Secondary Cases of Certain Communicable Diseases Among Non-Immune Family Contacts

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IN order to determine the relative infectivity of scarlet fever, mumps, chicken pox, whooping cough, and measles, a study was made from data for 1930, 1931, and 1932, secured in Berkeley, Calif. The number of secondary cases among susceptible family contacts was obtained and the secondary attack rate per 100 of these contacts was computed. The observations were made from epidemiological histories of 105 cases of scarlet fever, 1,716 of mumps, 1,456 of chicken pox, 1,043 of whooping cough, and 2,344 of measles, all of which had been reported to the city health department.

The following definitions are used in this study:

Primary case—The first case appearing in a family. When 2 cases appeared simultaneously or when 1 followed the other before the expiration of the minimum incubation period only the first case was listed as primary with susceptible contacts, the second being classified as primary cases with no susceptible contacts.

Susceptible contact—Any person in the family group who did not give a history of a previous attack of the disease. In this study it was impossible to separate the susceptible children and susceptible adults. For this reason the group of suspectible contacts may be fictitiously large as some of the adults may have had a previous attack which was forgotten. However, the histories were all taken by trained public health nurses and every effort was made to obtain accurate information.

Secondary case—Any member of the family group developing the disease after the expiration of the minimum incubation period, dating from the onset of the primary case.

Secondary attack rate—The percentage of susceptible family contacts that developed the disease.

The secondary attack rates for the 5 diseases studied are shown in Table I. They bear out the generally accepted idea that scarlet fever (secondary attack rate 6.0) is relatively less communicable than the other common communicable diseases,[1] that measles (50.5) is highly communicable, and that the communicability of mumps (26.9) chicken pox (38.8), and whooping cough (40.9), falls between the 2 extremes.[2]

The secondary attack rate of measles is more than 8 times that of scarlet fever, in spite of the fact that approximately twice as many susceptible persons were exposed per primary case in scarlet fever as in measles, the ratios being 3.1 and 1.6 respectively.

The secondary attack rate of 50.5 for measles is somewhat lower than that found by other observers. This is

TABLE I

ATTACK RATES AMONG SUSCEPTIBLE FAMILY CONTACTS

SCARLET FEVER, MUMPS, CHICKEN POX, WHOOPING COUGH AND MEASLES

	Total number cases	Primary cases no susceptible contacts	Primary cases with susceptible contacts	Number of susceptible contacts	Number of secondary cases	Secondary attack rate
Scarlet fever	105	9	81	250	15	6.0
Mumps	1,716	433	806	1,770	477	26.9
Chicken pox	1,456	447	572	1,126	437	38.8
Whooping cough	1,043	344	402	726	297	40.9
Measles	2,344	909	800	1,258	635	50.5

probably because of the difference in the age composition of the groups studied and because only those cases developing after the minimum incubation period were used in computing our rates. Chapin [3] found a secondary attack rate of 76.2 among 8,300 susceptible persons exposed to 8,043 primary cases. However, he included among his secondary cases every case in the family except the first, even those developing on the same day with the primary case. If the 1,723 cases developing during the first 7 days of illness of the primary case are excluded from Chapin's series the secondary attack rate is 65.1, not greatly in excess of that found in this study. The rate of 53.3 found by Halliday [4] is based on a study of 120 susceptible contacts living in tenements in Glasgow under such conditions that "from the epidemiological standpoint, each tenement building described may almost be regarded as a household in itself." Of the 120 susceptibles 64 developed measles but in this number were 13 primary cases. If the primary cases are subtracted it leaves 107 susceptibles, 51 of which developed the disease, a secondary attack rate of 47.7, slightly lower than that found by us. Butler [5] found that of 3,039 susceptibles

TABLE II

COMPARISON OF ATTACK RATES AMONG SUSCEPTIBLES

MEASLES

	Chapin		Halliday		Butler	Kelly and Reite
	Original	Corrected	Original	Corrected		
Susceptible contacts	8,309	8,309	120	107	3,059	1,258
Secondary cases	6,333	4,580	64	51	2,023	635
Secondary attack rate	76.2	55.1	53.3	47.7	66.1	50.5

