THE INFECTIOUS DISEASES OF 8,900 CHILDREN

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Preliminary Note.

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The method of collecting the data here presented is believed to be comparatively new in its application; and it is believed that it has never been applied so widely before.

The method originated from the observation made in field epidemiological work that the mother of the household was usually well posted on what had happened in her family, and was usually the only one who could give, or calculate, the dates of these happenings. Hence it was recognized that the mothers of the race hold, in the mass, the minute personal history of the individuals of the race in greater detail and in better chronological order than any other class; moreover, that this is especially true of the diseases their children have suffered.

During an investigation of poliomyelitis extending over several years in Minnesota, the histories of the patients were so collected as to show the infectious diseases each had had. This has been done from time immemorial perhaps, but the figures obtained were tabulated and indicated infection so wide-spread amongst the children as to be appalling. True we all know and have laughed over the apparent inevitableness of measles, whooping cough, scarlet fever, etc., amongst children, and we all know in a general way that sooner or later the whole population suffers from some one or more of these infections. But these studies, inaugurated in Minnesota as a side issue of the poliomyelitis investigation, gave such definite and irrefragible figures* as to make it appear worth while to determine the same facts in the same way in Canada; *i. e.*, from the mothers, through the schools.

The usual medically collected statistics on the cases of infectious diseases are vitiated by two well known, absolutely established facts: first, physicians do not report all the cases they see; second, and far more important, although its importance does not seem to have been taken in really as yet, physicians do not see a very large proportion of the total cases, and, therefore, even if the health officers' ideal of every physician reporting every case he sees were realized, our medically collected statistics would be still very far short of the truth—at least 50 per cent., probably 75 per cent. in error.

*Much of the collecting and tabulating of the Minnesota data was done by or under Dr. A. J. Chesley, now Director: Division of Epidemiology, Minnesota State Board of Health.

Calculating cases from deaths is a good method, provided we know the deaths and the factors to be applied to them. Since we do not know the factors to be applied to them as a rule, it is absolutely worthless as a rule. We can only find the factors to be applied by dividing the cases by the deaths; we must know the cases in order to divide them; and if we know the cases there is no object in calculating them.

One of the by-products of this investigation is a complete demonstration that most of our fatality rates—*i. e.*, deaths to cases—are wrong and far too high.

Objections to the method usually take the following forms:

1st. That the mothers do not know the information asked, *i. e.*, what infections, and when, their children have suffered. A very little inquiry amongst any set of mothers will dispose of this objection at once.

2d. That the mothers would refuse the information asked. Table No. 1 indicates that the mothers in London, connected with the twenty-three schools concerned, responded for 74 per cent. of the school enrollment; in over one half the schools, the returns were 80 per cent. or over of the enrollment; and in only three schools did the returns fall below 70 per cent. of the enrollment; while in addition returns were made on nearly half as many more children, over and under school age.

3d. That the mothers would give frivolous or stupid answers. These returns showed frivolous or stupid answers in about 5 per cent. of the total; in 95 per cent. they were quite evidently straightforward, direct replies, consistent with themselves and with each other.

4th. That with the best will in the world, the mother's diagnosis would be fallacious. It is quite true that the average mother cannot recognize the infectious diseases with the swiftness and certainty of a trained expert, especially in the early stages of the attack. But this was not the task set the mothers. They were asked to record what their children had had, after the attacks had run their full course, generally years after; when opportunity for reflection and comparison with the neighbors' children had been afforded; and long after the diagnosis had been threshed out and settled. Remember also that the cases the physician does not see are often recognized by the laity, through comparisons with the cases he does see, as well as by consultation with the more experienced older mothers. Finally, these errors tend to correct themselves, for in large series of cases the diseases likely to be mistaken for each other are likely to be mistaken 50 per cent. one way, 50 per cent. the other.

TABLE NO. 1.—SHOWING

TABLE NO. 1.

