Bulletin of the World Health Organization, 61 (3): 501-507 (1983)

Estimation of incidence of poliomyelitis by three survey methods in different regions of the United Republic of Cameroon*

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Surveys were conducted in one urban and two rural regions of the United Republic of Cameroon to estimate the annual incidence of paralytic poliomyelitis. Three different survey methods were used: a review of hospital and clinic registers, a school survey, and a house-to-house survey. The house-to-house survey identified the highest number of lame children and gave estimates of incidence of between 18.8 and 32.6 per 100 000 population in the three regions. The estimates of incidence obtained by the two other survey methods in the urban region did not differ significantly from that obtained by house-to-house survey but, in the rural regions, were significantly lower. It is concluded that house-to-house surveys are a sensitive method of identifying lame children in both urban and rural regions. School surveys and review of hospital and clinic registers, while equally sensitive in urban regions, are less sensitive in rural regions and may significantly underestimate the annual incidence of paralytic poliomyelitis. These limitations should be borne in mind when using the survey methods.

Reports from many developing countries indicate a low incidence of paralytic poliomyelitis in rural regions of low population density (*1*, J. John, unpublished data, 1981). Estimates of incidence in these countries are usually based on routine hospital and health centre reporting. Other methods of estimating the incidence of paralytic poliomyelitis, as used in Burma and Egypt, have indicated that the apparently low incidence in rural regions is possibly a result of under-reporting of disease, rather than low rural attack rates (*2*, *3*).

In 1978, 231 cases of paralytic poliomyelitis were reported in the United Republic of Cameroon (*4*), of which 72 (31%) were in Yaoundé, the capital city. On the basis of this report, the annual incidence of poliomyelitis is 19.0 per 100 000 population in Yaoundé, and 2.3 per 100 000 in the rest of the country (using population figures from the 1976 census). To investigate this reported difference in incidence, we studied the prevalence of flaccid paralysis in three regions of different geography and population density. In each of these regions, we estimated the prevalence of lower extremity flaccid paralysis and the annual incidence of paralytic poliomyelitis by review of hospital and health centre registers, a house-to-house lameness survey, and a school lameness survey.

BACKGROUND

Paralytic poliomyelitis has been well studied in Yaoundé, which is situated at a latitude of 4°N in the tropical rain forest of the south of the United Republic of Cameroon. Serosurveys conducted in 1973 showed that over 90% of unimmunized children had antibodies to poliovirus types 1, 2, and 3 by the age of 4 years (*5*). Clinical observations at the Central Hospital during the early 1970s showed that 78% of children with flaccid paralysis had onset of paralysis before the age of 2 years (*6*). The annual incidence of poliomyelitis during the early 1970s was estimated to be 48 per 100 000 population, with most cases occurring between January and June (*6*).

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The only estimates of incidence of poliomyelitis in the United Republic of Cameroon outside Yaoundé have been obtained from passive health centre reporting which, as in 1978, has suggested a low incidence in rural regions of low population density.

METHODS

Survey regions

One urban and two rural regions were chosen for study. The regions differed in topography, population density, and climate (Fig. 1). Yaoundé, with a population of 313 700 is located at an altitude of 1295 m in mountainous tropical rain forest. The population density is over 90 inhabitants per km^2, and the mean daily temperature is 24 °C. The primary school attendance rate in Yaoundé is 85%; routine poliomyelitis immunization was begun in 1976.

The Bamenda region, at an elevation of 2550 m, is located on a high grassland plateau with a population of 33 700 and a population density of 30–45 inhabitants per km^2. The mean daily temperature in the Bamenda region is 21 °C. The primary school attendance rate is 61% and routine poliomyelitis immunization was begun in 1976.

The Eséka region, at an elevation of 200 m, is non-mountainous equatorial rain forest with a population of 28 900 and less than 20 inhabitants per km^2. The mean daily temperature is 27 °C. The school attendance rate in the Eséka region is 61% and routine poliomyelitis immunization was begun in 1979.

