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Vaccination and the Decline in Paralytic Poliomyelitis[1]

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THE pattern of wide variation in the annual incidence of paralytic poliomyelitis is evident in the years since 1950, which have seen a remarkable rise and decline in this unpredictable disease. Commencing with 284 cases in 1950, paralytic poliomyelitis increased year by year to the all-time peak of 3,691 cases in 1953, and then declined progressively to 368 cases in 1956 (Figure 1).

The protective effect of poliomyelitis vaccine in preventing the paralytic complications of poliomyelitis under field conditions was first demonstrated in the well-known Francis Report of the American Field Trial of 1954. Numerous subsequent comparisons of paralytic attack rates in groups of vaccinated and unvaccinated children of comparable ages, including our experience with the Canadian vaccination program of 1955, have confirmed this reduction in paralytic cases effected by the vaccine. The Canadian vaccination program commenced in April, 1955, and by the beginning of the 1956 poliomyelitis "season", some 1,800,000 children had been vaccinated, 90 per cent of whom had received 2 or more doses of vaccine. In general, the majority of vaccinations were to be found at that time in children of primary school age, although in some provinces vaccinations had been extended as well to pre-school children and to older children of school age. It will be recalled that comparatively few vaccinations were carried out during the summer of 1956.

Knowing that vaccination confers significant protection against paralytic attack, but realizing that poliomyelitis is a disease of wide annual fluctuation, it has been felt desirable to examine the part that vaccination of this large segment of the younger population may have contributed to the decline in incidence experienced during 1955 and 1956. Sabin (1) has shown that sub-

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clinical infection can occur in those who have received formalinized vaccine, and Gelfand, Fox and LeBlanc (2) have demonstrated that two doses of Salk vaccine do not materially influence the frequency and duration of alimentary infection, or the amount of virus excreted in the faeces. Thus a killed virus vaccine alone may be expected to have little effect on the dissemination of poliomyelitis virus in nature, so that it can be anticipated, therefore, that vaccination will not affect the incidence of paralytic poliomyelitis in the unvaccinated population; its protective effects will be seen only in the age-groups receiving the vaccine. Because of this selective effect of the vaccine, it can be expected that a decreasing proportion of all paralytic poliomyelitis will be found in the vaccinated ages resulting in a modification of the age-distribution pattern of paralytic poliomyelitis seen in pre-vaccination years. It is of interest, therefore, to examine and compare the age-distribution pattern of paralytic poliomyelitis for the pre-vaccination years, 1952–54, with post-vaccination years, 1955–56, for evidence of these effects. With the co-operation and assistance of provincial communicable disease control directors and epidemiologists incidence figures of paralytic poliomyelitis by age have been assembled for this purpose.

Age-specific Paralytic Attack Rates

It is of interest first to examine these rates over a number of years for evidence of changes that may have occurred between pre-vaccination and post-vaccination years. Figure 2 shows paralytic attack rates per 100,000 population by 5-year age-groups for individual years from 1952 to 1956, plotted on a semi-logarithm scale. It will be observed that although the magnitude of the rates varies, the curves for each of the pre-vaccination years 1952 to 1954 are roughly the same, in that rates rise to a peak at ages 5–9 and then decline gradually with age. An examination of the curves for the post-vaccination years 1955 and 1956 shows a similar pattern except that the rate of maximum incidence observed in the pre-vaccination years at ages 5–9 has been displaced to the pre-school age-group in these years. The pronounced instability seen in the curve for 1956 can probably be explained by the small number of cases experienced in that year.

The percentage distribution of paralytic poliomyelitis in pre-vaccination years 1952–54 is compared with post-vaccination years 1955–56, by single year of age up to age 14 and by 5-year age-groups from 15 years upward (Fig. 3). In the pre-vaccination years, the maximum distribution of paralytic poliomyelitis cases occurred in the older pre-school and younger school ages, followed by a gradual decline with age, while in the 1955–56 picture, the relative deficiency in the proportion of cases occurring at ages 5 to 10 is apparent.

Focusing attention upon individual years at the extremes of the period under consideration, a comparison of the percentage distribution of paralytic poliomyelitis by 5-year age-groups in the pre-vaccination year 1952 and post-vaccination year 1956 shows a similar picture (Fig. 4). In the former, the peak distribution at ages 5 to 9, followed by a gradual decline with age is evident. When the 1956 distribution is examined, the relative reduction

FIG. 1. Paralytic Poliomyelitis, Reported Annual Incidence 1950–56, Canada.

