosing, each person of 15 years of age and older was asked to pay 75 CFA. Treatment was given free to children. The distribution team recorded the full name, sex, and age of treated people, each of whom received an individual treatment card.

Population census and mapping the village

An exhaustive census of the population was performed

*CFA = Communauté Financière Africaine; 100CFA = 1 French franc.

in July 1994. All the compounds were revisited after one month to check the data of residents who were absent during the first census. Information recorded for each person was the full name, sex, age, and status within the compound. This allowed us to identify individuals who were presumably in authority, i.e. the compound head, and the senior woman. An accurate position of the compounds was obtained simultaneously using a global positioning system (Traxar®, Motorola Inc.). The distances between each compound and the distribution point were then calculated with an accuracy of 100 m. A map of the area was drawn using a geographic information system (Atlas GIS®, Strategic Mapping Inc.).

Assessment of participation in treatment

Assessment of individual participation in the distribution was achieved by inspection of individual treatment cards. If the card were missing, participation was assessed by questioning the subject him- or herself, and relatives of the same household.

Data analysis

Analysis was performed using a two-step procedure. Univariate analysis was first performed using EpiInfo (CDC) in order to identify the potential explanatory variables to integrate into the subsequent model. Multivariate analysis was then performed using the logistic model included in Egret® (Statistics and Epidemiology Research Corporation and Cytel Software Corporation). The explanatory variables associated with drug coverage were identified using a backward stepwise regression. The likelihood ratio was calculated at each step, in order to check that the removal of the variable did not change the likelihood of the model. 95% confidence intervals (CI) were calculated for drug coverages and odds ratios (OR).

Results

Study area

As shown in the map (Fig.1), the most remote compound was located 5·3 km from the *lamido*'s house. For

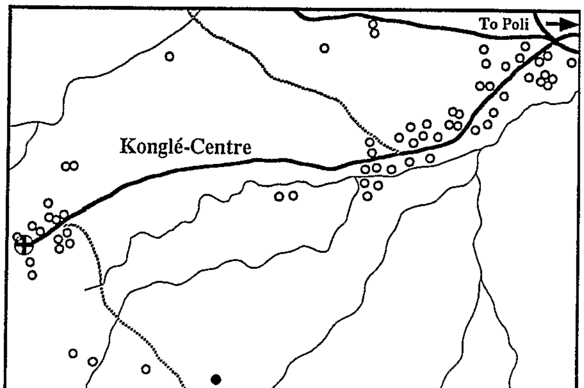

Fig. 1. Map of study area in Cameroon.

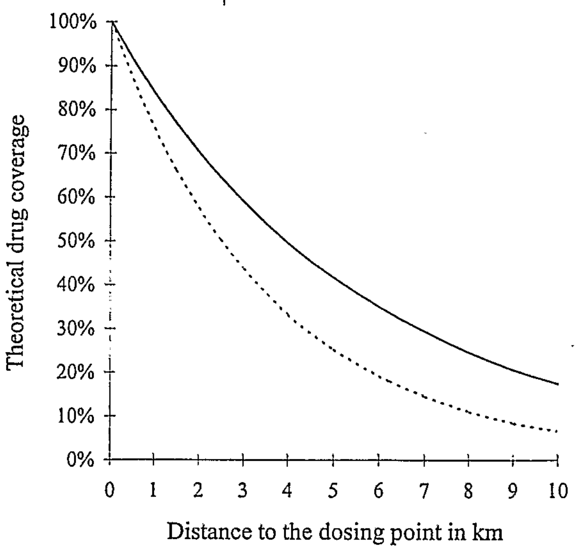

Fig. 2. Theoretical ivermectin coverage related to the distance from the distribution point, using model 1, OR = 0·84 (——) and model 3, OR = 0·76 (-----).

analysis, 2 groups of compounds were distinguished according to accessibility to the *lamido*'s house. Group A included the compounds in Konglé-Centre, on the plain near the road between the town of Poli and the *lamido*'s house. Group B included the compounds in Wakiri and Kpah, that could be reached from Konglé-Centre only by footpaths. The total population was 498, including 451 above the age of 5 years (Table 1); 309 and 142 of the latter lived in areas A and B, respectively.

