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Sonne dysentery in day schools and nurseries: an eighteen-year study in Edmonton

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SUMMARY

A study of Sonne dysentery infections in 19 primary and 11 secondary day-schools and 4 day-nurseries has been made over a period of 18 years in an urban area. Measures were taken throughout to try to prevent and control outbreaks. Sonne dysentery was not endemic in the school population and, even at times of high incidence, epidemics were localized within a few of the primary schools, usually in the spring or autumn terms. Incidence rates of Sonne dysentery were highest in primary schools with large infant departments and in nurseries. Secondary schools entirely escaped outbreaks.

The co-operation of head teachers was engaged for all precautionary measures in schools. A policy of immediate exclusion of suspected and infected children was useful in preventing and controlling school epidemics of dysentery. Toilet hygiene was often poor in schools with outbreaks, and this was found to be a profitable field for applying control measures. Infected kitchen workers were only occasionally involved.

Recommendations are given in the light of this study, and some reference is made to the more difficult problem posed by dysentery outbreaks in day-nurseries, where temporary closure may be the best policy. It is important that responsibility for infectious disease control in schools be clearly delineated in the re-organized health services of 1974. Teachers can play an important part in limiting infection.

INTRODUCTION

During the period 1951–68 general practitioners in the Edmonton district of Enfield in London were encouraged by the medical officer of health to seek a laboratory diagnosis for cases of gastroenteritis. Contacts were followed up by the public health department and school teachers co-operated in case-finding. The bacteriological investigations were carried out at Edmonton Public Health Laboratory. Intestinal infections discovered in school-children during this period were recorded in a special file as part of the record-keeping routine of the laboratory.

The study reported here is concerned with Sonne dysentery infections in the school-children who constituted the index (i.e. first) cases in their household and who are assumed to have acquired their infection outside the home. These children fall into two groups. Those who were first seen by their family doctor as an acute case of diarrhoeal illness were grouped as *GP index cases*. The remainder, described as *MOH index infections*, were children diagnosed by the medical officer of health either after they had been sent home from school suffering from diarrhoea or vomiting or after the investigation of contacts of known cases of dysentery. Infected school-children who were home contacts of known index cases are not included since they may well have acquired infection in the home.

From 1953 onwards this study formed part of a larger survey of all dysentery in the borough of Enfield, which has already been reported (Thomas & Tillett, 1973). That survey showed that primary schools and nurseries were foci for the spread of dysentery in the community. Some of the survey results will be referred to in this report.

INCIDENCE OF SONNE DYSENTERY

In the general Enfield survey, where the mid-period population was 273,857, the average annual incidence rates per 10,000 population of Sonne dysentery index infections were 21·2 for pre-school children, 44·8 for primary-school-children aged 5–10 years, 3·8 for secondary-school-children aged 11–14 years and 1·1 for adults. It appears from these rates that dysentery is a disease of primary schools and is only a minor problem in secondary schools. Only a small proportion of pre-school children in this population attended nurseries, but within this small number many cases of dysentery were observed.

In the local study of Edmonton schools covering the years 1951–68 a total of 1088 Sonne dysentery index infections were found in children attending 19 primary schools. The district had just under 100,000 inhabitants and these schools had a mid-period population of 7667 children. There were 605 (56 %) GP index cases and 483 (44 %) MOH index infections. Of the latter group three-fifths of the children admitted to symptoms. Thus, there was an average annual incidence rate of primary schoolchild index infections of 78·8 per 10,000, which was even higher than that of 44·8 found in the same age group in the Enfield survey. Edmonton is more densely populated than the other areas of Enfield.

Distribution of cases in time

Two hundred and sixty-nine (25 %) of the index infections were diagnosed in the months September–December during the autumn term or Christmas holiday; 642 (59 %) were diagnosed in January–April during the spring term and Easter holiday; 177 (16 %) were diagnosed in the summer months May–August, more than nine-tenths of these before the summer holiday.