This shows a total of 8,903 children returned, 1,778 under, 5,788 at, and 1,337 over school age (6–14). Of those over school age, 387 were attending the Collegiate Institute, and were of school age so far as the Collegiate Institute was concerned.

TABLE NO. 1—SHOWING NUMBER OF CHILDREN RETURNED.

Schools.	Returns by Age and Sex.			Returns to show School Age.			School enrollment at census time.	Percentage of enrollment returned.
	Total children.	Males.	Females.	Total under 6.	Total 6 to 14.	Total over 14.		
Public Schools:								
Aberdeen	816	363	453	299	437	80	512	85%
Alexandra	330	169	161	42	258	30	319	80%
Chesley Ave.	699	334	365	183	428	88	507	84%
Colborne St.	88	46	42	10	76	2	84	90%
Empress Ave.	469	240	229	70	339	60	397	85%
Grand Ave.	183	96	87	40	129	14	146	88%
King St.	94	50	44	17	71	6	96	74%
Lorne Ave.	816	423	393	185	522	109	612	85%
Princess Ave.	260	124	136	39	188	33	466	42%
Quebec St.	91	48	43	12	79	0	101	78%
Rectory St.	385	186	199	68	290	27	394	73%
Richmond St.	88	45	43	25	61	2	81	75%
Simcoe St.	685	327	358	138	446	101	553	80%
St. George's	1,026	511	515	242	664	120	743	89%
Talbot St.	561	293	268	105	380	76	450	80%
Victoria St.	574	305	269	104	419	51	537	78%
Wortley Rd.	494	251	243	139	287	68	335	85%
17 Schools	7,659	3,811	3,848	1,718	5,074	867	6,333	80%
Separate Schools:								
Sacred Heart	93	46	47	4	83	6	129	63%
St. Mary's and St. Martin's‡	215	104	111	31	159	25	282	56%
St. Nicholas*	75	40	35	1	67	7	80	83%
St. Peter's	281	152	129	24	212	45	278	76%
5 Schools	664	342	322	60	521	83	769	67%
Collegiate Inst.	580	298	282	0	193†	387†	721	80%
Grand Total	8,903	4,451	4,452	1,778	5,788	1,337	7,823	74%

* This school is now known as St. Michael's and is so designated in the report of the Catholic Board of Education.

† Both figures carrying the dagger must be combined to get the children of school age in the case of the Collegiate Institute.

‡ St. Mary's and St. Martin's are two different schools, in two different parts of the city. The cards were, however ,inextricably mixed and are reported together.

These returns represented twenty-three different schools. Owing to an unfortunate mixing of the cards of two small schools (St. Mary's and St. Martin's), there are only twenty-two groups, each corresponding with one school, except one, which represents the two "mixed" schools.

These groups are presented in the tables 1, 2 and 4 to bring out the variations amongst them, as well as to point out the great uniformity also.

The total 8,903 children were practically exactly divided in sex, almost

TABLE NO. 2.—SHOWING COMPARATIVE RATES, MALE AND FEMALE.

	Males.	Females.	Males, total attacks.	Females, total attacks.	Males, attacks per head.	Females, attacks per head.	Female ratio (males 100).
Aberdeen	363	453	653	920	1.8	2.0	111
Alexandra	169	161	404	405	2.3	2.5	108
Chesley Ave.	334	365	730	863	2.1	2.3	109
Colborne St.	46	42	117	113	2.5	2.6	104
Empress Ave.	240	229	474	508	1.9	2.2	115
Grand Ave.	96	87	219	207	2.2	2.3	104
King St.	50	44	125	88	2.5	2.0	80
Lorne Ave.	423	393	1,010	996	2.3	2.5	108
Princess Ave.	124	136	307	346	2.4	2.5	104
Quebec St.	48	43	104	99	2.1	2.3	109
Rectory St.	186	199	399	474	2.1	2.3	109
Richmond St.	45	43	87	84	1.9	1.9	100
Simcoe St.	327	358	720	883	2.2	2.4	109
St. George's	511	515	1,175	1,240	2.3	2.4	104
Talbot St.	293	268	665	665	2.2	2.4	109
Victoria St.	305	269	691	682	2.2	2.5	113
Wortley Rd.	251	243	517	500	2.0	2.0	100
Sacred Heart	46	47	123	120	2.6	2.5	96
St. Mary's and St. M.	104	111	213	246	2.0	2.2	110
St. Nicholas	40	35	101	107	2.5	3.0	120
St. Peter	152	129	314	295	2.0	2.2	110
Coll. Inst.	298	282	991	1,003	3.3	3.5	106
	4,451	4,452	10,139	10,844	2.27	2.43	107
	8,903		20,983		2.35		

