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 were 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 of age 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.

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

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 Wakiiri and Kpah, which are contiguous and located several kilometres away on the north side of Mount Pangou (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 microfilaremia was 80%-8% (76%-1% in Konglé-Centre, and 87%-8% in Wakiiri-Kpah), and the arithmetic mean microfilarial load was 861 microfilariae per skin snip (671 in Konglé-Centre and 1174 in Wakiiri-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...
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 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 were significantly different (P=0.001). 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 0-2-3 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 agea

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Males</th>
<th></th>
<th>Females</th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. recorded</td>
<td>No. treated</td>
<td>No. recorded</td>
<td>No. treated</td>
<td>No. recorded</td>
</tr>
<tr>
<td>5-14</td>
<td>48</td>
<td>14 (29.2%)</td>
<td>58</td>
<td>18 (31.0%)</td>
<td>106</td>
</tr>
<tr>
<td>15-24</td>
<td>29</td>
<td>8 (27.6%)</td>
<td>43</td>
<td>12 (29.5%)</td>
<td>72</td>
</tr>
<tr>
<td>25-34</td>
<td>26</td>
<td>10 (38.5%)</td>
<td>58</td>
<td>25 (42.1%)</td>
<td>84</td>
</tr>
<tr>
<td>35-44</td>
<td>30</td>
<td>15 (50.0%)</td>
<td>50</td>
<td>17 (34.0%)</td>
<td>80</td>
</tr>
<tr>
<td>45-54</td>
<td>22</td>
<td>7 (31.8%)</td>
<td>29</td>
<td>6 (20.7%)</td>
<td>51</td>
</tr>
<tr>
<td>≥55</td>
<td>28</td>
<td>12 (42.9%)</td>
<td>30</td>
<td>2 (6.7%)</td>
<td>58</td>
</tr>
<tr>
<td>Total</td>
<td>183</td>
<td>66 (36.1%)</td>
<td>268</td>
<td>80 (29.9%)</td>
<td>451</td>
</tr>
</tbody>
</table>

aBoys 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

<table>
<thead>
<tr>
<th>Variables</th>
<th>Regression coefficient</th>
<th>Standard error</th>
<th>P</th>
<th>Odds ratioa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1b</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.68</td>
<td>0.41</td>
<td>0.09</td>
<td>0.50</td>
</tr>
<tr>
<td>Distance (in km)</td>
<td>-0.18</td>
<td>0.07</td>
<td>&lt;0.01</td>
<td>0.84 (0.72-0.95)</td>
</tr>
<tr>
<td>Place of residence (A=0; B=1)</td>
<td>-0.76</td>
<td>0.25</td>
<td>0.03</td>
<td>0.47 (0.28-0.77)</td>
</tr>
<tr>
<td>Compound size (1-3 people=0; ≥4 people=1)</td>
<td>0.77</td>
<td>0.36</td>
<td>0.03</td>
<td>2.17 (1.07-4.40)</td>
</tr>
<tr>
<td>Model 2c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-1.15</td>
<td>0.40</td>
<td>0.004</td>
<td>0.31</td>
</tr>
<tr>
<td>Participation of compound head</td>
<td>1.36</td>
<td>0.32</td>
<td>0.001</td>
<td>3.90 (2.09-7.26)</td>
</tr>
<tr>
<td>(untreated=0; treated=1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance (in km)</td>
<td>-0.11</td>
<td>0.09</td>
<td>0.24</td>
<td>0.90 (0.75-1.08)</td>
</tr>
<tr>
<td>Place of residence (A=0; B=1)</td>
<td>-0.48</td>
<td>0.33</td>
<td>0.15</td>
<td>0.61 (0.32-1.19)</td>
</tr>
<tr>
<td>Model 3d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.44</td>
<td>0.77</td>
<td>0.57</td>
<td>0.65</td>
</tr>
<tr>
<td>Compound size</td>
<td>1.86</td>
<td>0.64</td>
<td>0.004</td>
<td>6.41 (1.18-22.68)</td>
</tr>
<tr>
<td>(1-3 people=0; ≥4 people=1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance (in km)</td>
<td>-0.27</td>
<td>0.16</td>
<td>0.09</td>
<td>0.76 (0.55-1.05)</td>
</tr>
<tr>
<td>Place of residence (A=0; B=1)</td>
<td>-1.03</td>
<td>0.60</td>
<td>0.08</td>
<td>0.36 (0.11-1.15)</td>
</tr>
</tbody>
</table>

a95% confidence interval in parentheses.

bAll subjects aged ≥5 years

cSubjects aged ≥5 years who were neither the head of the compound nor the senior woman in the household.

dHeads 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 three 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).

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<0.01, 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 1.14-4.1).

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 dwelling size 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 re-
COMMUNITY TREATMENT WITH IVERMECTIN

Ivermectin is distributed using a community self-treatment strategy and health education operations and to improve drug coverage is, however, essential to refine the preliminary ivermectin distribution programmes for several years. Infor-
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ticipants was impossible until recently, when chemotherapy-based control of onchocerciasis, as com-

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tions have been performed as part of the ivermectin distribution programmes. The method should particularly aim at reach-

ing people living in small compounds. Three hypotheses 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 foot-

paths, whereas the people in Konglé-Centre could use a smooth, straight and wide road. Second, the authority of the

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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 at-

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metres 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 situa-

tion that allows us to ignore the complex factors related to the economic situation of the target population. As a conse-

quence, 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 conclud-

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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


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Announcements

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