Univariate analysis of factors associated with participation in treatment

Amongst the 451 people 5 years of age and older, 146 (32·4%) were given ivermectin.

Sex and age. The drug coverage in males and females was 36·1% (CI 29·1–43·0%) and 29·9% (CI 24·4–35·3%), respectively (Table 1). The difference was not significant (P=0·2, OR=1·3). Detailed analysis within each age group showed that the coverage in males and females was not significantly different in people less than 35 years of age (31·1 and 34·6%, respectively; P=0·6). Conversely, the coverage in males 35 years of age and older was higher than in females belonging to the same age group (42·5 and 22·9%, respectively; P=0·04, OR=2·5, CI 1·3–4·9).

Number of people per compound. The 498 persons recorded in Konglé lived in 87 compounds (mean compound size: 5·8 persons). Drug coverage varied according to the compound size, although it was difficult to find any general trend. However, comparison of coverages for people living in compounds with 1–3 persons, 4–10 persons, and more than 10 persons (18·0, 35·5, and 32·0%, respectively) gave evidence of a significant difference (P=0·03). This was related to the low coverage in people living in small dwellings. When multivariate analysis was performed, only 2 classes were considered: compounds with 1–3 subjects, and compounds with more than 3 people.

Place of residence and distance between the compound and the distribution point. The drug coverage in Konglé-Centre (area A) and in Wakiri and Kpah (area B) was 38·2 and 19·7%, respectively. These proportions was significantly different (P=0·0001). The mean distance from the dosing point was 2·6 km for the treated population (range 0–5·2 km, standard deviation 1·7), and 3·3 km for people who did not participate (range 0·02–5·3 km, standard deviation 1·4). The difference was significant (P=0·002). There was a trend for the coverage to decrease as the distance between the place of residence and the dosing

Table 1. Population recorded and ivermectin coverage according to sex and age[a]

	Males		Females		Total	
Age group (years)	No. recorded	No. treated	No. recorded	No. treated	No. recorded	No. treated
5–14	48	14 (29·2%)	58	18 (31·0%)	106	32 (30·2%)
15–24	29	8 (27·6%)	43	12 (29·5%)	72	20 (28·8%)
25–34	26	10 (38·5%)	58	25 (42·1%)	84	35 (41·0%)
35–44	30	15 (50·0%)	50	17 (34·0%)	80	32 (40·0%)
45–54	22	7 (31·8%)	29	6 (20·7%)	51	13 (25·5%)
⩾55	28	12 (42·9%)	30	2 (6·7%)	58	14 (24·1%)
Total	183	66 (36·1%)	268	80 (29·9%)	451	146 (32·4%)

[a]Boys and girls less than 5 years of age (24 and 23, respectively), and thus ineligible for treatment, are not included in the Table.

Table 2. Logistic regression analyses of factors associated with participation in ivermectin treatment

Variables	Regression coefficient	Standard error	P	Odds ratio[a]	
Model 1[b]					
Constant	−0·68	0·41	0·09	0·50	–
Distance (in km)	−0·18	0·07	0·008	0·84	(0·73–0·95)
Place of residence (A=0; B=1)	−0·76	0·25	0·003	0·47	(0·28–0·77)
Compound size (1–3 people=0; ⩾4 people=1)	0·77	0·36	0·03	2·17	(1·07–4·40)
Model 2[c]					
Constant	−1·15	0·40	0·004	0·31	–
Participation of compound head (untreated=0; treated=1)	1·36	0·32	<0·001	3·90	(2·09–7·26)
Distance (in km)	−0·11	0·09	0·24	0·90	(0·75–1·08)
Place of residence (A=0; B=1)	−0·48	0·33	0·15	0·61	(0·32–1·19)
Model 3[d]					
Constant	−0·44	0·77	0·57	0·65	–
Compound size (1–3 people=0; ⩾4 people=1)	1·86	0·64	0·004	6·41	(1·18–22·68)
Distance (in km)	−0·27	0·16	0·09	0·76	(0·55–1·05)
Place of residence (A=0; B=1)	−1·03	0·60	0·08	0·36	(0·11–1·15)

