POLIOMYELITIS IN LONDON IN 1949

BY

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Timing

Both summers were on the whole hot and dry compared with the damper, cooler summer of 1948. The climatic conditions are compared in Table I. It will be seen that the summer rainfall in 1947 and 1949 was much lower than in 1948, whereas the temperatures were higher. The epidemic rise began almost at the same time in the two years.

As has already been recorded in detail (Daley and Benjamin, 1948), the rise in notifications in 1947 occurred in the week ending May 31, while in 1949 the disease became epidemic about the middle of June. Whereas, however, the first epidemic gathered momentum rapidly, especially during July, and reached a sharp peak at the end of August, the 1949 outbreak grew slowly, so that even in July there was doubt whether it would reach the proportions of the 1947 outbreak. The notifications, however, climbed gradually and steadily through August, remained more or less stationary in September and October, and finally reached a late peak at the beginning of November. Decline was at first as rapid as in 1947, but through December the incidence stabilized at an abnormally high level, and the usual

After a respite of but one year poliomyelitis struck again at the population of London County. In 1948, in London as elsewhere, the incidence of the disease fell to the endemic level of the years preceding the first explosion of 1947, but in 1949 the second epidemic occurred of much the same proportions as the first. In 1947 there were 702 "corrected notifications" in London, with a fatality rate of 7%; in 1949 there were 668 corrected notifications, with a fatality rate of 7.1%. There were, however, peculiar differences between the two epidemics, which are recorded here to add to the patient accumulation of evidence which may yet provide the solution to the epidemiological riddle presented by poliomyelitis.

COUNTY OF LONDON

1949 Poliomyelitis Epidemic
Corrected Notifications

TABLE I.—Weather Conditions 1947–9 (From the Royal Observatory, Greenwich)

Month	Mean Daily Temperature (° F.)			Mean Degree of Humidity*			Mean Weekly Rainfall†		
	1947	1948	1949	1947	1948	1949	1947	1948	1949
June	62.7	58.4	57.9	68	74	70	0.55	0.53	0.18
July	66.2	61.0	67.0	72	71	58	0.14	0.25	0.20
August .. .	68.7	60.6	64.3	62	77	65	0.08	1.00	0.26
September ..	63.6	58.5	64.8	70	74	71	0.35	0.22	0.27
October .. .	52.6	52.6	56.6	77	79	82	0.03	0.46	1.01
November ..	46.2	47.0	44.4	79	85	83	0.27	0.45	0.55
December ..	42.4	44.0	43.1	84	85	81	0.51	0.28	0.35

* Saturation equals 100. Humidity is measured at intervals throughout the day.

† Rain collected in a gauge whose receiving surface is 5 in. (12.7 cm.) above the ground. The figures are the means of the sums of the weekly rainfall.

interepidemic level was not reached until the middle of January, 1950.

There is no obvious climatic reason why the 1949 epidemic curve should have begun to rise so slowly, but it is possible that the fall in temperature during September may have checked any tendency to an accelerated rise, and the sharp drop in temperature (with rising humidity) in late October may have contributed to bringing the outbreak to an end. In 1947 the epidemic curve began to fall with the temperature, but the rapid decline, despite a high average temperature, suggests that the epidemic had exhausted itself regardless of climatic changes.

Geographical Distribution

The distribution of cases* in London in 1949 is shown in the accompanying map. This picture is strikingly at variance with that for 1947 (Daley and Benjamin, 1948), when, though there were isolated areas with a statistically significantly higher or lower incidence than average, the complete map gave a general impression of wide scatter, no area escaping. In 1949 the incidence was higher to the north of the Thames than to the south, and there were wide areas—for example, in Deptford and Greenwich—without recorded cases.

The numbers in the map indicate the week of epidemic rise in notifications (week ending June 18=1) in each borough. Here again there are differences. In 1947 any suggestion of spread from foci was effaced by the rapid diffusion of the attack throughout the county. The slower epidemic rise of 1949 made it possible to discern directions of spread, of which there may have been two main streams: (a) from Hampstead in the north-west, southward and eastward, the eastward branch finally turning south to take in Deptford and Greenwich; (b) from Lewisham in the south-east in a north-westward and westward direction.