TABLE III

ATTACK RATES AMONG SUSCEPTIBLE CONTACTS IN FAMILIES WITH 1, 2, 3, 4, AND 5 OR MORE SUCH CONTACTS
SCARLET FEVER, MUMPS, CHICKEN POX, WHOOPING COUGH AND MEASLES

No. Susceptibles in Family	Scarlet Fever				Mumps				Chicken Pox				Whooping Cough				Measles			
	Primary cases	Susceptible contacts	Secondary cases	Secondary attack rate	Primary cases	Susceptible contacts	Secondary cases	Secondary attack rate	Primary cases	Susceptible contacts	Secondary cases	Secondary attack rate	Primary cases	Susceptible contacts	Secondary cases	Secondary attack rate	Primary cases	Susceptible contacts	Secondary cases	Secondary attack rate
1	10	10	0	0	290	290	84	29.0	258	258	122	47.3	206	206	108	52.4	496	496	255	51.4
2	23	46	0	0	258	516	129	25.0	170	340	135	39.7	118	236	95	40.2	195	390	184	47.2
3	20	60	4	6.7	152	456	130	28.5	88	264	102	38.6	50	150	46	30.7	74	222	109	49.1
4	17	68	8	11.8	62	248	70	28.2	33	132	52	39.4	16	64	22	34.4	26	104	60	57.7
5 or more	11	66	3	4.5	44	260	64	24.6	23	132	26	19.7	12	70	26	37.1	9	46	27	58.6

TABLE IV

NUMBER OF SECONDARY CASES PER PRIMARY CASE IN FAMILIES WITH 1, 2, 3, 4, AND 5 OR MORE SUSCEPTIBLE CONTACTS
SCARLET FEVER, MUMPS, CHICKEN POX, WHOOPING COUGH AND MEASLES

No. susceptibles in family	Scarlet Fever			Mumps			Chicken Pox			Whooping Cough			Measles		
	Primary cases	Secondary cases	Aver. No. Secondary cases per prim. case	Primary cases	Secondary cases	Aver. No. Secondary cases per prim. case	Primary cases	Secondary cases	Aver. No. Secondary cases per prim. case	Primary cases	Secondary cases	Aver. No. Secondary cases per prim. case	Primary cases	Secondary cases	Aver. No. Secondary cases per prim. case
1	10	0	0	290	54	0.28	258	122	0.47	206	108	0.52	496	255	0.51
2	23	0	0	258	129	0.50	170	135	0.79	118	95	0.80	195	184	0.94
3	20	4	0.20	152	130	0.85	88	102	1.16	50	46	0.92	74	109	1.50
4	17	8	0.47	62	70	1.12	33	52	1.57	16	22	1.37	26	60	2.30
5 or more	11	3	0.27	44	64	1.45	23	26	1.13	12	26	2.16	9	27	3.00

exposed in the home, 2,023 developed measles, a secondary attack rate of 66.1. He does not state whether primary cases and only those developing the disease after the minimum incubation period were included among the 2,023 cases. Table II shows the above rates, both the original and those corrected, to correspond as closely as possible to the group studied by us.

In order to determine if the secondary attack rate varied significantly in families with different numbers of suspectible persons, a grouping was made according to whether 1, 2, 3, 4, and 5 or more susceptibles were exposed. The rates were computed for the different diseases by groups and are shown in Table III. While the numbers are not sufficiently large in some of these groups to warrant drawing definite conclusions, it is evident that there is no fixed relationship between the secondary attack rates and the number of susceptible family contacts.

While the secondary attack rates do not increase or decrease regularly according to the number of susceptible contacts, Table IV shows that secondary cases resulting from each primary case shows a steady increase from the 1 susceptible contact group to the 5 or more groups for each disease except scarlet fever and chicken pox, and in the latter it is true except for the group of 5 or more contacts. The smallest increase was in scarlet fever from 0.20 secondary cases per primary case in the group with 3 susceptible contacts to 0.47 in the group with 4 susceptibles. The greatest increase was in measles from 0.51 secondary cases per primary case in the 1 contact group to 3.0 in the 5 or more.

SUMMARY

1. Measles has the highest infectivity of any of the diseases studied.

2. The secondary attack rates among susceptibles of any of the diseases studied do not vary uniformly according to the number exposed in the family.

3. The average number of secondary cases per primary case increases as the number of susceptible contacts increases, but there is great variation among the different diseases.

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