exactly half (4,451) being males, almost exactly half (4,452) being females.

To get a clear view of the children under consideration it is necessary to picture to oneself the twenty-two groups, each of approximately the same number of each sex; the ages of each group ranging from infants in arms to twenty-one years or in a very few cases, to twenty-four.

Table No. 2 gives the total attacks of each of eight infectious diseases suffered by this particular set of children, tabulated to show the attacks by sex.

The eight diseases tabulated were chicken pox, diphtheria, German measles, measles, mumps, pneumonia, scarlet fever and whooping cough.

It will be noted how closely the attacks per child agree in the twenty-one groups, exclusive of the Collegiate Institute. In the Collegiate Institute the attack rate (irrespective of sex) is 3.43 as against the similar attack rate for the remaining children of 2.28; or about 50 per cent. higher. This depends, as will be conclusively shown later, on the greater average age of the Collegiate Institute children.

TABLE NO. 3.—SHOWING COMPARATIVE ATTACKS OF EIGHT INFECTIONS IN MALES AND FEMALES

Schools.	Total males.	Total females.	Chicken pox.		Diphtheria.		German measles.	
			Males.	Females.	Males.	Females.	Males.	Females.
Wortley	251	243	86	77	11	22	18	15
Rectory	186	199	66	81	7	11	14	20
St. Mary's and St. Martin's	104	111	32	37	5	8	8	10
Collegiate Inst.	298	282	185	176	41	36	41	53
	839	835	367	371	64	77	81	98

Schools.	Measles.		Mumps.		Pneumonia.		Scarlet fever.		Whooping cough.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
Wortley	135	139	81	64	26	22	35	32	125	129
Rectory	114	136	60	69	20	20	18	22	100	115
St. Mary's and St. Martin's	58	69	34	34	9	9	13	16	54	63
Collegiate Inst.	256	255	162	171	35	27	87	89	184	196
	563	599	337	338	90	78	153	159	463	503

Perhaps the most striking point brought out is the higher attack rates shown for females, reaching an average for the total of about 7 per cent.

To which disease if any is this higher rate attributable?

The Collegiate Institute, as one group of older children, and St. Mary's and St. Martin's, Wortley Road and Rectory as a second group showing all ages, chiefly eight to fourteen are given above by age and disease (Table 3.) It will be seen that, so far as these figures go, no very noticeable

TABLE NO. 4.—SHOWING TOTAL ATTACKS OF EIGHT INFECTIONS.

Schools.	Total children.	Total attacks.	Chicken pox.	Diphtheria.	German measles.	Measles.	Mumps.	Pneumonia.	Scarlet fever.	Whooping cough.
Aberdeen	816	1,573	282	49	47	420	215	72	84	404
Alexandra	330	809	145	24	25	222	106	42	64	181
Chesley Ave.	699	1,593	284	47	71	412	197	67	75	440
Colborne St.	88	230	45	5	8	58	31	7	15	61
Empress Ave.	469	682	142	0	47	319	148	33	58	235
Grand Ave.	183	426	86	13	27	117	55	14	23	91
King St.	94	213	34	4	8	71	17	8	11	60
Lorne Ave.	816	2,006	421	38	64	531	329	61	121	441
Princess Ave.	260	653	120	18	25	155	123	21	42	149
Quebec St.	91	203	40	0	8	49	23	8	9	66
Rectory	385	873	147	18	34	250	129	40	40	215
Richmond	88	171	40	3	3	52	18	5	15	35
Simcoe	685	1,603	297	47	65	443	200	65	127	359
St. George's	1,026	2,415	415	56	107	651	406	87	122	571
Talbot St.	561	1,330	213	33	52	396	174	53	92	317
Victoria	574	1,373	242	35	69	376	191	68	71	326
Wortley Rd.	494	1,017	163	33	33	274	145	48	67	254
Sacred Heart	93	243	44	7	6	70	31	4	19	62
St. Mary's and St. Martin's	215	459	69	13	18	127	68	18	29	117
St. Nicholas	75	208	30	4	11	61	45	6	13	38
St. Peter	281	609	79	19	14	204	95	24	37	137
Collegiate Inst.	580	1,994	361	77	94	511	333	62	176	380
	8,903	20,983	3,699	548	836	5,769	3,079	808	1,310	4,939

