Is poliomyelitis a serious problem in developing countries? - lameness in Ghanaian schools

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Summary

A postal survey of lameness in schools throughout Ghana showed an estimated prevalence of lameness attributable to poliomyelitis of 5-8 per 1000 school-aged children and an estimated annual incidence of paralytic poliomyelitis of 23 per 100 000 population. Official reported incidence rates range from 0-1 to 2-1 per 100 000 population, indicating that at least 90% of cases are not reported. No evidence of epidemics was found to account for these high rates. These suggest that mean annual incidence rates in tropical endemic countries have always been as great, if not greater, than those experienced by temperate countries during epidemic periods in the twentieth century and that the total number of cases of paralytic poliomyelitis occurring in the world each year has been reduced by only 25%, since the advent of polio vaccine. Immunisation against poliomyelitis must have a high priority in Ghana and other tropical countries where the disease is endemic.

Introduction

Serological surveys have shown that poliomyelitis is endemic in Ghana. Low annual incidence rates of 0-1 to 2-1 (mean 1-0) per 100 000 population are reported for paralytic poliomyelitis. No epidemics have ever been recorded. Yet Nicholas and co-workers found a high prevalence of lameness attributable to poliomyelitis (seven per 1000 children aged 6 to 15) in the Danfa Project district of rural Ghana, implying a mean annual incidence of at least 29 per 100 000 population. This supported a suspicion first raised by Paul from studies in Egypt that the mean annual incidence rates in endemic countries might be as high as those in countries experiencing epidemics.

Lameness carries a high social cost. If the prevalence rates throughout Ghana were similar to those in the Danfa area it would mean that immunisation against poliomyelitis should be given a higher priority. During the Danfa study it was found that headteachers were reliable in reporting cases of lameness, and that the prevalence of lameness attributable to poliomyelitis could be estimated from the prevalence of reported cases of lameness due to any cause. We report here the results of a postal survey of lameness in a sample of schools throughout Ghana using a teacher questionnaire that was tested and validated during the Danfa study.
Population and methods

After permission was obtained from the Ministry of Education a questionnaire and a stamped addressed envelope was sent to the headteacher of each school in the sample.

Questionnaire—This requested the school’s enrolment and the name, current age, age at onset of lameness, residence at onset, and present class in school of each lame child.

Sampling frame—This was the official 1971 list of all primary and middle schools in Ghana. Schools exist in all districts. Nevertheless, to avoid a bias towards the urban areas, whose population has greater access to schools, a random sample of schools was drawn that was stratified and self-weighted according to the school-age population by region and urban/rural classification of town or village using information from the 1970 national census. Settlements with less than 5000 population were classed as rural. Of children attending primary or middle schools 99% are aged from 6 to 19. Based on confidence intervals for the range of prevalence that might be expected, we calculated a target sample size of 510 schools with an expected enrolment of 60,000. This was a 5% sample of all schools in Ghana.

Results

In the first instance 377 (73.9%) schools responded. After reminders were sent, another 100 schools responded improving the response rate to 93.5%. The total enrolment of schools returning questionnaires was 74,609.

The prevalence of lameness, standardised for school-aged population by strata, was 7.8 per 1000 school children (table I). There were no significant regional differences. The difference in urban and rural prevalence rates was statistically significant (P < 0.01). This difference, however, was due primarily to the low urban primary school rate.

<table>
<thead>
<tr>
<th>Table I—Prevalence of lameness in Ghanaian schools</th>
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<tbody>
<tr>
<td>School enrolment</td>
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<tr>
<td>Urban primary</td>
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<tr>
<td>Urban middle</td>
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<tr>
<td>Total</td>
</tr>
<tr>
<td>Rural primary</td>
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<td>Rural middle</td>
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<tr>
<td>Total</td>
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<td>Grand total</td>
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*SE (standard error) of a proportion for a random cluster sample with unequal cluster size.
†Standardised for school age population by strata (region, primary: middle school age, urban/rural classification of town or village).
†SE (standard error) of a proportion for a stratified cluster sample with unequal cluster size.11

The median age of onset for cases with onset of lameness under 6 years was 21 months (table II). After adjusting for the male : female school enrolment, the male : female ratio of cases with onset under 6 years was 1.65, a male predominance that has been noted in other studies.

Calendar year of onset was calculated as follows: 1973 minus current age plus age of onset. The figure shows the trend of age-adjusted incidence rates for the years 1957 to 1967. No epidemic trend is noticed nor do any of the rates exceed two standard deviations of the expected rate based on a constant annual risk to children under 6. Because of some imprecision in reporting current age or age at onset, somewhat greater fluctuations in annual incidence may have been obscured.

<table>
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<tr>
<th>Table II—Age of onset of all cases of lameness*</th>
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<tr>
<td>Age group (months)</td>
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<tr>
<td>No. (%) of cases</td>
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<td>Cumulative percentage</td>
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*For cases where age of onset was reported.