[a]95% confidence interval in parentheses.
[b]All subjects aged ⩾5 years
[c]Subjects aged ⩾5 years who were neither the head of the compound nor the senior woman in the household.
[d]Heads of compounds only.

point increased. The highest drug coverage (57·8%) was recorded in the population living within 500 m of the dosing point, whereas the lowest (11·2%) was in the population living in compounds located further than 4·5 km away. However, the proportion of treated people in the compounds located between 3·5 and 4·5 km from the *lamido*'s home was 36·3%, a value above the mean coverage recorded in the whole study area. The map (Fig. 1) shows that many compounds were located within this distance in both areas A (85 people living in 16 compounds) and B (77 people living in 14 compounds).

Participation of authoritative persons in the compounds. The drug coverage in the 366 people who were not recorded as compound heads was 42·7% when the latter participated in the treatment, and 13·2% when he did not. This difference was highly significant ($P<10^{-6}$, OR=4·9, CI 2·8–8·6). Similarly, the drug coverage was higher in compounds where the senior woman participated in the treatment than when she did not (51·0 and 32·7%, respectively; P=0·01, OR=2·1, CI 1·1–4·1).

Multivariate analysis of factors associated with participation in treatment

Logistic models, using backward stepwise regression, were performed to identify the factors associated with the dependent variable, i.e., participation in treatment (untreated=0, treated=1).

Model 1, including all the 451 people 5 years of age and older. All the variables that were found to be associated with participation in treatment by univariate analysis were included in this model. These potential explanatory variables were sex, age (either quantitative, or using 2 age groups: 5–34 and ⩾35 years), distance between the compound and the dosing point, place of residence (group A=0, group B=1), and compound size (<4 persons=0, ⩾4 persons=1).

The regression coefficients of the explanatory variables, after removing the variables that did not contribute significantly to the model, are shown in Table 2. Only 3 variables were associated with participation: distance from the dosing point, place of residence, and dwelling size. When the distance from treatment point increased, the drug coverage decreased exponentially. The odds ratio for the place of residence showed that the probability of people living in area B having been treated was approximately half that for the residents in area A. The odds ratio for the dwelling size showed that the probability of having been treated was about twice as high for people living in dwellings with more than 3 persons, compared with that for individuals living in smaller compounds.

Model 2, including 285 people over 5 years of age, who were neither the compound head nor the senior woman in the compound. Two variables were added to the potential explanatory variables included in model 1: participation of compound head, and participation of the senior woman in the compound (no=0, yes=1). The model (Table 2) gave evidence that the only explanatory variable associated with participation was the attitude of the compound head. As there was presumably an interaction regarding participation between the 2 individuals considered as authoritative in the compound, a new variable, the product (participation of the compound head) × (participation of the senior woman), was added to the model. The inclusion of this variable did not significantly change the maximum likelihood estimates of the model, and thus this interaction term was removed.

The coefficients for distance and residence area are also shown in Table 2, in order to calculate a standardized value of the odds ratio for the variable 'participation of compound head'. The model showed that participation was closely associated with the attitude of the compound head. When the latter was treated, the probability of the other family members taking treatment was about 4 times as high as in the contrary case. This result was independent of the place of residence and of the distance from the dosing point.

Model 3, including only the 81 compound heads. The variable most closely associated with participation was the compound size (Table 2). The probability of heads of large compounds taking treatment was about 6 times as high as that of heads of smaller compounds. The place of residence and the distance from the dosing point were also associated with participation in treatment, and the odds ratios for these variables were similar to those given in the first model. This result agrees with those obtained in the 2 preceding models, and provides evidence that the attitude of the compound heads was the strongest influence on the participation of the other family members.

Synthesis of the results. The analysis showed that participation of people in treatment was closely associated with the attitude of the compound head, and that the latter was influenced by 3 variables: dwelling size, place of residence (A or B), and distance from the dosing point.