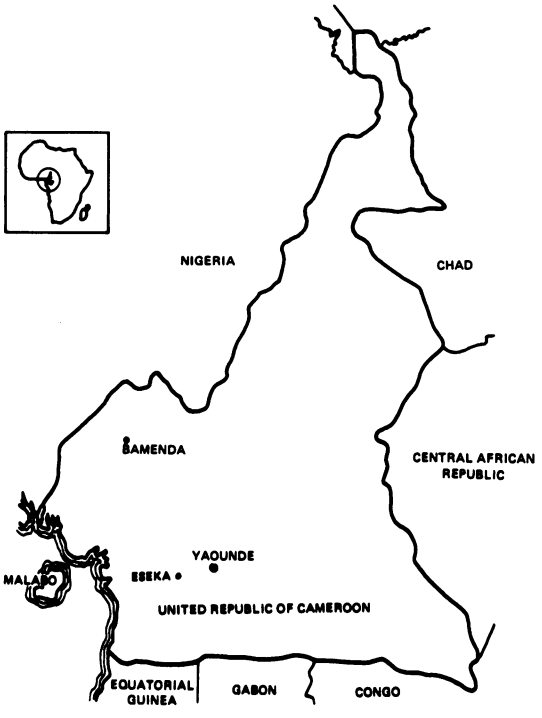

Fig. 1. Map of the United Republic of Cameroon, showing the three regions where the surveys were carried out.

Hospital and clinic register review

All hospitals, maternal and child welfare clinics, and health centres in each region were visited. A physician and nurse systematically searched the registers for 1975–78 at each centre, and recorded the names of children diagnosed as having poliomyelitis, by year of onset. Names were cross-checked between centres to prevent duplication. The total number of children with a diagnosis of poliomyelitis was divided by 4 to give the annual average. This was then divided by the 1976 population of the survey region to give an estimate of the annual incidence.

House-to-house lameness survey

House-to-house lameness surveys of children 5–11 years of age were conducted according to the recommendations of LaForce et al. (*7*). A two-stage cluster sampling method was used for children in Yaoundé. The first-stage sampling units were 30 *quartiers* (neighbourhoods) chosen at random from the 1976 neighbourhood population lists; the second-stage sampling units were households clustered about a starting household, which was selected at random by direction and house number from the geographic centre of the *quartier*, as described elsewhere (*4*). In each second-stage unit, households were surveyed until a total of 150 children, born during the years 1967–74, had been registered.

In the Bamenda and Eséka regions, all villages were sampled giving a total population of approximately 30 000 in Bamenda and 28 000 in Eséka. All households in each village were visited to ensure that the entire population had been surveyed.

A survey team was formed in each of the three regions. Each team consisted of a physician and a nurse trained in the examination of lame children, and a group of interviewers. Village and *quartier* chiefs were notified of the survey 2 weeks in advance by official government circular. The day prior to the survey, the chief was visited and the purpose of the survey explained. The chief was requested to ensure that the inhabitants would remain at home on the following day until they had been visited by the survey team. Interviewers arrived early in the morning of the day of the survey, and recorded the name and age of all children aged 5–11 years. The interviewer then

asked if any of the children were lame, their names were noted, and a return visit was arranged with the lame child and parent for the following day.

At the return visit, made by the physician or the nurse, the child was examined and the parents were questioned regarding date of onset of paralysis and place of residence at time of onset. The child was observed walking across the room. Muscle tone in the involved extremity or extremities was assessed by passive range of motion, with the child seated with feet on the floor. Muscle mass was estimated by palpation, and mid-calf and mid-thigh measurements were taken. Deep tendon reflexes were examined and sensation was tested for ability to differentiate sharp and dull ends of a pin. The degree of disability was classified as follows:

Type I: flaccid paralysis of the lower extremity, sensation intact, able to walk without assistance;

Type II: flaccid paralysis of the lower extremity, sensation intact, able to walk with assistance (prosthesis, cane);

Type III: flaccid paralysis of the lower extremity, sensation intact, unable to walk.

If the lame child was not present at the first return visit, a second visit was arranged. Children absent at the second visit were not included in the analysis.

The prevalence of lower extremity flaccid paralysis was calculated by dividing the number of children with flaccid paralysis and intact sensation by the total number of children surveyed. This figure was then divided by 5 (the maximum number of years each child was considered to be at risk for poliomyelitis infection) to give an estimate of the annual incidence of poliomyelitis with residual lower extremity paralysis among the children at risk. Finally, this incidence was multiplied by 0.17 (the proportion of the population under 5 years of age) to obtain the annual incidence of poliomyelitis with residual lower extremity paralysis.

School lameness survey

The surveys of schoolchildren aged 5–11 years followed the recommendations of LaForce et al. (*7*). In Yaoundé, schools were selected randomly from the Ministry of Education lists of primary school enrolment for 1978–79, until a total of 15 000 students were available for examination. The overall ratio of private to government schools was maintained in the sample. In Bamenda and Eséka, all schools were surveyed to give approximately 10 000 and 8000 students, respectively.

