

EPIDEMIOLOGY OF HAEMOLYTIC STREPTOCOCCAL INFECTION IN RELATION TO ACUTE RHEUMATISM

I. HAEMOLYTIC STREPTOCOCCAL EPIDEMIC AND FIRST APPEARANCE OF RHEUMATISM IN A TRAINING CENTRE

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(With 1 Figure in the Text)

INTRODUCTION

The reawakening of the rheumatic process in patients by respiratory infections, particularly tonsillitis, has been fully described by many observers including Raven (1923), Boas & Schwartz (1926-7), Hiller & Graef (1928), Schlesinger (1930), Collis (1931) and Coburn & Pauli (1935).

Reports concerning the appearance of rheumatism in apparently healthy communities after such epidemics have still further stressed the linkage between the two conditions. Thus Glover & Griffith (1931) and Bradley (1932) described outbreaks in schools after epidemics of haemolytic streptococcal tonsillitis. The circumstances under which a similar outbreak occurred in a training centre are here recorded.

TRAINING CENTRE Sd

The personnel of this establishment consisted partly of 188 apprentices, aged 15-17 years, divided into four classes of approximately fifty members named A, B, C and D. Class D was the most advanced and had been together for the longest period, while classes C, B and A joined in that order. In addition, there were approximately 360 trained men, the majority being in the age group 21-26 yr.

The community was shifted as a unit to temporary quarters in the country in May 1940. Near the end of September 1940, the new apprentices in class A were joined. Previously the members of this class had been at school or work in separated areas, and a 3-4 weeks preliminary course was their only experience as a unit.

The workshops and teaching rooms in the new quarters were reasonably adequate for the purpose and were used by both apprentices and trained men. The type of living accommodation, however, differed in these two groups. The trained men were billeted in private houses, whereas the apprentices were housed partly in semi-permanent wooden huts and also in a large country house. This house was in good repair and provided messing, recreation, and part of the dormitory accommodation, while the temporary huts supplied the bulk of the dormitory space. These huts had been placed on grass lawns beside the house without adequate approach roads. As a result of excessive rain, the huts became surrounded by heavy mud and were generally damp. Although there was no indication of overcrowding in the dormitories, the 'black-out' system considerably

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restricted ventilation at night. The recreation hours of the trained men were spent either in the privacy of their billets or elsewhere away from the centre. The only recreation room for the apprentices was a living room in the house, and it was unsuitable for the numbers making use of it. As a result the apprentices tended to spend several hours in the dormitories before turning in.

History of the outbreak

The health of the apprentices and other personnel during the summer months was excellent, relatively few cases of respiratory infection occurring. A survey of the records showed that in the 13 weeks of July, August, and September only twelve cases of tonsillitis were treated in the sick bay. During the next 12 weeks of October, November and early December, ninety-eight respiratory infections were admitted as follows:

No. of cases	Diagnosis
20	Scarlatina
51	Tonsillitis or pharyngitis
7	Sinusitis
8	Otitis media or externa
5	Bronchitis
7	Common cold

Chronological order of cases

Fig. 1 shows the occurrence of all notified respiratory infections in relation to time and indicates that the epidemic included most of the clinical manifestations of haemolytic streptococcal infection. Cases of scarlatina, tonsillitis and various secondary complications occurred at irregular intervals, with the greatest incidence during the week ending 29 October.

Class distribution of cases

The number of cases in relation to apprentice classes and trained men is shown in Table 1.

Table 1. *To show the distribution of cases in trained men and in classes of apprentices*

Diagnosis	Total no. cases	No. of cases in apprentices class					Trained men
		A	B	C	D	Total	
Scarlatina	27	14	8	4	0	26	1
Tonsillitis, pharyngitis	56	22	6	7	4	39	17
Sinusitis	7	2	2	0	2	6	1
Otitis	8	6	1	1	0	8	0
Common cold	9	5	0	0	2	7	2
Bronchitis pneumonia	6	2	2	0	0	4	2
Totals	113	51	19	12	8	90	23

The incidence of all conditions listed in the table among the trained men and apprentices was 64 and 474 per 1000 respectively over the period of observation, and emphasizes the extent to which the apprentices bore the brunt of the epidemic. The different classes of apprentices suffered in inverse proportion to the length of their existence as a unit, the youngest class, A, experiencing the greatest number of cases. Not only did most of the primary infections occur in this class, but complications such as otitis media were also more common. Class B presented the next highest incidence, and 78% of all infections in apprentices were divided between these two younger classes.