Incidence varied greatly from year to year and followed no apparent pattern. The school year was measured from September to August and the annual number of infections found in any of the 19 primary schools ranged between 1 and 135. In 4 school years fewer than ten infections were found and in 5 school years more than 100. Sonne dysentery did not therefore appear to be endemic in the schools.

This was further substantiated when outbreaks were considered. A large outbreak was defined as 10 or more index infections in any one term at any one school and a small outbreak as 5–9 infections. No outbreaks were observed in the

Table 1. *Numbers of outbreaks and sporadic incidents observed in* 19 *primary schools during* 18 *years and the numbers of children affected*

	Large outbreaks	Small outbreaks	Sporadic incidents	
Number observed in the 19 schools	29	14	148	
Total number of infections involved	763 (70 %)	95 (9 %)	230 (21 %)	1088

Table 2. *School terms during which Sonne dysentery was diagnosed in any of the* 19 *primary schools*

	Number of school terms			
	Autumn	Spring	Summer	Total terms
Large outbreaks in one or more school	7	10	3	20
Small, but no large outbreaks in progress	—	1	3	4
Only sporadic infections	7	5	9	21
No infections found in any schools	4	2	3	9
	18	18	18	54

11 secondary schools in the area, but 29 large outbreaks were observed in 13 of the 19 primary schools and accounted for 70 % of the 1088 total infections in that age group (Table 1). Fourteen small outbreaks in ten primary schools accounted for a further 9 % of total infections. No school was entirely free from sporadic cases throughout the 18-year period, although four schools escaped outbreaks.

Table 2 shows the distribution of outbreaks and sporadic cases over the school years. Outbreaks were in progress during 24 of the 54 school terms studied and sporadic infections were found during a further 21; nine terms were free of infection. Outbreaks were unusual in summer terms and the sporadic cases were often the tail end of outbreaks in the previous term. During the greater part of the study (i.e. 30 terms) there were no outbreaks in any of the primary schools.

Epidemics were localized, and even when large outbreaks were in progress by no means all the schools in the area were infected. Table 3 shows the average number of schools with small outbreaks, with sporadic or with no infections, during terms when large outbreaks were in progress. In one term (Spring 1962) there were as many as three large outbreaks; nevertheless, 9 of the 19 schools had no index infections that term. Whatever the number of large outbreaks in a term a large proportion of the schools remained wholly unaffected. In only two terms were less than half the schools free from known infection and these were the first term of the study when there were only four schools and the spring term of 1967 when there were eight schools free from infection.

The largest number of index infections found in one school in one term was 63, of which 55 were MOH index infections. The largest proportions of school populations found as index infections in outbreaks were 15 % in one outbreak in the

Table 3. *Primary schools affected by Sonne dysentery: distribution of cases in 19 schools during 54 terms*

Number of schools affected by large outbreaks	Total terms in which this number of large outbreaks was observed	Average number of schools during these terms with: Small outbreaks	Sporadic cases	No infections
0	34	0·1	2·1	16·7
1	12	0·3	2·4	15·3
2	7	0·9	5·6	10·6
3	1	0	7	9

autumn of 1962 and 16 % in an outbreak which lasted through the autumn and spring terms of 1967/8 in a school at the border of the area. Including sibs, 18 % of the latter school population was found infected. This school was the subject of a special report (Thomas, Haider & Datta, 1972). Fifty-three per cent of cases found during outbreaks were MOH index infections, whereas 87 % of sporadic cases were GP index cases detected by their family doctors. The remaining 13 % of sporadic cases were discovered at home after they had been excluded from school because of diarrhoea or vomiting.

Distribution of cases between schools

The size of the schools ranged from 87 to 932 places with an average of 404. Three schools took only juniors (8- to 10-year-olds) and in the remainder just under half of the places were filled by infants (5- to 7-year-olds). The number of infections in a large school would be expected to be higher than those in a small school with fewer children at risk. This was observed. However, the infection rate per 100 pupils would be expected to be the same in all schools, all things being equal. The correlation between average annual infection rate and the number of infant places in each school was looked at and then the correlation between rate and the number of junior places. As the numbers involved were not normally distributed random variables, the correlations were evaluated by the ranking method of Kendall (1962).

