The Severity of Poliomyelitis In Multiple-Case Households

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DURING the 1953 poliomyelitis season an attempt was made on a national scale to assess the value of gamma globulin as a prophylactic agent in modifying the severity of illness when administered to subsequent cases among household contacts of a diagnosed case of poliomyelitis. One difficulty in such an evaluation may arise from the occurrence of subsequent cases which are clinically less severe than the case initially recognized in multiple-case households. Moore and Kessell (*1*) have found that, in monkeys inoculated intracerebrally with poliomyelitis virus, decreasing concentrations of the virus produce longer incubation periods. They have also found that as the incubation period is lengthened, illness is less severe. Gard (*2*), working with Theiler's mouse encephalomyelitis virus, obtained similar results. Accordingly, it was decided to examine the relative severity of initial and subsequent cases of poliomyelitis occurring in households during a period when gamma globulin was not available as a prophylactic agent.

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Methods

Case Records

In the city of Los Angeles for the years 1948, 1949, 1951, and 1952, 130 multiple-case households were identified by matching names and addresses of reported cases of poliomyelitis. No special effort was made in Los Angeles throughout any of the years studied to unearth multiple-case households of poliomyelitis.

In 6 households, either one or both cases were treated at home. All of the cases in the 124 remaining households were hospitalized in the Los Angeles County General Hospital. The clinical records of these cases were used as a source of information for this report. Since not all of the records were available, data were obtained on the cases in 102 households.

Criteria of Diagnosis

For consistency in the clinical diagnosis of poliomyelitis, it was decided to include only the paralytic cases, or, if nonparalytic, only those which had a characteristic history and cerebrospinal fluid findings compatible with a diagnosis of poliomyelitis. Application of these criteria eliminated 20 households.

In the 82 households, poliomyelitis cases are distributed as follows: In 69 households there was 1 initial and 1 subsequent case; in 4 households there occurred 1 initial and 2 subsequent cases; in 1 household there was 1 initial and 3 subsequent cases; in 7 households 2 persons became ill on the same day; and in 1 household 2

persons became ill on the same day, and 1 case occurred subsequently. Because of the inability to differentiate the initial from the subsequent case in the 7 households in which 2 persons became ill on the same day, these households were eliminated from the study. This analysis is based on the 75 initial and 81 subsequent cases in the 75 remaining multiple-case households.

The onset of illness in each case was established as the onset of a continuous illness which led to the diagnosis of poliomyelitis. Through the use of this criterion, it is felt that the interval between onsets of illness of poliomyelitis cases in multiple-case households was consistently determined and thus these cases can be compared.

Measure of Severity

Shortly before discharge from the hospital, muscle examinations were performed routinely on each patient by a physiotherapist. Although the same individual did not perform all of these "checkout" examinations, the method of muscle testing and the recording of results remained the same, and one of two physiotherapists performed most of the muscle gradings. Under the treatment routine of diagnosed poliomyelitis cases at Los Angeles County General Hospital, nearly all patients are discharged to their homes or to a second hospital within 2 weeks following onset. This length of stay has been controlled by Los Angeles City Health Department requirements. Patients were required to remain in the hospital for 2 weeks after date of onset in 1948 and 1949 and for 1 week after date of onset in 1951 and 1952. Accordingly, the discharge (checkout) examination was performed on nearly all patients not sooner than 1 week and rarely more than 2 weeks following onset of illness.

Table 1. Age distribution of initial and subsequent cases of poliomyelitis in 75 multiple-case households

Age in years	Initial cases	Subsequent cases
0–4	38	32
5–9	23	25
10–14	5	7
15–19	1	2
20–24	2	4
25–29	5	3
30+	1	8
All ages	75	81

Table 2. Sex distribution of initial and subsequent cases of poliomyelitis in 75 multiple-case households

Age in years	Initial cases		Subsequent cases	
	Male	Female	Male	Female
Less than 15	44	22	41	23
15 and over	3	6	6	11
All ages	75		81	