An estimate of the prevalence (Pr) of lameness attributable to poliomyelitis for school aged children may be calculated using the same sensitivity (S1) and specificity (S2) derived during the Danfa study14

Pr = S1 + S2 - 1
S1 + S2 - 1

where Pr (prevalence of all cases of lameness for school aged children) = 0.00783 (see table I for standardised prevalence of all cases of lameness in school children), S1 = 0.831, S2 = 0.997, and the standard error (SE) of Pr = SE† Pr. The estimated prevalence of lameness attributable to poliomyelitis (Pr) for all of Ghana was 5.8 (SE = 0.59) per 1000 school aged children standardised for school-aged population by strata. The standard error was somewhat underestimated due to S1 and S2 being assumed constant. The prevalence for rural areas was 6.9 per 1000 school aged children, a rate similar to that found by examining the school children in the Danfa district (7.2 per 1000).4 Note that the prevalence is better expressed per 1000 school-aged children rather than per 1000 schoolchildren. The assumption that the prevalence of lameness due to poliomyelitis in schoolchildren is similar to that in non-school children is an important one and is supported by the Danfa study.4

The estimated prevalence reported here depends to a large extent on whether the sensitivity (S1) and specificity (S2) of headteacher performance in this study were similar to that in the Danfa study. It seems reasonable to assume so for three reasons. Firstly, in other studies done in tropical developing countries poliomyelitis is by far the leading cause of lameness.1, 4 Secondly, to a certain extent headteachers are randomly assigned to schools in Ghana, which diminishes the bias of the Danfa sample. Thirdly, after completing this study we examined children in survey schools in urban Accra. We found the S1 of headteacher performance there to be 0.765, and the S2 to be 0.998. Ideally, one would like to determine the S1 and S2 for a random sample of each population studied. This, however, may need extensive resources.

Discussion

These results confirm the findings of the Danfa study1 and indicate that the prevalence of lameness attributable to poliomyelitis is high throughout Ghana.

The lower urban rate was due to a lower prevalence among urban primary school children. This appears to be a recent development since urban middle schools have a rate similar to rural primary or rural middle schools. The reason for this change
is not clear. It seems unlikely that the prevalence of wild poliovirus has diminished, resulting in the gradual accumulation of susceptibles, since Pasca and Afoakwaa recently found that in Accra 86, 88, and 93%, of children had antibodies to poliovirus types 1, 2, and 3 respectively by 4 to 6 years of age. Another explanation may be the more widespread use of polio vaccine in urban areas in the past 10 years. It is estimated that up to 20%, of children in Accra may have received oral polio vaccine. Faecal contamination could have spread the vaccine virus to other children.

The age group 0-4 years represents 20% of the total population in Ghana. Given a prevalence of 5-8 per 1000 school-aged children by age 5, there must be about 2100 new cases of paralytic poliomyelitis each year, an incidence of 116 per 100 000 children 0-4 years or 23 per 100 000 population. If those who had fatal cases or recoveries completely are included the incidence rate would be even higher. Why is this incidence so much higher than that previously presumed for Ghana and other endemic countries?

The hypothesis most commonly proposed to explain the low incidence rates reported from these countries is that children infected early in life are partially protected by maternal antibodies, breastfeeding factors, or other age-related mechanisms.

In 1955 Sabin presented strong arguments refuting this hypothesis and suggested instead that the virulence of the wild poliovirus may have been low in the past in endemic countries but may have increased in recent years in those countries experiencing epidemics. Although the severity of some epidemics may be related to the virulence of the prevalent poliovirus, there is little epidemiological evidence to support this hypothesis as the explanation for the low rates reported previously from endemic countries, and it is a difficult one to test.

Much less attention has been paid to the hypothesis that cases from tropical developing countries may be recognised and seriously underreported. The association that Paul and Cockburn found between decreasing infant mortality rates and increased reporting of poliomyelitis may be due much more often to the better reporting of all diseases that accompanies the improved living standards rather than to an actual increase in the disease. We have shown that at least 90%, of cases of paralytic poliomyelitis in Ghana are not reported.

It does not follow that when a disease becomes epidemic its incidence must be greater than during a period when it was endemic. The cumulative incidence of new cases during a period in which epidemics occur intermittently may be the same or even less than during a period of sustained endemicity. The mean annual age adjusted incidence rate in Ghana for the period 1957-67 as determined by this study was 22 per 100 000 population. For the USA for the period 1944-54 the rate was 20 per 100 000.

We therefore suggest that the mean annual incidence rates of paralytic poliomyelitis in tropical endemic countries have always been as great, or even greater, than those experienced by temperate countries during epidemic periods in the twentieth century and that the problem was not recognised and reported. If this is true we estimate that the total number of cases of paralytic poliomyelitis occurring in the world each year has been reduced by only 25%, since the advent of polio vaccine. We recommend that vaccination against poliomyelitis should be given a high priority in tropical developing countries and that similar studies be carried out in other countries to test our hypothesis. We found the teacher questionnaire to be valuable for estimating the impact of poliomyelitis in Ghana. We think it may also be used as one method of evaluating the success of the immunisation effort.

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References

1. Pasca, S, and Afoakwaa, S N, Transactions of The Royal Society of Tropical Medicine, and Hygiene, 1971, 85, 501.


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