Size of infant department

The correlation between the size of *infant* department and the infection rate was 0·35 and was statistically significant ($P < 0{\cdot}02$), whereas that between infection rate in a school and the size of the *junior* school department was 0·15 and was not significant. Fig. 1 shows the mean and range of incidence rates at groups of schools according to the size of their infant departments.

There were three schools in the study which took junior children only. Although one experienced an outbreak (Thomas *et al.* 1972) all three of these schools were free from known infection during all but two of the school years studied. This was a record achieved by only two other primary schools and these had small infant departments of 120 and 157 places.

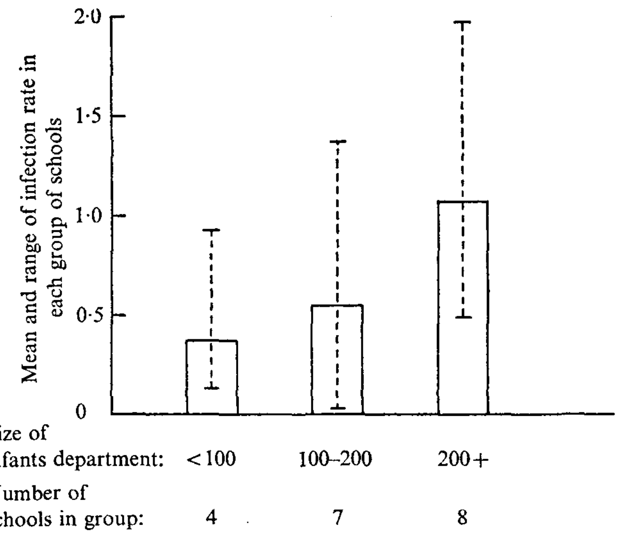

Fig. 1. Annual Sonne dysentery infection rate per 100 pupils in schools according to the size of their infant departments.

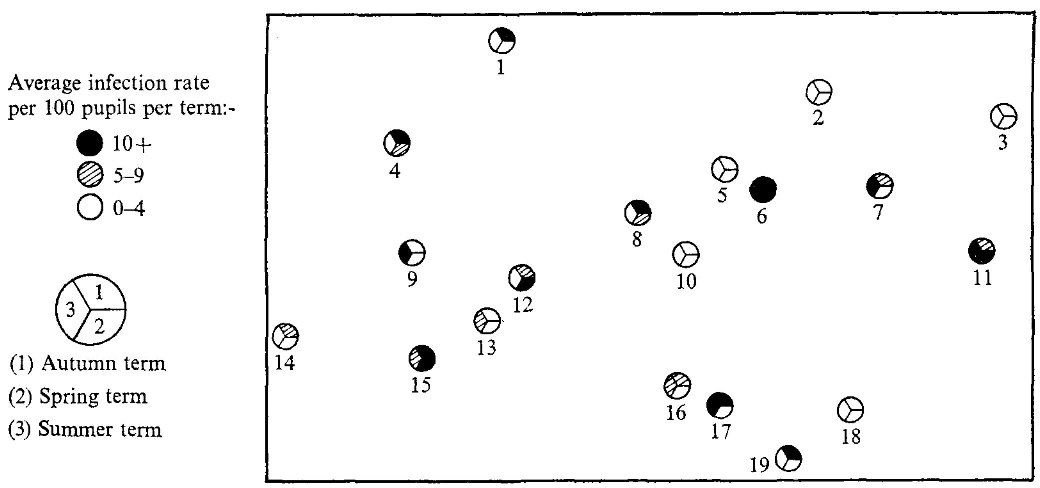

Fig. 2. Average Sonne dysentery incidence rates according to term and relative location of primary schools in Edmonton.