In the checkout examination a record was made of the area of the body involved, such as limb, trunk, or neck, and the degree of involvement was recorded as none, slight, moderate, marked, or severe. Bulbar involvement was recorded as either present or not present. The degree of muscle involvement was scored as follows: no involvement was assigned a value of 1; slight, 2; moderate, 3; marked, 4; and severe, 5. No bulbar involvement was graded as 1, and bulbar involvement, as 2. In scoring body areas, neck, trunk, and limbs may be weighted equally or according to muscle mass of the particular area (*3*). Analysis of the data in this report gave similar results with either method. For simplicity, the scoring system that weights areas equally is used in the data presented. With this method of grading, nonparalytic poliomyelitis received a numerical score of 7 (lowest possible score), and poliomyelitis with maximal involvement of neck, trunk, and limbs, plus bulbar involvement, received a numerical score of 32 (highest possible score). Two initial cases received a score of 32 on the basis of death within a few days of onset, although complete muscle examination had not been performed. Since excluding these cases did not alter the results, they were retained in the analysis.

Approximately 40 percent of the cases occurred in children under 5 years of age, and it is well known that examination in this age group is difficult. Because comparisons are made between initial and subsequent cases, and approximately the same number from each occurred in

this age group, there is no reason to believe that the results obtained are biased as a result of including the young children.

In order to obtain larger numbers, paralytic cases are grouped as follows: slight involvement (numerical values 8–13), moderate involvement (14–20), severe involvement (21–32). Cases are further grouped according to the interval between the onsets of the initial and subsequent cases, as noted in the accompanying tables.

Statistical significance was tested by the method of X^2.

Results

Comparisons by age and sex of initial and subsequent cases of poliomyelitis in 75 multiple-case households are presented in tables 1 and 2. It is of interest that of 9 cases occurring in persons over 30 years of age 8 were subsequent cases. There is no difference in the sex distribution of initial and subsequent cases. However, as has been found in other studies (*4*), males were more frequently affected before puberty and females, after puberty.

Table 3 shows the interval between the onset of illness of the initial case and subsequent cases in 82 households. In this series, 61 percent of the subsequent cases occurred within 4 days of the initial case and more than 95 percent within 2 weeks. These results are in agreement with those of Siegel and Greenberg (*5*) and earlier investigations of others (*6*, *7*).

Among 75 initial cases, 57, or 76 percent, were paralytic; among 81 subsequent cases, 47, or 58 percent, were diagnosed as paralytic (table 4). Thus, it can be seen that a greater proportion of paralytic cases occurred among the group of initial cases. This difference between initial and subsequent cases is statistically significant.

Table 3. Interval between onset of illness of initial and subsequent cases of poliomyelitis in 82 [1] multiple-case households

Interval in days	Number subsequent cases	Cumulative percentage
Same day	8	9
1–4	46	61
5–8	22	85
9–12	10	97
13–16	2	99
17–20	1	100
Total	89	100

[1] These 82 households include 8 households in which the onsets of illness in 2 cases occurred on the same day.

Table 4. Distribution of paralytic and nonparalytic illnesses in initial and subsequent cases of poliomyelitis in 75 multiple-case households

Type of illness	Initial cases	Subsequent cases	Total
Nonparalytic	18	34	52
Paralytic	57	47	104
Total	75	81	156

X^2 of this distribution = 4.6; P = 0.03 (approx.).

Tabulated according to the severity of paralysis, 35 of the 57 initial paralytic cases were classified as slight in severity, 17 as moderate, and 5 as severely paralyzed. Among the 47 subsequent paralytic cases, 35 were also classified as slight, and 6 each were considered as moderate and severe paralysis (table 5). Although these differences are not statistically significant, there appears to be a trend toward decreased severity in subsequent cases in a household.

The distribution of paralytic and nonparalytic illness in subsequent cases of poliomyelitis is shown in table 6 according to the interval between the onset of initial and subsequent cases. Among 63 subsequent cases with onset within 7 days of the initial case, 41, or 65 percent, were paralytic; among 18 subsequent cases whose onsets were more than 7 days from the initial case, 6, or 33 percent, were paralytic. This difference in proportion of paralytic illness between subsequent cases occurring 1 week or less after the initial case and those occurring more than 1 week after the initial case is statistically significant.