Age Distribution

Here the most striking difference between the two epidemics is discernible (Table II). For some time observers in the U.S.A. have noted that the age incidence of the disease has tended steadily to rise, an observation that was

TABLE II.—Age Distribution of Poliomyelitis Cases,* 1937-49

Age Group in Years	Cases									
	1937-46		1947		1948		1949			
							No.			%
	No.	%	No.	%	No.	%	M	F	Total	
Under 1	22	3.7	32	4.5	8	5.7	23	20	43	6.4
1-4	228	38.1	164	23.4	39	27.6	181	132	313	46.9
5-9	143	23.9	169	24.1	19	13.5	68	55	123	18.4
10-14	74	12.4	88	12.5	24	17.0	30	20	50	7.5
15-24	82	13.7	129	18.4	22	15.6	27	36	63	9.4
25+	49	8.2	120	17.1	29	20.6	37	39	76	11.4
Total	598	100	702	100	141	100	366	302	668	100

TABLE III.—Cases* of Poliomyelitis and Polio-encephalitis

Year	Total No.	Under 5 Years of Age	
		No.	%
1921-3	209	116	55.5
1924-6	266	152	57.1
1927-9	206	117	56.8
1930-2	182	107	58.8
1933-5	225	112	49.8
1936-8	280	114	40.7
1939-41	159	72	45.3
1942-4	88	41	46.6
1945	70	22	31.4
1946	39	14	35.9
1947	702	196	27.9
1948	141	47	33.3
1949	668	356	53.3

* "Cases" here and elsewhere in this article means "corrected notifications."

confirmed in London in 1947, when only 27.9% of cases occurred in children under the age of 5 (Table III). But in 1949 the age incidence returned abruptly to its former proportion, and 53.3% of the cases occurred among children under 5. This is appreciably higher than the figure of 41.8% for the "endemic" years 1937 to 1946. Not, indeed, since 1932 has so high a proportion of cases occurred in children under 5.

Possible Association with Inoculation

There has been a full discussion elsewhere (Bradford Hill and Knowelden, 1950) of the possibility that in some cases, and in certain circumstances, poliomyelitis may follow immunization, and since investigations are still proceeding it is not proposed to comment on this feature at present. We should stress, however, that this association, even if proved, is *not* responsible for the sharp differences in age distribution as between 1947 and 1949.

All cases notified in London were closely investigated in order to trace any history of recent inoculation.† Out of a total of 356 cases under age 5 only 58 had any such history, and only in 33 did any genuine association between paralysis and injections appear to be established; in 8 there was some doubt, and in the remaining 17 the doubt was considerable. These additional cases may have accentuated the eventual character of the outbreak, but they are not relatively numerous and cannot be the cause. We must also remember that some unrecognized "immunization" cases may—and perhaps must—have occurred in 1947. Inoculation trauma may be an important problem, but it did not colour the epidemiological picture in London in 1947 or 1949 to any important extent.

Sex

The usual preponderance of males was seen, especially between the ages of 1 and 4, where there were 181 male to 132 female cases—a ratio of 1.37 to 1, compared with 1.34 to 1 in 1947 (Table IV).

TABLE IV.—Male/Female Ratio in 1947 and 1949

Age	1947	1949
Under 1 year	1.67	1.15
1-4 years	1.34	1.37
5-9	1.64	1.24
10-14	1.20	1.50
15-24	0.68	0.75
25+	1.14	0.94
Total	1.21	1.21

In view of the small numbers involved the differences between the ratios in 1947 and 1949 cannot be regarded as statistically significant. Taken together, they indicate that the excess of males is greater at younger ages and is actually replaced by an excess of females after age 15.

Diagnosis, Progress, and Fatality

By courtesy of the medical superintendents of the hospitals concerned the following statistics were obtained of their poliomyelitis admissions in 1949, and they are compared with similar figures for 1947 (Table V).

TABLE V.—Diagnosis, Progress, and Fatality in 1947 and 1949

Sample from London Hospitals	No. of Cases		% of Confirmed Cases	
	1947	1949	1947	1949
Admitted with diagnosis of poliomyelitis	686	655	—	—
Diagnosis confirmed	391	354	100	100
Paralytic cases	255	218	65	62
Residual paralysis	159	162	41	46
Deaths	20	25	5	7

† "Recent inoculation" means inoculation within the four weeks preceding notification.

Multiple Cases

In 1949 more than one case in the same family was reported 14 times; in 1947 this occurred 27 times. This difference is not statistically significant. Multiple cases in 1949 were more numerous north of the river (11) than south of the river (3). Indeed, there were more multiple cases in St. Pancras (4) than in all South London. The numbers involved were, however, so small that the results cannot be regarded as statistically significant.

Discussion

The most striking features, then, of the 1949 epidemic are (a) the return of the age incidence to its usual level, and (b) the geographical distribution. In regard to age incidence, it seems reasonable to suppose that the herd immunity of the population was raised considerably during the 1947 epidemic. Thus infants born after the middle of 1947 may have had a very much lower herd immunity than the remainder of the population. It is mainly the increased incidence in the first two years of life that has caused the alteration in the percentage age distribution.