New buildings

The age of the buildings varied, nine schools being built before 1914 and five after 1945. No association was found between the age of the premises and the incidence rate of Sonne dysentery, even when allowance was made for the relative sizes of the infant departments. Four schools were rebuilt between 1950 and 1966 and it was disappointing to note no improvement in attack rates of dysentery – three of the four schools had slightly higher rates during the 7 years after rebuilding compared with the 5 years before rebuilding.

The 19 schools were spread over an area of about 3½ square miles. In Fig. 2 they are shown in their relative positions but the compass reference has been omitted. This figure shows the average incidence in each school during autumn, spring and summer terms. Schools tending to have high incidence at certain times of the year are not obviously clustered. Neither was a consistent pattern of spread of dysentery through the area seen when maps for individual years were studied.

The number of infants under 8 years old in a school was the *only* factor found which appeared to distinguish between schools with high or low dysentery infection rates. It was noted that the average number of outbreaks at 11 schools with under 200 infants was 1·1 and at the eight schools with over 200 infants was 3·9. This difference was highly significant ($P < 0{\cdot}001$).

OBSERVATIONS IN SCHOOLS WITH SONNE DYSENTERY OUTBREAKS

Visits to schools usually revealed bright and cheerful classrooms even in old buildings, but the maintenance of the toilets was never quite satisfactory in schools experiencing outbreaks of dysentery. The toilet equipment varied from modern to appalling. Frequently there was visible faecal soiling, including soiled toilet rolls. Also observed were situations where there were no accessible basins, blocked basin outlets, shared towels and no supervision.

School meals services were centrally organized and were not the source of any trouble. Some school servery kitchens, however, were poorly equipped. Occasionally servery staff, probably victims of an outbreak, were found to be infected. Children in some schools helped with the food serving and were seen to handle dishes and cutlery. Kitchen staff were also found to be helping in the cloakrooms.

Children were seen sucking their fingers and thumbs, sharing sweets and passing round chewed pencils and rubbers.

MEASURES TAKEN TO CONTROL AND PREVENT OUTBREAKS

Control

At the first signs of plural cases of dysentery a school was visited by a member of the local health department and a representative from the laboratory. This meant an immediate visit if two or more cases were diagnosed from the same school within 10 days. With the co-operation of the head teacher an inspection of the premises was carried out, together with appropriate bacteriological sampling. Inspection started in a classroom in order to praise and proceeded to the inevitably unsatisfactory lavatories. Arrangements were made for supervision of toilet hygiene, issue of individual paper towels, and a supervised disinfectant hand-dip after toilet, before meals and on re-entry to the classroom. Hand-dipping was found valuable because it focused attention on the state of the hands, giving the supervisor an opportunity to check that hands had been well washed beforehand. Even before fairly effective disinfectant solutions had been introduced this measure proved useful in checking the spread of infection. Frequent cleaning of toilet premises by attendants wearing rubber gloves was also advised.

Standing arrangements to exclude from schools any pupils with gastroenteritis symptoms, together with their siblings, pending negative bacteriological reports on their faeces specimens were enforced. These children were re-admitted only with the written permission of the M.O.H.

If new cases continued to arise for more than 1 week after the first visit to the school, screening of the kitchen staff was carried out and any infected persons were excluded until three consecutive faeces specimens, collected on different days and at least 3 days after completing any antibacterial treatment, had been reported negative by the laboratory. If an outbreak reached large proportions, closure of severely affected classes was sometimes necessary. Sometimes two infected classes were found to be sharing the same toilet facilities – for example a boys' lavatory. No child would be re-admitted to these classes until they had negative bacteriological reports. In the meantime there was thorough cleaning of the premises.

Antibacterial drugs were not useful in the control of infection. Indeed, in the majority of cases studied *Sh. sonnei* persisted in the stools after appropriate drug treatment (Thomas & Tillett, 1973; Thomas *et al.* 1972).