In Bamenda and Eséka, where only 61% of the children attend school, the survey was designed to cover the school catchment area. Children in school were thus surveyed for lameness and, in addition, were asked to identify lame children aged 5–11 years who were siblings or neighbours and were not enrolled in school at the time of the survey.

A physician and nurse team was formed and trained in each region, and made two visits to each school.

At the first visit, the purpose of the study was explained to the school director, who was asked to fill in a standard enrolment form giving the total number of students born between 1967 and 1974. All children in each class were asked to walk past the survey team, and the lame students were identified. In Bamenda and Eséka, all students were requested to give the name of any lame sibling or neighbour who did not attend school.

A return visit was then arranged with the school director, who was requested to ensure that all lame children attending school or living in the school catchment area were present and accompanied by a parent.

At the second visit, parents were interviewed and children examined as in the house-to-house survey. Paralysis was listed as type I, II, or III. A further visit was made to cover those not present at this examination.

In Bamenda and Eséka, the survey team also asked village chiefs, village elders, and traditional healers in each school catchment area to supply the names of lame children residing in their village. Names obtained in this manner were cross-checked with those found during the school survey to avoid duplication.

The prevalence of lower extremity flaccid paralysis was calculated by dividing the number of children with flaccid paralysis and intact sensation by the total number of children surveyed. In Yaoundé, the school enrolment figure for 5–11-year-olds was used as the total. In Bamenda and Eséka, the enrolment figure for 5–11-year-olds was divided by 0.61 (the school attendance rate) to give the number of children born between 1967 and 1974 living in the school catchment area. The annual incidence of paralytic poliomyelitis with residual lower extremity paralysis was calculated as described previously.

RESULTS

Hospital and clinic register review

The annual incidence of paralytic poliomyelitis, estimated by hospital and clinic register review, was 33.0 per 100 000 population in Yaoundé, 4.4 per 100 000 in Bamenda, and 6.9 per 100 000 in Eséka (Table 1). The estimate of annual incidence in Yaoundé is significantly higher than those in Bamenda and in Eséka (χ^2 test, $P < 0.001$).

Table 1. Annual incidence of paralytic poliomyelitis during 1975–78, estimated by review of hospital and clinic registers

Region	Population (1976 census)	No. of poliomyelitis cases 1975–78	Annual incidence (per 100 000 population)
Yaoundé	313 700	414	33.0
Bamenda	33 731	6	4.4
Eséka	28 839	8	6.9

House-to-house lameness survey

The prevalence of lower extremity flaccid paralysis, as estimated by house-to-house lameness survey, ranged from 5.5 to 9.6 per 1000 children (Table 2). The annual incidence of paralytic poliomyelitis with residual lower extremity paralysis, estimated from these figures, ranged from 18.8 to 32.6 per 100 000 population in the three regions studied. These rates were not significantly different. The 95% confidence interval for the estimated incidence in Yaoundé was 25.5–30.1 per 100 000 population.

School lameness survey

The prevalence of lower extremity flaccid paralysis, as estimated by school lameness survey, ranged from 2.2 to 8.7 per 1000 children (Table 3). The annual incidence of paralytic poliomyelitis with residual lower extremity paralysis, estimated from these figures, was 29.7 per 100 000 population in Yaoundé, 7.6 per 100 000 in Bamenda, and 13.5 per 100 000 in Eséka. The incidence in Yaoundé was significantly higher than those in Bamenda and Eséka (χ^2 test, $P < 0.001$). The 95% confidence interval for the estimated incidence in Yaoundé was 27.1–32.3 per 100 000 population.

Fig. 2 summarizes the survey results in all three regions.

Table 2. Annual incidence of paralytic poliomyelitis with residual lower extremity paralysis during 1967–74, estimated by house-to-house lameness surveys

Region	No. of children born 1966–74	Residual paralysis		Estimated annual incidence[a]	
		No. of cases	Prevalence per 1000 children	Per 1000 children under 5 years	Per 100 000 population
Yaoundé	4534	37	8.2	1.6	27.8
Bamenda	4332	24	5.5	1.1	18.8
Eséka	4057	39	9.6	1.9	32.6

[a] These figures have not been corrected for upper extremity paralysis, death, or spontaneous recovery of cases.