If we compare the numbers of cases at each age in 1949 with those which would have been expected if the same total of cases had been distributed as in 1947 (Daley, 1948) we obtain the differences shown in Table VI.

TABLE VI.—Difference in Actual and Expected Cases for 1949

Age	Actual Cases, 1949	Expected on 1947 Distribution	Difference
0—	43	30	+13
1—	116	42	+74
2—	87	45	+42
3—	73	31	+42
4—	37	38	—1
5—9	123	161	—38
10—14	50	84	—34
15—24	63	123	—60
25+	76	114	—38
Total	668	668	

It will be seen that the largest difference, both absolutely and relatively, is in infants between 1 and 2 years of age, and that differences are positive—that is, actually greater than expected—for infants who at the time of the 1947 epidemic were under 18 months of age and who presumably were not exposed to infection as much as older infants. Many of them would have been young enough possibly to have had some temporary protection from their mothers if the latter had experienced an infection—clinical or subclinical—at any time.

The number of cases occurring in 1949 in each borough at ages 0–14 has been compared with that expected on the basis of the average county rate, and the excesses and deficiencies have been worked out. The following are regarded as statistically significant: Hammersmith, +14.7 (high); Kensington, +13.0 (high); St. Pancras, +14.9 (high); Westminster (City), +12.3 (high); Finsbury, –4.9 (low); Poplar, –7.4 (low); Deptford, –8.5 (low); Greenwich, –12.5 (low); Lewisham, –13.1 (low); Bermondsey, –7.0 (low); and Lambeth, –13.8 (low). In general, boroughs north of the river had an incidence higher than average, while the converse was true of the southern boroughs. A greater number of births in the north than in the south might be a possible explanation of this phenomenon, but in fact the infant population (0–4 years) forms a smaller proportion of the total in the north than in the south (7.6 as compared with 8.8).

Higher local immunity after the 1947 epidemic might perhaps have influenced the local distribution of cases—high-incidence areas in 1947 having a low incidence in 1949—but the relationship is not a simple one. In 1949 Hammersmith, Kensington, St. Pancras, and Westminster showed a higher-than-average incidence; and, while Kensington and St. Pancras were areas of notably lower-than-average incidence in 1947, Westminster was only slightly so and Hammersmith was not so at all. Again the low-incidence areas in 1949 were Finsbury, Poplar, Deptford, Greenwich, Lewisham, Bermondsey, and Lambeth. Of these Lewisham, Bermondsey, Deptford, and Finsbury had a higher-than-average incidence in 1947, but Lambeth and Greenwich were only average, and Poplar was much lower than average in both epidemics.

Boroughs, of course, are not closed communities; on the contrary, neighbouring communities affect each other, and this prevents their behaving as independent variables. Consider two neighbouring communities A and B. Suppose that in 1947 A had higher-than-average incidence while the incidence in B was only average. Let us assume that from causes other than relative immunity the incidence in B in 1949 is much higher than average; it would constitute a large reservoir of infection so close to A as perhaps to outweigh the advantage of the immunity gained by the high incidence of A in 1947, and so lead to A again having a higher-than-average incidence. This would need to happen only to a small extent to upset the simple correlation between 1947 and 1949; in fact, it did happen only to a small extent, and not in any instance where deviations from average were statistically significant in both years. Examples are Fulham, Chelsea, and Hackney—above average in 1947, surrounded or bordered by high incidence in 1949, and again above average in that year.

Conversely, there will be some boroughs which experienced low incidence in 1947 and which would be expected to be above average in 1949 but failed to be because they were surrounded by small reservoirs of infection. Examples of this are Stepney and Poplar, Camberwell, Greenwich, and Woolwich. The result is to obscure the effect of the 1947 epidemic in modifying the herd immunity in 1949, and, by the same token, it invalidates any attempt on this occasion to relate the inter-borough variations to social factors such as housing or economic environment.

Summary

An account is given of the outbreak of poliomyelitis in 1949 in the administrative County of London. The effect of the earlier outbreak in 1947 in raising herd immunity may perhaps be seen in the much younger age distribution of cases, which reverses the trend of the last twenty years, and to some extent in the changed geographical distribution of cases.

A sample of hospital admissions indicates that the percentage of paralytic cases was approximately the same as in 1947.

Sex ratios were not significantly altered. The fatality rate (approximately 7%) was the same in both outbreaks. The 1949 outbreak showed a more leisurely development both in time and in space than the previous epidemic.

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