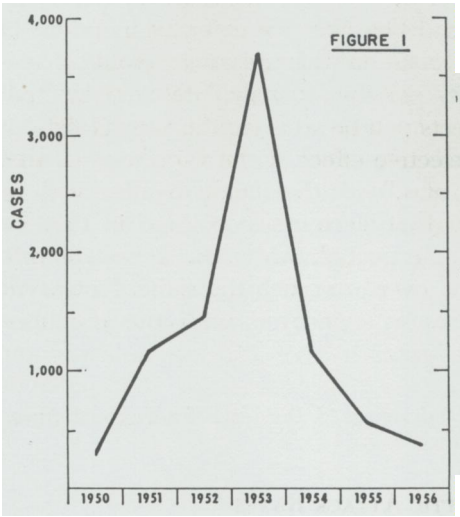


FIG. 2. Paralytic Poliomyelitis 1952–56 rates per 100,000 population for specified age-groups, Canada (8 provinces).

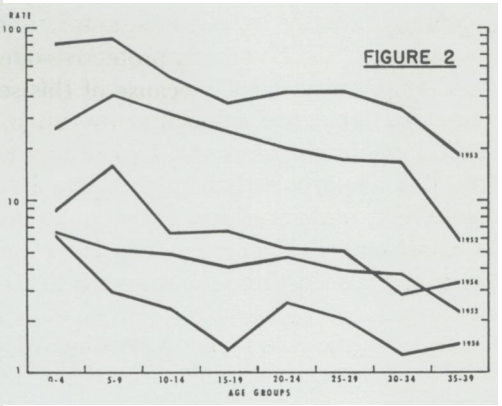


FIG. 3. Paralytic Poliomyelitis Percentage Distribution for Specified Ages 1952–54 and 1955–56, Canada (8 provinces).

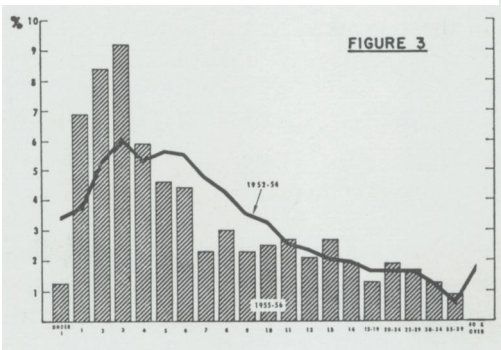
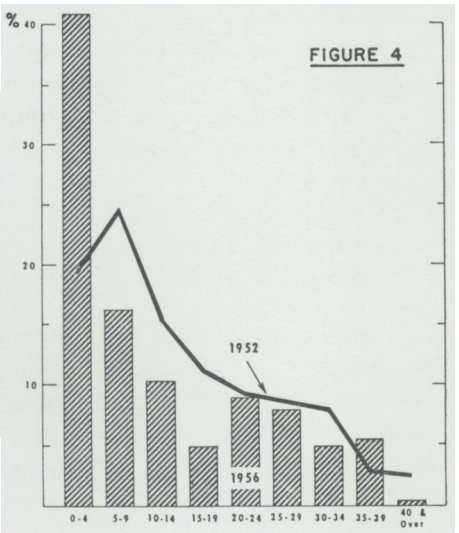


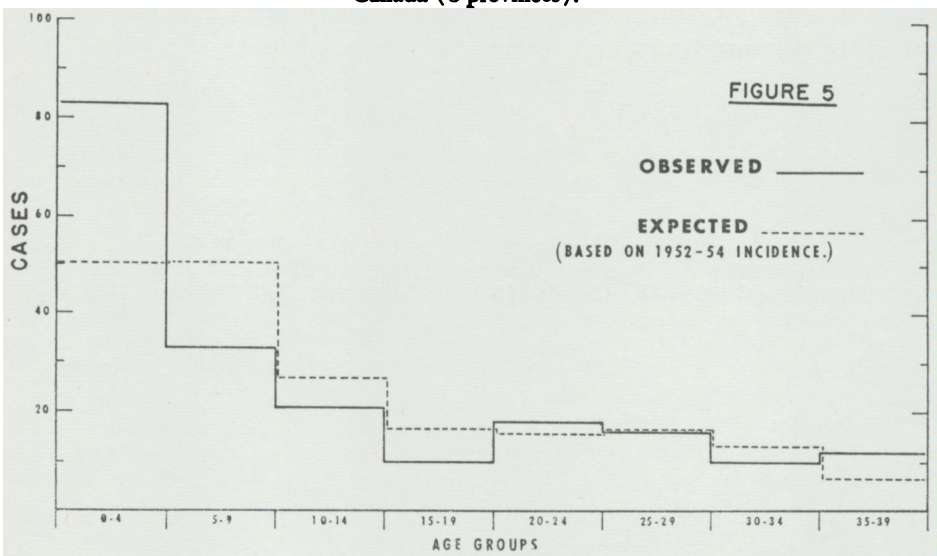
FIG. 4. Paralytic Poliomyelitis Percentage Distribution for Specified Ages 1952 and 1956, Canada (8 provinces).



