Comparison of techniques for the estimation of the prevalence of poliomyelitis in developing countries

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Although reliable data on the prevalence and trends of paralytic poliomyelitis are necessary for health planning, they are often difficult to obtain in developing countries. Comparisons were made of the cost and the time taken to obtain prevalence rates of residual poliomyelitis paralysis in a single community by (1) a surveillance and reporting system using physicians and other practitioners, (2) a school survey covering grades 1 to 12, (3) annual surveys of grade 1 schoolchildren, and (4) a house-to-house questionnaire survey. These techniques gave poliomyelitis prevalence rates of 3–5 per 1000 school-age children, and poliomyelitis incidence rates of 12–29 per 100 000 population per year. The annual grade 1 school survey was the cheapest and easiest to carry out and appears reliable in areas with a high rate of school enrolment.

In many developing countries, the official reporting of poliomyelitis does not provide a realistic picture of the magnitude of this disease. For example, the Assistant Director-General of Health Services of the Government of India has estimated that only 1 in 15 poliomyelitis cases is reported to the health authorities (*1*). Partly because of incomplete reporting, poliomyelitis has been considered to be a problem in the developed countries only. It has been stated that as infant mortality rates fall, paralytic poliomyelitis rates are likely to rise (*2*). However, surveys in India and other developing countries with infant mortality rates of over 100 per 1000 live births (more than 8–10 times the current rates in North America and northern Europe) have shown that paralytic poliomyelitis is a serious problem in many developing countries.

In 1969 it was shown that the rate of residual poliomyelitis paralysis in Vellore, India, was 2–3 per 1000 population.[a] In Ghana, in 1974, a residual paralysis prevalence of 7 per 1000 schoolchildren was found from questionnaires given to teachers (*3*). Since then, lameness surveys in Burma (*4*), Egypt (*5*), the Philippines (*6*), Thailand (*7*), Indonesia (*8*), Malawi (*9*), the Ivory Coast (*10*), Brazil (*2*), Bangladesh (*11*), and parts of India (*1, 12*) have reported

residual paralysis prevalence rates varying from 1 to 19 per 1000 children. For comparison, a survey of families in the United States in 1936 showed a residual paralysis prevalence of 3.04 per 1000 children (*13*).

The determination of local poliomyelitis prevalence and incidence is necessary for effective health planning. Countries with relatively low rates of poliomyelitis may elect not to commit their limited health resources to combat this disease, whereas countries with high rates will institute control programmes according to their conditions and resources. Periodic assessment of poliomyelitis activity is required to evaluate the effectiveness of control programmes in countries with high prevalence, and to monitor the epidemiological changes in countries with low rates.

The incidence of poliomyelitis can be estimated in a variety of ways. Surveillance and reporting by health care providers is used in many countries, but is not currently feasible in most developing countries with relatively few or unevenly distributed health personnel. Community-wide house-to-house surveys for residual paralysis provide good estimates of prevalence, but these are time-consuming and expensive. If school enrolment rates are high, school surveys provide a simpler and cheaper data collection method (*3*). Since over 90% of poliomyelitis in developing countries occurs in children less than 5 years old (*3, 12, 14*), surveys of children in the first year (grade 1) of school are likely to produce useful data.

The present publication compares poliomyelitis data collection by (1) a surveillance system, (2) a grades 1–12 school survey, (3) a grade 1 school survey, and (4) a house-to-house community-wide survey in a single community.

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[a] *Annual report, 1970*. Enterovirus Laboratory, CMC Hospital, Vellore, 1970, p.7.

METHODS

Vellore is a district headquarters town, 130 km
west of Madras in Tamil Nadu State in the southern
part of India. The Government of India census of
1981 reported the population of Vellore as 174 000.
The urban infant mortality rate in Tamil Nadu is
reported to be 79, the country-wide urban infant
mortality rate is 81, and the overall Indian infant
mortality rate is 130 per 1000 births (15). Tamil Nadu
has a documented primary school enrolment rate of
greater than 90%, as do 15 other of the 31 States and
Union territories of India.[b]

A local surveillance system for acute poliomyelitis
cases was instituted by the Department of Virology,
Christian Medical College (CMC) Hospital, in 1980,
and reports have regularly been received from the
two Vellore hospitals and from a *siddha vaidya*
(practitioner of an Indian system of medicine) who
specializes in lameness. In fact, the largest proportion
of poliomyelitis cases was reported by the *siddha
vaidya*. All children reported with poliomyelitis were
seen by study physicians to confirm the diagnosis
and their residence within the municipal limits of
Vellore.

A survey of all schoolchildren was carried out in
1979. All of the 66 officially registered schools in
Vellore were visited and the children examined class
by class by study physicians. Absentees, if reported to
have muscle weakness or lameness, were visited and
examined at home. A diagnosis of poliomyelitis was
made if the following criteria were met: (1) presence
of atrophic and hypotonic muscle weakness, (2) ab-
sence of sensory loss, and (3) history of a rapid onset
of paralysis without subsequent progression.