Prevention

Preventive exclusion of gastroenteritis suspects was policy in the schools regardless of whether dysentery was currently prevalent. Good communication with the head teacher was important. Schools kept a stock of outfits for collecting specimens from children with symptoms of gastroenteritis. Such children were excluded from school by their teacher and given a faeces container and a printed envelope form for supplying name, age, address and school to the M.O.H. They were not re-admitted until a negative report had been sent from the laboratory to the M.O.H. and public health department.

It was considered that these measures for the prevention and control of outbreaks had a good effect. Despite intensive efforts to examine specimens from all suspects, index infection was never confirmed in more than 16 % of the school population during any outbreak. These proportions do not include infected sibs. Nevertheless they are considerably lower than the two-thirds usually quoted for an uncontrolled outbreak (Annotation, 1966). A large part was played by the policies of school exclusion and screening of suspect contacts since over half the infections in school outbreaks were *MOH index infections*.

DAY-NURSERIES

Only one of a number of day-nurseries in the area continued throughout the period of study. This unit, of about 55 places, suffered four dysentery outbreaks, the largest of which affected 28 (51 %) of infants. Every nursery was affected at some time.

Prevention of outbreaks of dysentery in day-nurseries was attempted by screening new entrants and children returning from residential institutions or hospitals, as these were the children who often introduced infection. It was usually practicable to screen these children before arrival, but occasionally specimens were taken on the first day and the children segregated until cleared. Any child attending a nursery who developed diarrhoea or vomiting was isolated and then excluded until bacteriologically cleared.

The procedure described for controlling outbreaks in primary schools was not found adequate at day-nurseries or nursery classes. Here prompt closure was more effective. The nursing hygiene was good in these institutions, but could not prevent case-to-case infection between incontinent toddlers. If two or more cases of dysentery were confirmed it became the practice to close the nursery for 3 days and wash it down with phenolic disinfectant. Thereafter staff and children could be re-admitted, provided that they had a minimum of two negative reports on faeces specimens. Observations were made in Edmonton between 1950 and 1954 of five nursery outbreaks where this closure procedure was followed, and four outbreaks where there was no closure but merely exclusion of infected persons. In the former a total of 168 children lost an average of 15·7 days attendance and 46 % became infected, and in the latter 154 children lost 18·8 days each and 63 % became infected. In the nurseries practising closure the premises were 'infected' on average for $8\frac{1}{2}$ days and a mean of 5·0 specimens were examined per head compared with 30 'infected' days and 7·5 specimens tested per head at the nurseries practising exclusion. Although it cannot strictly be concluded that these differences resulted from the differences between procedures, a policy of closing infected nurseries for a period of 3 days was continued because of the apparent benefit in cost of time and effort. The nursery supervisors were given direct access to the laboratory service for testing faeces specimens and they were responsible for isolation and exclusion.

SEASONAL PATTERN OF INFECTION

To the pertinent question 'Where does dysentery go in summer' we would answer that we have observed a link between dysentery outbreaks and infant-school toilet facilities. Dysentery bacilli deposited on surfaces survive longer in cold dark damp conditions than in warm light dry surroundings. The degree of contamination of lavatory accommodation by any one infected person is therefore likely to be greater in winter. The long summer vacation eliminates opportunity for cross-infection by congregation in communal toilets and interrupts the chain of transmission. In the autumn term a large number of 'virgin' infants, susceptible to dysentery, arrives at school for the first time and, if infection is offered by a convalescent excreter or carrier, a build-up of infected children can develop, sometimes quite rapidly. The Christmas holiday is not long enough to interrupt this significantly. By Easter, outbreaks tend to dwindle.