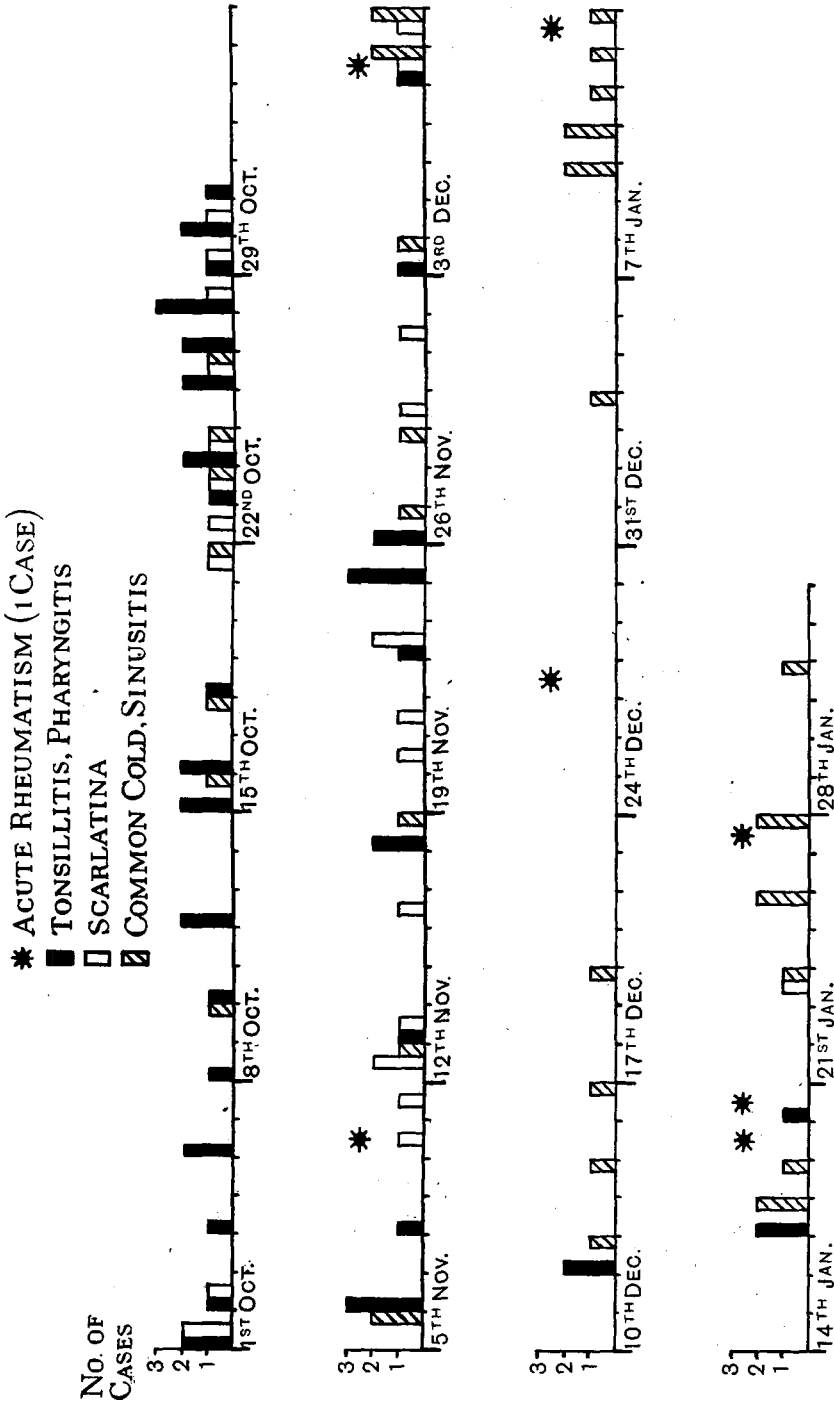


Fig. 1. To show the occurrence of all notified cases of upper respiratory tract infection, scarlatina and acute rheumatism.

Dormitory distribution of cases in apprentices

Classes A and B, with six exceptions, slept in the four dormitory huts, while classes C and D, with six members of class B, slept in the house. Classes A and B each occupied two huts and, as Table 1 shows, the respective totals for combined infections were fifty-one and nineteen. All but four of the fifty-one cases of scarlatina were in hut occupants.

Bacteriological examinations

Only a limited investigation was possible and consisted of the taking of throat swabs from all persons in the sick bay at the time of visiting the institution, the results being collected in Table 2. Of the fourteen sick patients, ten had haemolytic streptococci in the throat flora. An indication of the probable extent of streptococcal infection was given by the three positive swabs from the four out-patients.