Table 3. Annual incidence of paralytic poliomyelitis with residual lower extremity paralysis during 1967–74, estimated by school lameness surveys

Region	No. of children surveyed	No. of children in school catchment area	School attendance rate (%)	Residual paralysis		Estimated annual incidence[a]	
				No. of cases	Prevalence per 1000 children	Per 1000 children under 5 years	Per 100 000 population
Yaoundé[b]	9391		85	82	8.7	1.8	29.7
Bamenda	8503	13 393	61	31	2.2	0.4	7.6
Eséka	6307	10 339	61	41	3.9	0.8	13.5

[a] These figures have not been corrected for upper extremity paralysis, death, or spontaneous recovery of cases.

[b] The catchment area was not surveyed.

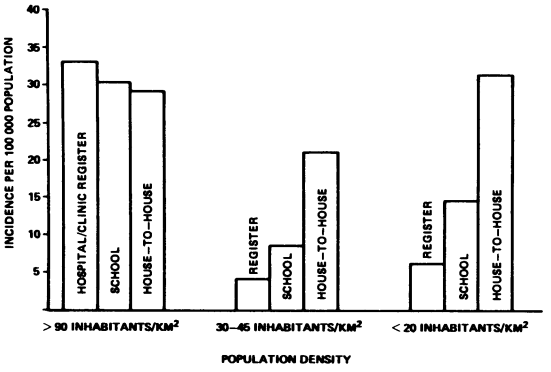

Fig. 2. Annual incidence of poliomyelitis with residual lower extremity paralysis in three regions of the United Republic of Cameroon with different population densities, estimated by three survey methods.

Type of paralysis and age at onset

A total of 254 children with flaccid paralysis of the lower extremity were found in the school and house-to-house surveys. Of the 246 for whom age at onset of paralysis was known, over 80% had been less than 3 years old (Fig. 3). There was no significant difference in the age of onset or extent of paralysis in the three regions. In the different regions, 69–82% of lame children were able to walk without assistance, 13–24% could walk with either a cane or prosthesis, and 4–7% were unable to walk (Table 4). Between 17% and 23% of children were living outside the survey region at the time of onset (Table 5).

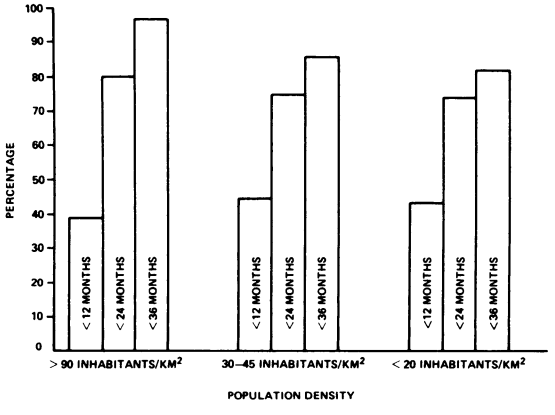

Fig. 3. Percentage of children with flaccid paralysis, by age of onset, in three regions of the United Republic of Cameroon, as found in the combined house-to-house and school surveys (cumulative total).

Table 4. Type of paralysis found among lame children in the combined school and house-to-house surveys in the United Republic of Cameroon, 1979

Region	Type I		Type II		Type III	
	No.	%	No.	%	No.	%
Yaoundé	98	82	15	13	6	5
Bamenda	38	69	13	24	4	7
Eséka	66	82	11	14	3	4

Table 5. Proportion of children living outside the survey region at the time of onset of paralysis, house-to-house survey, 1979

Region	No. of children with flaccid paralysis	Children living outside region at time of onset	
		No.	%
Yaoundé	37	7	19
Bamenda	24	4	17
Eséka	39	9	23

Time required to complete the surveys

The time required to complete each survey in the three regions is shown in Table 6. The house-to-house lameness survey, which required over 1400 person-hours in each region, was the most time-consuming. The review of hospital and clinic registers was the least costly technique. More time was required for each of the survey methods in the regions of low population density than in the region of high density.

DISCUSSION

The annual incidence of paralytic poliomyelitis was estimated in one urban and two rural regions of the United Republic of Cameroon. The regions had different population densities and varied from highland savanna to tropical rain forest. The estimates obtained relate to children who were born at least two years prior to the introduction of routine poliomyelitis immunization programmes, except for that based on review of hospital registers in Yaoundé. This rate reflects the incidence during the early years of the poliomyelitis control programme, which was established over a 4-year period, during which time the reported poliomyelitis incidence decreased by over 70%.