In 1980 and 1981, a survey of grade 1 schoolchil-
dren in all registered schools and in unregistered
schools that were known to the investigators was
carried out by study physicians using the methods and
criteria listed above.

In 1981, a house-to-house poliomyelitis survey was
conducted by trained lay interviewers. The criteria for
diagnosis were simplified to weakness or paralysis of
limb(s) with visible atrophy that had been acquired by
the child between 6 months and 5 years of age, in the
absence of mental retardation. To reduce costs,
confirmation of the diagnosis by a physician was not
attempted.

The annual incidence of poliomyelitis in the popu-
lation of Vellore was estimated from the prevalence
data in the surveyed children using a formula similar
to that suggested by LaForce et al. (16). To correct for
the affected children who recover completely or die,

[b] Data from the Ministry of Education and Social Welfare,
Government of India, quoted in *An analysis of the situation of
children in India*, New Delhi, UNICEF, 1981, p.56.

the number with residual paralysis is multiplied by
1.33 (16). In order to account for the years of risk
experienced by the children, the number of surveyed
children is multiplied by 5. Finally, the corrected rate
per 1000 children is multiplied by the proportion of
the population under the age of 5 years (this is 0.14 in
India (17)), and by 100 in order to arrive at the esti-
mate for the annual incidence per 100 000 popu-
lation. Correction for upper limb paralysis, as sug-
gested by LaForce et al., was not necessary, since all
paralysis meeting the criteria had been included in the
survey.

RESULTS AND DISCUSSION

The data from the 1979 survey of all schoolchildren
(grades 1–12) and the grade 1 school surveys of 1980
and 1981 are presented in Table 1, which shows the
calculated prevalence and incidence rates. The 95%
confidence limits were derived using the binomial
confidence interval (18). Table 2 displays the results
of the surveillance reports from medical practitioners
(western and traditional). The results of the house-to-
house questionnaire survey are presented in Table 3.
Although the 1981 census enumerated 174 000 per-
sons in Vellore, our survey covered only about
141 500 persons (81%). The age-specific population
sizes were calculated on the assumption that the
under-fives accounted for 14.4%, the 5-year-olds for
2.8%, and children aged 6–15 years for 27.4% of the
total population (19).

The poliomyelitis prevalence rates in schoolchil-
dren (school surveys) and in school-age children
(house-to-house survey) of this urban community are
similar to the rates reported from a nearby rural
community (5.6 per 1000 children) (12), and from
other Indian communities (3.7–7.5 per 1000 children)
(1). These prevalence rates are similar to the US rates
of the 1930s, and the estimated incidence is compar-
able to the reported US incidence in the early 1950s
(13.5 per 100 000 population) (2).

The incidence from reported cases is not equal to
the estimated incidence derived from the school and
community surveys because these figures are
measures of different groups of events. The reported
incidence represents cases of all ages which occur in a
single year, whereas the calculated incidence is based
on the experience of a single age cohort during the
preceding 5 years. Moreover, the surveillance system
and the community survey are likely to miss mild
cases, while the school surveys may not detect the
most severe cases. In any event, the three figures are
of the same order of magnitude and demonstrate a
current incidence of poliomyelitis in Vellore as high
as that in the United States during the pre-vaccination

Table 1. School survey data on poliomyelitis prevalence and derived annual incidence rates, Vellore

Year and school grades	No. of children surveyed	No. of children with residual paralysis	Poliomyelitis prevalence/1000 schoolchildren[a]	Estimated annual incidence/ 100 000 population
1979 Grade 1–12	34 112	110	3.22 (2.62–3.82)	12.0
1979 Grade 1[b]	3 972	21	5.29 (3.03–7.54)	19.7
1980 Grade 1	5 123	21	4.10 (2.35–5.85)	15.3
1981 Grade 1	4 979	20	4.02 (2.26–5.77)	15.0

[a] 95% confidence limits are given in parentheses.

[b] Data extracted from the 1979 grade 1–12 survey.

Table 2. Number of poliomyelitis cases reported by medical and traditional practitioners in Vellore, 1980–1981

Year	No. of cases	Annual incidence/ 100 000 population[a]
1980	51	29.3
1981	43	24.7

[a] Assuming a population of 174 000 for both years.

Table 3. House-to-house community survey for poliomyelitis prevalence, 1981

Age (years)	No. of children surveyed	No. with residual paralysis	Prevalence/ 1000 children[a]
0–4	20 376	87	4.27 (3.81–4.73)
5	3 962	14	3.53 (2.59–4.48)
6–15	38 771	84	2.17 (1.93–2.40)

[a] 95% confidence limits are given in parentheses.