emphasis is laid on any one disease, the tendency being for the females to run higher in all. The discrepancy is less marked in the Collegiate Institute however.

TABLE NO. 4.

In this table, the total attacks are separated into their component parts. Here again the striking point is the extreme uniformity of the twenty-one public school groups; and the higher figures of the Collegiate Institute.

It is also worth noting that over one half of the total attacks of these eight diseases are due to measles and whooping cough; chicken pox and

TABLE NO. 5.—SHOWING NUMBER OF CHILDREN AT EACH AGE WHO HAD BEEN SICK IN THE FOUR SCHOOLS.

Wortley Rd., Rectory St., St. Mary's and St. Martin's.

Age.	Total well males.	Total well females.	Total sick males.	Total sick females.	Total well.	Total sick.	Grand total.
1	12	18	4	3	30	7	37
2	12	13	8	4	25	12	37
3	6	11	8	6	17	14	31
4	11	6	20	15	17	35	52
5	14	11	32	24	25	56	81
6	7	12	33	39	19	72	91
7	7	6	44	44	13	88	101
8	6	4	41	43	10	84	94
9	2	2	41	46	4	87	91
10	1	1	47	44	2	91	93
11	1	0	39	32	1	71	72
12	3	1	37	32	4	69	73
13	0	2	28	29	2	57	59
14	1	2	24	35	3	59	62
15	1	3	17	14	4	31	35
16	0	0	12	13	0	25	25
17	0	1	6	7	1	13	14
18	1	0	8	10	1	18	19
19	1	0	4	11	1	15	16
20	0	0	2	9	0	11	11

mumps, each contribute about one seventh; scarlet fever one fourteenth; and the other three together about one tenth.

TABLE NO. 5.

The extremely widespread distribution, practical universality, of these infections is shown by a list of the sick and well at each age for St. Mary's and St. Martin's, Wortley Road, and Rectory (1094 children). It will be seen that after the age of eight there are almost no children reported as free of one or other of the eight infections.

There are many other items of valuable information yet to be worked out from these figures as time may permit, but the immediately practical point now available is the demonstration of the enormous numbers of these infections actually occurring day after day, year after year, in excess of any official figures collected or published. This excess may be estimated from the tables already given; but more accurately by calculations from the actual returns showing what the returns would be had we them all. Since not far from one half of the total children are here recorded, the factors applied are not so large as to be unusually fallacious.

Calculations Showing the Number of Attacks in a Standard Population of 50,000.

The United States Standard Million (United States Census Bureau, 10th Annual Report, Table XII, page 426) gives the relative figures for 1,000 population as:

TABLE NO. 6.

Under five years	12.0% of the total population.
5 — 9	11.6 " " "
10 — 14	10.6 " " "
15 — 19	9.9 " " "
	44.1% of the total population.

The same proportions, but expressed as a percentage of the total children (under 20), *not* of the total population, would be:

TABLE NO. 7.

Under 5 years	27.2 of total under 20 (Standard Population).
5 — 9	26.3 " " " "
10 — 14	24.0 " " " "
15 — 19	22.4 " " " "
	99.9 of total number under 20.