Table 7 classifies the severity of paralysis in subsequent cases occurring within 7 days of the initial case, and in those occurring more than 7 days from the initial case. Among 41 cases occurring within 7 days, 30 were classified as slight, 6 as moderate, and 5 as severe paralysis. Among 6 cases occurring more than 7 days after the initial case, 5 were considered to be slightly

and 1 severely paralyzed. Although these differences are not statistically significant, there may be a trend toward decreased severity in subsequent cases as the interval between the initial and subsequent case increases.

Table 5. Severity of paralytic illness in initial and subsequent cases of poliomyelitis in 75 multiple-case households

Severity grade [1]	Initial cases	Subsequent cases
Slight	35	35
Moderate	17	6
Severe	5	6
Total	57	47

[1] The corresponding numerical grades, determined as described in the text, are as follows: slight: 8–13; moderate: 14–20; severe: 21–32.

Discussion

This study was performed to test the hypotheses (*a*) that subsequent cases of poliomyelitis are less severe than the initial case in a multiple-case household, and (*b*) that subsequent cases are progressively less severe as the interval between the initial and subsequent case increases. We feel that the data support these hypotheses. From these data and data obtained in the experimental diseases (*1*, *2*), it might be suspected that infection in multiple-case households is simultaneous and that some of the variation observed in the incubation period and severity

Table 6. Distribution of paralytic and nonparalytic illnesses in subsequent cases of poliomyelitis, according to the interval between the onset of initial and subsequent cases, in 75 multiple-case households

Type of illness	Interval between initial and subsequent case (days)		Total
	1–7	8–20	
Nonparalytic	22	12	34
Paralytic	41	6	47
Total	63	18	81

X^2 of this distribution = 5.5; P = 0.02 (approx.).

Table 7. Severity of paralytic illness in subsequent cases of poliomyelitis, according to interval between onset of the initial and subsequent cases, in 75 multiple-case households

Severity grade	Interval in days	
	1–7	8–20
Slight	30	5
Moderate	6	0
Severe	5	1
Total	41	6

is due to the quantity of virus ingested. Nevertheless, other interpretations of the data must be considered.

For example, in a multiple-case household, the first clinically recognizable case might not actually be the first case; if not, this would suggest that the true first case was mild. Such an event may occur, but probably only rarely, as it was observed only once in over 50 multiple-case households carefully studied during 1953.

Further, after one case is recognized, the index of suspicion is high and subsequent cases, though mild, are more likely to be recognized. This may be a true criticism of the first hypothesis, but does not apply to the second: that subsequent cases of poliomyelitis are progressively less severe as the interval between the initial and subsequent case increases.

Because muscle examinations were performed on patients shortly before discharge, these were not done at the same time in the course of the disease in all cases. Since more severe cases tended to remain in the hospital longer and were examined later in the course of illness, we believe that if such cases had been examined at the same time as the majority (about 14 days after onset), the severe cases would have appeared even more severe. This probably would have made the difference observed between initial and subsequent cases greater and would strengthen the data rather than weaken it.

Information concerning the relative severity of initial and subsequent cases occurring in a multiple-case household is of considerable importance in evaluating a biological product

which may modify the severity of the paralytic illness (*8*). Thus, if subsequent cases can be shown frequently to be milder in the naturally occurring disease, this fact must be carefully weighed in attempting to evaluate the beneficial effect of the biological product.

More such comprehensive studies are necessary, but the present series suggests that any modification of severity of illness in subsequent cases given gamma globulin must be interpreted in the light of what may be observed in families in which no biologic is administered.

Conclusions

In a study of 82 households with multiple cases of poliomyelitis, it has been found that initial cases are more likely to be paralytic than are subsequent cases and that subsequent cases are more likely to be nonparalytic in type as the interval between the initial and subsequent case increases. Possible interpretations of these results have been discussed.

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Since the preparation of this paper, Siegel and Greenberg (9), in a study of poliomyelitis in multiple-case households in New York City, have also found that a higher percentage of nonparalytic illness occurs in subsequent than in initial cases.

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