Table 2. *Results of examination of throat flora for haemolytic streptococci from cases and attendants in sick bay, together with four out-patient boys*

No. of cases	Diagnosis	Results			
		-	+	++	+++
4	Tonsillitis	1	0	3	0
1	Otitis	1	0	0	0
1	Post-scarlatinal convalescent	1	0	0	0
1	Acute scarlatina	0	0	1	0
3	Subacute rheumatism	0	1	1	1
3	Injuries	1	1	1	0
1	Impetigo	0	1	0	0
4	Out-patients	1	1	0	2
Total 18		5	4	6	3

Dick test results

All the apprentices were Dick tested on 16-19 December 1940, the percentage results being as follows:

Table 3. *Result of Dick test*

Class	Positive	Negative	Pseudo-reaction
A	36.8	60.5	2.7
B	65.3	32.6	2.1
C	52.7	41.6	5.7
D	47.1	52.9	0

Classes B, C and D therefore showed a progressive reduction in Dick-positive reactors, according to the class age, as was expected. On the other hand, the proportion of susceptibles remaining in class A after the epidemic was only 36.8% as compared with the next smallest group, viz. 47.1% in the oldest class, D. Unfortunately, the pre-epidemic Dick reactions were unknown, but it was reasonable to suppose that the youngest and most recently formed group, namely, class A, contained at least as high a proportion of positive reactors as the 65.3% noted in class B, the next in age.

The ultimate effects of the epidemic were therefore not entirely disadvantageous, for the antitoxin immunity of class A was raised, probably as a direct result, above that of any other class.

Occurrence of acute rheumatism

At the time of writing, eight cases of acute rheumatism have been notified as follows:

Table 4. *Cases of acute rheumatism notified*

Name	Age	Designation	Class	1. Onset of rheumatism	2. Previous illness	Interval between 1 and 2 days
Oliver, C. D.	16	Apprentice	B	10. xi	Scarlatina 1. x	40
Newman, F.	16	"	A	18. xi	Tonsillitis 28. x	21
Hubbard, S. V.	16	"	A	19. xi	Tonsillitis 12. x	38
Horwell, F. G.	16	"	C	8. xii	Pharyngitis 1. x	69
Clarke, J.	16	"	B	21. xii	Scarlatina 12. xi	50
Payne, B. G.	17	"	B	19. i.	Nil	—
Hall, E. J.	16	"	B	27. i	Scarlatina 29. xi	59
Lillington, G. E.	16	"	A	20. i	Scarlatina 12. xi	69

All eight cases were in apprentices and all but one had already been admitted to the sick bay during the streptococcal epidemic, with pharyngitis or scarlatina.

DISCUSSION

The investigation provided a good example of the circumstances under which a typical outbreak of haemolytic streptococcal infection developed, with the subsequent appearance of acute rheumatism in boys previously healthy. It was unlikely that the recorded figures gave an indication of the full extent of the epidemic, for the apprentices, as a group, were keen to keep abreast of their class mates and were apt to conceal minor illnesses.

Factors which contributed to the outbreak were first, the introduction of the susceptible class A apprentices at a time when the risk of infection was high. As suggested by Dudley (1926) this probably resulted in an increase in virulence of the infecting organism in passage.

Following the increase in virulence, the number of clinical infections appearing in a given class varied with the age of the class and with the susceptibility of its members. Thus almost 80.0% of the cases occurred in the younger classes, A and B. Contrary to expectation, the ratio of the number of cases of scarlatina to those of tonsillitis and pharyngitis in class A was 1 : 1.5, and in class B was 1 : 0.75, which suggested that the members of class A had experienced greater contact with infection prior to the epidemic than had those of class B.

The Dick test results showed that the influence of the epidemic on the antitoxin immunity of class A was very considerable and, within a few weeks, produced an effect which, under normal circumstances, would have occupied many months.

The marked difference in the total incidence of respiratory infections, viz. 51, 19, 12 and 8 in classes A, B, C and D respectively, was a good example of the effect of herd immunity, the class of longest age showing the greatest percentage of survivors irrespective of the individual immunity.

Undoubtedly the second factor of importance was the lowering of resistance, induced partly by the damp conditions in and around the dormitory huts and the lack of adequate drying rooms. As a result, wet socks and boots were continuously worn, for there was a general reluctance to put more than one pair of boots into daily use. There was also a tendency for the boys to spend too little time in sleep and rest after a day which was fully occupied by a curriculum including both practical and theoretical work.

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The third factor was the high infection risk to which the apprentices were exposed, resulting from the overcrowded state of the recreation room and the close contact around the central-heating stoves of dormitories.

Acute rheumatism did not appear until the streptococcal outbreak had been in progress for some time, and all save one case had been involved in that epidemic. Moreover, all cases of rheumatism occurred in apprentices and, with one exception, in the two classes which were most seriously involved in the epidemic. Environmental features common to all classes, such as dietary factors and physical and mental stress, were thus completely occluded by the factor of preceding streptococcal infection.

SUMMARY AND CONCLUSIONS

1. The circumstances attending an outbreak of haemolytic streptococcal infection in a training centre, followed by acute rheumatism, are described.
2. The incidence of streptococcal infections in trained men and apprentices was 64 and 474 per 1000 respectively.
3. Of streptococcal infections 78·0% occurred in members of two younger classes of apprentices.
4. The eight cases of acute rheumatism were all in apprentices, seven cases being in the same two classes. All but one case had had tonsillitis or scarlatina during the epidemic.
5. The smallest percentage of post-epidemic Dick-positive reactors was found in the youngest class which had suffered most in the outbreak.

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