previously seen in the proportion of cases occurring in the school ages is again apparent. The relatively larger proportion of cases in age-group 0–4 will be noted.

The marked reduction in the decline in the over-all incidence of paralytic poliomyelitis since the pre-vaccination years has been previously mentioned. If it can be assumed that without vaccination this decrease would have occurred equally at all age-groups, it is possible to calculate an expected incidence in 1956 by applying adjusted age-specific rates for the years 1952–54 to the appropriate 1956 population of each age-group. Figure 5 compares the expected incidence calculated by this means, with the incidence observed in 1956 by 5-year age-groups. It will be seen that more cases occurred in 1956 in the 0–4 age-group than might have been expected, while the expected and observed numbers of cases at ages 20 and over are much the same. However, a consistent deficiency in observed cases as compared with the numbers expected is seen throughout ages 5 to 19 years.

FIG. 5. Paralytic Poliomyelitis 1956 Observed and Expected Incidence for Selected Ages, Canada (8 provinces).



SUMMARY

It would appear that in addition to the over-all decline in paralytic poliomyelitis seen in recent years at all ages and in each age-group, there has also been a selective reduction in paralytic poliomyelitis in the school ages since 1955. This has been demonstrated by a reduction in paralytic attack rates and in the proportion of all paralytic cases occurring in these age-groups to an extent greater than the experience of past years would lead one to expect. It will be recalled that at the beginning of the 1956 poliomyelitis "season", the main concentrations of vaccination were in the school years. Therefore, it would seem reasonable to infer that the relative lack of paralytic cases which has been demonstrated in the vaccinated ages is the reflection of the

protective effect of the vaccine program. In doing this, however, the possible "natural" immunizing effect of the epidemic year 1953 should not be overlooked. It will be of very considerable interest to follow the incidence of paralytic poliomyelitis over the next few years with the expectation that further changes in the age distribution pattern will parallel the progressive development of vaccination programs.

REFERENCES

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INDUSTRIAL HEALTH PROGRAMS

Industrial health programs suitable for the maintenance of employee health in large or small plants generally consist of the following ten procedures: preplacement medical examinations; confidential health records; first aid for the sick or injured; rehabilitation of the sick or injured; health education; sanitation; industrial hygiene; statistical studies of absenteeism due to sickness or injury; periodic medical examinations; adequate medical care in isolated regions. There is ample evidence that many management groups have health programs because they are helpful to their employees, even if costly. A listing of the benefits to be expected would include: reduction of injury and occupation disease rates; reduced compensation costs; lower costs of production; improved management-labour relations; better human relations; less absenteeism; reduced labour turnover; improved relationships with the general community. In the last analysis, management is merely another group of employees within the framework of the industrial concern and participates equally with other employees in the benefits of a health program.

A psychiatric approach to industrial personnel problems revealed, in the course of a survey, that 62% of the more than 4,000 cases observed reached the discharge status through traits of social incompetence rather than occupational incompetence. The conclusions were that dissatisfaction on the part of both the employer and the employee generally arose, not from the employee's inherent inability to do his work, but rather from his inability to adjust himself to the conditions under which he was to do the work. The solution to emotional problems in industry cannot be the exclusive province of management, medical department or personnel. It can only be met by closely-knit co-operation of all three.

Today, women comprise about 23% of the Canadian labour force and are playing a vital role in our current phenomenal industrial expansion. The conservation of the health of this very important group of workers presents a major challenge to industry and to medicine. The industrial physician can also help materially with the problems of the older worker and in the important field of accident prevention.

From an address to the Convention of Industrial Physicians in Hamilton by T. A. Rice, International Harvester of Canada, Hamilton, and past president of the Canadian Manufacturers' Association.