The probability of the heads of the largest compounds taking treatment was about 6 times that of the heads of smaller compounds (model 3). This attitude seemed to influence the attitude of the other family members (model 2). This is in accordance with the results of model 1, showing that the probability of people living in large compounds being treated was about twice as high as that of people living in smaller dwellings.

The probability of compound heads being treated was higher in area A than in area B.

The probability of being treated decreased exponentially with the distance between the compound and the dosing point. Using the odds ratios calculated in models 1 and 3, it was possible to draw theoretical curves showing this decrease (Fig. 2). The probability of the compound heads taking treatment was halved as soon as the distance from the treatment point reached 2·5 km. Considering the population as a whole, the coverage was halved when the distance exceeded 4 km.

Discussion

As noted by EVANS *et al.* (1993), 'the literature provides little insight into the determinants of a community's sustained willingness to participate in (lymphatic) filariasis control activities'. Studies are still scarcer on chemotherapy-based control of onchocerciasis, as community treatment was impossible until recently, when ivermectin became routinely available. Crucial operational research has been performed as part of the ivermectin distribution programmes for several years. Information is available on knowledge, attitudes, and perceptions of populations living in areas endemic for onchocerciasis (RICHARDS *et al.*, 1991), and on the cost-effectiveness of various methods of distribution (POND, 1991; AKPALA *et al.*, 1993). Apart from this, very little is known about the individual characteristics of the patients who actually participate in treatment. Such information is, however, essential to refine the preliminary health education operations and to improve drug coverage. This will be particularly important when ivermectin is distributed using a community self-treatment strategy (REMME, 1995). The present study was aimed at analysing factors in a rural area in northern Cameroon.

Participation in the distribution was relatively low, despite the high endemicity of onchocerciasis. This was particularly so for females over 35 years old. The analysis gave evidence of the determining role of the compound heads regarding participation of the other family members. This influence appeared to be particularly marked in a traditional community such as Konglé.

The present study demonstrated that the heads of large compounds participated more than the others and, as a consequence, the coverage was higher in people living in large compounds. Three hypotheses may be put forward to account for this result. First, the heads of large households may consider themselves more responsible for the health of their family. Second, information from various sources (school, market, church or mosque, etc.) is more likely to reach large dwellings that house people of several generations. Third, the proportion of children is higher in large compounds, which is favourable to high coverage because those under 15 years of age were treated without charge.

Two distinct areas were distinguished in Konglé, based on accessibility. Drug coverage was twice as high in Konglé-Centre as in Wakiri and Kpah, 2 districts located some distance away on the side of a mountain. Besides this, coverage decreased as the distance to the distribution point increased. This distance decay phenomenon has been documented by several authors in various situations (KING, 1966). Three facts may be put forward to account for the results obtained in Konglé. The first is that residents in Wakiri and Kpah had to reach the dosing point by circuitous and uneven footpaths, whereas the people in Konglé-Centre could use a smooth, straight and wide road. Second, the authority of the *jauro* of Wakiri and Kpah was probably less than that of the *lamido* of Konglé, which is likely to have had consequences on the mobilization of the population. Third, we may assume that the health education operations organized before treatment were less intense in the 2 remote districts. In fact, it appeared from questioning the population that the nurse did not come to Wakiri and Kpah, due to difficulty of access. The mobilization of the population living in those districts was thus done by indirect methods, through several persons who attended the sessions in Konglé-Centre. As people living in the study area readily cover distances of several kilometres on foot, we think the third reason is the main one to account for the low coverage recorded in Wakiri and Kpah.

The present study took advantage of the fact that the payment required for treatment was affordable, a situation that allows us to ignore the complex factors related to the economic situation of the target population. As a consequence, analysis could be performed on objective data only. However, additional research on health-seeking behaviour would be useful to complete our understanding of the factors determining participation. Two conclusions can be drawn from the results obtained in Konglé. First, they provide additional evidence of the need for adequate mobilization of the population to ensure high coverage in ivermectin distribution programmes. The method should particularly aim at reaching people living in small or remote dwellings, which information is less likely to reach. Second, the location of dosing points should be chosen so that people do not have to walk more than a few kilometres. Data from Konglé indicate that dosing points located 3 km apart may ensure a good coverage. Community delivery methods, using selected villagers to treat the community with ivermectin, may deal satisfactorily with the latter issue.