Table 6. Time required to complete each lameness survey in the United Republic of Cameroon, 1979

Region	Hospital and clinic register review		School survey		House-to-house survey	
	No. in team	Total person-hours	No. in team	Total person-hours	No. in team	Total person-hours
Yaoundé	3	24	3	216	9	1458
Bamenda	3	96	3	288	9	1728
Eséka	3	120	3	312	9	2016

The house-to-house survey seemed to be the most sensitive method since it identified the highest number of lame children, and gave the highest estimates of annual incidence in the three regions. In each region, a similar percentage of children were living outside the survey region at the time of onset of flaccid paralysis, suggesting that the prevalence figures have not been unduly affected by migration in any one region. There was no significant difference in the regional figures found in the house-to-house surveys, and there thus appears to be no geographical variation in the incidence of poliomyelitis in the United Republic of Cameroon, as had been suggested by routine reporting from hospitals and health centres.

The school lameness survey and register review gave estimates of incidence in the rural regions that were significantly lower than the rates established by house-to-house survey. In the urban region of high population density, such a difference was not found. Low attendance at schools and the shortage of hospitals in the rural regions are probably responsible for the discrepancies in the incidence estimates.

Over 80% of all poliomyelitis with residual lower extremity paralysis occurred among children under 3 years of age in both the urban and rural regions, a finding consistent with that of Boche et al. in the early 1970s (*5*), and of Guyer et al. in 1976 (*8*). Most children with lower extremity paralysis had good muscular function, and only 4–7% were totally incapacitated.

Different periods of time and numbers of personnel were required to complete the various surveys. The register review required the least time and personnel, while the house-to-house lameness survey required the most. Surveillance in regions with low population density required more time than in the high density region, reflecting the wider dispersal of the population.

Because the reliability of each survey method varies according to the geographic features of the region and the population density, care must be taken in choosing the method to be used. Factors such as time and personnel available to conduct the survey, as well as the required precision of results, must be considered. If precise estimates of incidence are needed, such as in determining priorities for childhood disease control programmes, the house-to-house survey must be carried out unless the region has a high population density and high primary school attendance rate. In such cases, register review or school lameness survey may be considered as alternatives. However, if incidence estimates are required only as indicators of trends in poliomyelitis morbidity over specified periods of time, register review and school survey should be considered in all regions with constant population dynamics, regardless of primary school attendance rates and population density. Although these survey methods may give falsely low estimates of incidence in regions of low population density, repeat estimates over time will show changing trends. Incorporation of these survey techniques into routine health information systems will provide a means for estimating baseline incidence and for periodic evaluation of efforts to control paralytic poliomyelitis.

RÉSUMÉ

ESTIMATION DE L'INCIDENCE DE LA POLIOMYÉLITE PAR TROIS MÉTHODES D'ENQUÊTE DANS DIFFÉRENTES RÉGIONS DE LA RÉPUBLIQUE-UNIE DU CAMEROUN

Trois méthodes d'enquête ont été utilisées en vue d'estimer l'incidence annuelle de la poliomyélite paralytique dans la République-Unie du Cameroun. Les enquêtes ont été effectuées dans une région urbaine et deux régions rurales différant par la géographie et par la densité de la population. L'enquête porte-à-porte a permis de découvrir

le nombre le plus élevé d'enfants infirmes et a fourni des estimations similaires pour les trois régions. L'incidence annuelle évaluée par cette méthode allait de 18,8 à 32,6 pour 100 000 habitants. Les estimations de l'incidence, d'après l'enquête scolaire sur la claudication et l'examen des registres des hôpitaux et des dispensaires, ne différaient pas notablement, dans la région urbaine, de celles qui avaient été obtenues par l'enquête porte-à-porte, toutefois, les valeurs obtenues dans les régions rurales étaient significativement plus faibles. On en conclut que les enquêtes porte-à-porte sont une méthode sensible pour découvrir les enfants infirmes dans les régions urbaines comme dans les régions rurales. Les enquêtes scolaires sur la claudication et l'examen des registres des hôpitaux et des dispensaires sont d'une sensibilité égale dans les régions urbaines, mais sont moins sensibles dans les régions rurales et, de ce fait, sont susceptibles de sous-estimer sensiblement l'incidence annuelle de la poliomyélite paralytique. Il faut tenir compte de ce défaut lorsqu'on utilise ces différentes méthodes d'enquête à l'intérieur d'un système d'information sur la santé.

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