Table 4. Estimates of the cost of and time taken by different data collection systems

System	Time	Cost (rupees)[a]
Grade 1 school survey	2 weeks	600
Grade 1–12 school survey	3 months	4 000
Surveillance system	1 year	8 000
Community survey	3 months	25 000

[a] 1 rupee = US$ 0.11 (in early 1982).

era. It is possible that the difference in the incidence may reflect an increasing incidence of poliomyelitis in this community. A programme to control poliomyelitis in Vellore is therefore now being implemented by the local health authorities, CMC Hospital, and other voluntary agencies (20).

Table 4 lists the time taken by and the estimated cost (salaries, transportation, etc.) of the various data collection techniques for the town of Vellore. The surveillance system requires careful supervision, the maintenance of contact with physicians practising in hospitals, rapport with practitioners of traditional systems of medicine, and unremitting effort to detect all the poliomyelitis cases. The community house-to-house survey is an expensive and time-consuming effort, and could be repeated only at infrequent intervals. If such a survey is combined with the collection of data about other health problems, its cost may be more acceptable. The results of the grades 1–12 school survey agree well with those of the community-wide survey. The annual grade 1 school survey is just as accurate, can be done by one physician in about 2 weeks, and requires little effort beyond the data collection itself. Although the grade 1 school survey does not indicate the current incidence, it reflects the recent poliomyelitis situation, and can be used to make judgements about levels and trends of poliomyelitis morbidity (16), thereby assisting health planning and evaluation. The annual grade 1 school survey could also be used to gather information about the prevalence of other health problems, and to complete immunizations in those children who are not fully immunized.

Since many communities in India and other developing countries have high primary school enrolment rates, we recommend annual surveys of grade 1 schoolchildren as an appropriate technique for estimating poliomyelitis prevalence and incidence.

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RÉSUMÉ

COMPARAISON DE DIVERSES TECHNIQUES PERMETTANT D'ESTIMER LA PREVALENCE DE LA POLIOMYÉLITE DANS LES PAYS EN DÉVELOPPEMENT

Il est souvent difficile, dans les pays en développement, d'obtenir des données fiables sur l'incidence et les tendances de la poliomyélite paralytique alors que ces informations sont essentielles pour la planification sanitaire. Les rapports officiels ne permettent parfois pas d'évaluer de façon réaliste l'impact de cette maladie.

A Vellore, ville de 174 000 habitants de l'Inde méridionale, nous avons comparé les coûts respectifs en temps et en argent de quatre techniques utilisées pour déterminer les taux de séquelles paralytiques de la poliomyélite. Ces techniques sont les suivantes: 1) notification des cas aigus par les hôpitaux et les practiciens; 2) enquête sur la paralysie poliomyélitique chez les enfants des classes primaires et secondaires de toutes les écoles locales; 3) enquête portant uniquement sur les enfants de première année du cycle primaire dans toutes les écoles locales; et 4) enquête domiciliaire par questionnaire à l'échelle de la communauté. Dans cette région, le taux de mortalité infantile est d'environ 80 décès pour 1000 naissances et le taux de scolarisation dans le primaire supérieur à 90%.

Le taux d'incidence de la poliomyélite, calculé d'après les rapports communiqués par les médecins praticiens des hôpitaux pendant deux années consécutives était de 24 à 29 pour 100 000 habitants. Dans l'enquête sur les écoliers du primaire et du secondaire, le taux de prévalence des séquelles paralytiques de la poliomyélite était de 3,2 pour 1000 écoliers et dans l'enquête sur les élèves de première année des écoles primaires menée pendant trois années consécutives, il était de 4 à 5 pour 1000 écoliers. L'enquête domiciliaire a permis d'enregistrer des taux de 3,53 pour 1000 enfants de 5 ans et de 4,27 pour 1000 enfants de moins de 5 ans. Ces taux de prévalence de la poliomyélite donnent une incidence calculée de 12 à 19 pour 100 000 habitants et montrent que la prévalence et l'incidence de séquelles paralytiques de la poliomyélite sont élevées.

Le coût d'une enquête domiciliaire à l'échelle de la communauté est élevé. La notification des cas suppose un effort constant pour rester en contact avec les médecins et les praticiens et l'on risque d'omettre des cas bénins. Les enquêtes scolaires peuvent négliger les cas graves, mais elles sont relativement faciles à exécuter. L'enquête annuelle sur les élèves de première année des écoles primaires est la plus simple et la plus économique, et ses résultats sont comparables à ceux de techniques plus coûteuses.

Dans les communautés où le taux de scolarisation dans le cycle primaire est élevé, nous recommandons les enquêtes annuelles centrées sur les élèves de première année des écoles primaires car elles sont utiles pour estimer la prévalence et l'incidence de la poliomyélite ainsi que pour apprécier les tendances.

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