Our study in northern Cameroon should be extended. Although associations have been demonstrated in Konglé between individual factors and participation in treatment, the confidence intervals for the odds ratios were relatively wide. This was due to the limited size of the population studied and the relatively large variance of some of the variables. In addition, studies should be performed in other socio-cultural and geographical situations, particularly in forest areas, where the symptomatology of onchocerciasis is different. Lastly, our study was performed on the occasion of a first treatment round. The effect of the first dosing on some clinical signs and the occurrence of side effects might influence participation in subsequent treatment rounds. This should be evaluated in order to ensure the sustainability of ivermectin distribution programmes.

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References

Akpala, C., Okonkwo, P. O., Nwagbo, D. & Nwakoby, B. (1993). Comparison of three strategies for mass distribution of ivermectin in Achi, Nigeria. *Annals of Tropical Medicine and Parasitology*, 87, 399–402.

Evans, D. B., Gelband, H. & Vlassoff, C. (1993). Social and economic factors and the control of lymphatic filariasis: a review. *Acta Tropica*, 53, 1–26.

King, M. (1966). *Medical Care in Developing Countries*. London: Oxford University Press.

Pond, B. (1991). *Mass Distribution of Ivermectin*. Washington, DC: Africare & Bethesda, Maryland: The International Eye Foundation, pp. 19–41.

Remme, J. H. F. (1995). The African programme for onchocerciasis control: preparing to launch. *Parasitology Today*, 11, 403–406.

Richards, F., Klein, R. E., Gonzales-Peralta, C., Zea Flores, R., Zea Flores, G. & Ramirez, J. C. (1991). Knowledge, attitudes and perceptions (KAP) of onchocerciasis: a survey among residents in an endemic area in Guatemala targeted for mass chemotherapy with ivermectin. *Social Science and Medicine*, 32, 1275–1281.

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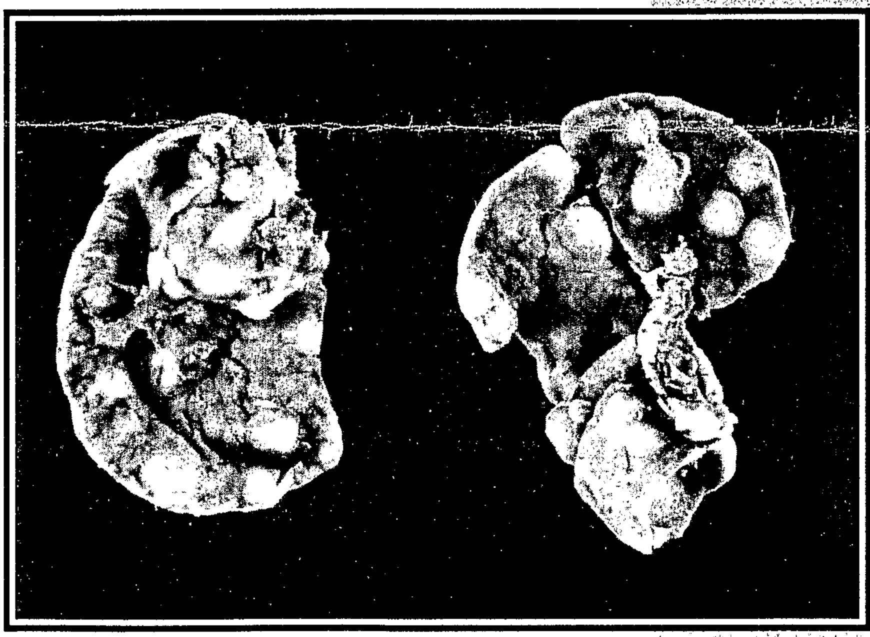

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