RECOMMENDATIONS AND DISCUSSION

Several recommendations arise out of this study of Sonne dysentery. Primary-school toilets should be equipped with foot-flushes, warm running water in unplugged basins, drip or powder soap and paper towels or blowers. Toilet use and hand washing should be supervised by special staff *not* involved in meals service. The teachers should be encouraged to exclude suspects and to re-admit them only after bacteriological clearance. During this study outbreaks were observed to follow the failure to exclude children who had recovered from an undiagnosed

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gastroenteritis but who were subsequently found to be excreting *Sh. sonnei*. Also some school class outbreaks appeared to be uncontrolled by the methods described, until symptomless excreters were detected and excluded.

Primary schools should be kept to a manageable size, especially with regard to the size of their infant department (perhaps less than 200 children under 8 years). Protection of older children could be achieved by keeping them separate from the infants, who are usually responsible for the spread of the disease. Supervision could then be concentrated on the susceptible infants.

The advice given in the 1971 Memorandum on Infectious Diseases in Schools (D.E.S., 1971) and in the guide issued by the Society of Medical Officers of Health and the Public Health Laboratory Service (1970) is not strict enough. In the former memorandum we would think it safer if bacteriological clearance were to be required for children under 11 years old (p. 14), instead of leaving this to the discretion of the M.O.H. or the principal school medical officer. In the latter guide we would like to see children in primary schools included with the younger children in the special category of 'Those most likely to transmit infection' (p. 197), as this would exclude such children from returning to school until free from infection.

Children of pre-school age in institutions present even greater problems in dysentery control. If closure is possible, this appears to be the quickest method of ending an outbreak. The development of more day-nurseries demands careful planning with this problem in mind.

Since this study the numbers of notifications of dysentery reported by the Registrar General fell sharply in 1969 and have remained at a figure which is about half that which was being reported previously. However, the amount of dysentery and gastroenteritis reported by the Royal College of General Practitioners Research Committee has increased during these years. Therefore a fall-off of interest in notification may account for part of the drop in the Registrar General's Reports. It is interesting to note in this connexion that the notifications and isolations of bacillary dysentery fell between 1946 and 1950 only to rise subsequently to unprecedented heights. Outbreaks in institutions continue to come to the attention of the Public Health Laboratory Service and there is no firm evidence that the disease is on its way out. Although Sonne dysentery is usually a mild disease the Enfield survey showed that 4 % of GP index cases were admitted to hospital and nearly half the remainder had cellular stools. The mortality rate for notified cases is about 0·1 % in England and Wales.

It seems likely that Sonne dysentery will continue to cause primary-school and nursery outbreaks. Indeed other gastroenteritis infections, such as Flexner and Shiga dysentery and possibly cholera, may cause school outbreaks in the future and so call for a similar approach to control and prevention. Since these can be differentiated with certainty only by laboratory methods, it is important to maintain bacteriological surveillance of all infective gastroenteritis. This would seem possible given active co-operation between laboratory, medical officers of health and their successor departments, general practitioners, nursery supervisors and head teachers. It is to be hoped that the reorganized health services in 1974 will continue to give clear responsibility within the local health department for the control of dysentery. The importance of a clear link between health department, school teachers and nursery supervisors must be realized.

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REFERENCES

ANNOTATION (1966). Sonne in schools. *Lancet* i, 584.

DEPARTMENT OF EDUCATION AND SCIENCE AND DEPARTMENT OF HEALTH AND SOCIAL SECURITY (1971). *Memorandum on the Control of Infectious Diseases in Schools.*

KENDALL, M. G. (1962) *Rank Correlation Methods.* London: Griffin.

SOCIETY OF MEDICAL OFFICERS OF HEALTH AND PUBLIC HEALTH LABORATORY SERVICE (1970). Dysentery and salmonella infections. *Public Health, London* **84**, 197–9.

THOMAS, M. E. M., HAIDER, Y. & DATTA, N. (1972). An epidemiological study of strains of *Shigella sonnei* from two related outbreaks. *Journal of Hygiene* **70**, 589–96.

THOMAS, M. E. M. & TILLETT, H. E. (1973). Dysentery in general practice: A study of cases and their contacts in Enfield. *Journal of Hygiene* **71**, 373.