Taking the 1,094 children of the Wortley Rd., Rectory St., St. Mary's and St. Martin's Schools (merely because these figures are now available), the 1,094 children there included show the following relative proportions amongst themselves:

TABLE NO. 8.

Under 5 years	11.6% of the group, 1094.
5 — 9	42.0 " " "
9 — 14	35.0 " " "
15 — 19	10.0 " " "
20	1.0 " " "
	99.6%

Hence it is evident that, as is quite natural considering the method of collecting the data (*i. e.*, through the schools) the school children are in great excess of the usual proportions. The figures, if the returns had been in actual proportion to the age distribution of an ordinary standard population, would have shown the following (the group of 458 children, 5–9 years old, is taken, in Table No. 10, as the 26.3% of the table, No. 7, above):

The Actual Total Infections per age group in London were as follows:

TABLE NO. 9.

1,094 children		Total infections.	Infections per child.
Under 5 years	157	96	0.61
5 — 9	458	868	1.90
10 — 14	359	1,029	2.87
15 — 19	109	322	3.00
20	11	34	3.09
	1,094	2,349	2.14

Calculated for a group standardized to agree with the United States Standard Million the following results are found:

TABLE NO. 10.

Standardized group.		Infections per child.	Calculated infections.
Under 5 years	474	0.61	289
5 — 9	458	1.91	870
10 — 14	418	2.87	1,200
15 — 19	390	3.00	1,170
	1,740	2.03	3,529

Calculated for a standard thousand of any standard population we get the following:

TABLE NO. 11.

Standard.		Infections per child.	Calculated infections.
Under 5 years	120	0.61	73
5 — 9	116	1.90	220
10 — 14	106	2.87	304
15 — 19	99	3.00	297
	441	2.03	894

I.E., for each standard thousand there are 441 persons under 20, representing 894 infections. Hence for 50,000 population there are (441 x 50) 22,050 persons under 20, having 44,700 infections; and 27,950 (50,000–22,050) 20 years old and upwards, having 83,850 (27,950 x 3) infections—a total for the 50,000 population of over 128,000 infections.

Note—for ease in calculation, the round number of 2.5 infections per head of a general standard population would give a fair average figure for the number of attacks of the eight listed infections suffered. This figure is based on the ground that adults suffer so little from these infections as to make the attacks added after 20 years of age negligible; but of course concerning typhoid fever, tuberculosis, smallpox and pneumonia, adults suffer as much or more than children, except in so far as vaccination may affect smallpox, or anti-typhoid inoculation may affect typhoid.

Total Annual Attacks Calculated for a Population of 50,000.

The annual attacks suffered by a standard population may be deduced as follows:

Calculated infections for total children in each 1,000 of the population.		Annual average.
Under 5 years.....	73; since these were suffered within 5 years, there were per year at least 73÷5 =	14 per year
5 — 9.....	220 " " " 220÷ 9	24 " "
10 — 14.....	304 " " " 304÷14	21 " "
15 — 19.....	297 " " " 297÷19	15 " "
	894	74

At 74 attacks per 1,000, a standard population, totalling 50,000 would yield 3,700 attacks per year, of the eight infections we are dealing with.

Taking the proportions of the eight different infections to each other as shown in Table 4, this would yield annually attacks of each disease as follows (very rough approximation):

Attacks of each of eight infections for 50,000 population per annum.

Measles, one-fourth (about) of total attacks, 925; whooping cough, one-fourth (about) total attacks, 925; chicken pox, one-seventh (about) total attacks, 530; scarlet fever, one-fourteenth (about) total attacks, 215; mumps, one seventh (about) total attacks, 530; pneumonia, diphtheria, German measles, together one-tenth (about) of total attacks, 370.

Special thanks are due to the London Public School Board, to Mr. C. B. Edwards, Inspector of the London Public Schools, to the London Separate School Board and to the Principals and Teachers of all the Schools, without whose co-operation this investigation would not have been possible.