# AN ANALYTICAL STUDY OF ONE HUNDRED CASES

of

# RHEUMATIC HEART DISEASE IN CHILDREN

by

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## Introduction.

In this Thesis are given the results of an investigation into the social and medical histories of one hundred cases of rheumatic heart disease.

In the first section of the Thesis are given the clinical findings upon which the diagnosis of heart disease has been based. In the next section follows the incidence rates of acute arthritis, chorea, growing pains, tonsillitis and scarlet fever, discovered in the histories of these patients. The results of tonsillectomy in the prevention of rheumatism are given. In other sections the subjects of enquiry are the social circumstances of the patients, and the relationship between the environment of the patients and the incidence of rheumatism among them.

Two series of control cases have been used in these investigations, the first control series was a group of 600 children drawn from the same localities and schools as the rheumatic heart cases, and the second control series a group of 500 boys from a public school in the City.

The examination of all these cases was carried out in the schools and school clinics in Hull, and in compiling their case-histories, use was made of Medical Records from the Maternity and Child Welfare Department and the School Medical Department of Hull. These records gave a very full account of the past illnesses of the children and added greatly to the reliability of the histories recorded.

In the final section of the thesis are discussed and summarised the results from this enquiry.

Historical.

It has been customary to say that Guillaume de Baillou (1538 - 1616 Ballonius) was the first author to use the term 'rheumatism', although acute rheumatism described under the name 'arthritis', is imperfectly described in the Hippocratic books. Baillou's writings were published posthumously in 1642.

Sydenham in 1683 furnished a clinical description of the disease, distinguishing it from gout and saying 'it is commonest in the autumn, chiefly attacking the young'. He described the chronic form, and in 1686 described chorea. In 1776 William Withering of Shropshire discovered the therapeutic action of digitalis upon the diseased heart, the drug being introduced into the Edinburgh Pharmacopœia in 1793. David Pitcairn in 1788 first drew attention to the fact that the heart was often attacked by rheumatic fever, an observation which was attributed to him by Mathew Baillie in 1797.

In 1789 Jeuner described disease of the heart followed by acute rheumatism, illustrating his remarks by dissections. Carditis seems at first only to have included pericarditis, endocarditis being discovered later by Baillie in 1797.

In 1831 Bright pointed out the close relationship of chorea to acute rheumatism and the frequent occurrence of heart murmurs in chorea.

In 1900 Poynton and Paine described a diplostreptococceus isolated from pericardial exudates, blood cultures and valve lesions, which they named the diplococceus rheumaticus.

Recent measures taken in the treatment of heart disease in children have been the opening of special homes at Willesden by the Invalid Children's Aid Association, followed by the opening of the Kurandai Home at Hartfield by the same Association. In 1921 the Birmingham Corporation converted the residential cripple school at Baskerville into a home of recovery for rheumatic children. In 1926 the Metropolitan Asylums Board set aside one block of the Queen Mary's Children's Hospital at Carshalton for the treatment of children with rheumatic fever, endocarditis and chorea.

Recent reports on Rheumatic Heart Disease in Children include those published by the British Medical Association in 1926, (with a supplementary report in 1927), the Report of the Medical Research Council (No,114) upon 'Social Conditions and Acute Rheumatism', and the Interim Report upon the Incidence of Rheumatic Heart Disease in Gloucestershire, Somerset and Wilts (1931), by the Health Authorities of these areas.

The Diagnosis of Heart Disease.

In this investigation Heart Cases with a mitral systolic murmur have been classified as mitral regurgitation, although it was realised that rheumatic endocarditis of the mitral valve almost invariably meant stenosis of that valve to a greater or a lesser extent.

It was also realised that there was less certainty in the diagnosis of heart disease in cases showing a mitral systolic murmur only, and in these cases the diagnosis of mitral regurgitation was based upon the following points :-

(a) A rheumatic history.

(b) An explosive type of mitral systolic murmur, limited to, or maximal at the apex.

(c) An abrupt or tapping type of apex beat, localised in character.

(d) Diminution or absence of the second heart sound at the apex, with accentuation of the second sound at the pulmonary area.

(e) An accentuation of the first heart sound at the apex.

A second group of cases were labelled mitral stenosis or mitral stenosis and regurgitation. These included cases of advanced stenosis with loud rough presystolic murmurs accompanied by a thrill, as well as

diastolic or mid-diastolic murmurs, softer in quality and heard best with the patient lying on his back and slightly inclined towards the left side. These diastolic murmurs were heard over a very small area internal to the apex. They became presystolic in time with a fast pulse-rate and returned to mid-diastole upon the heart slowing down.

In a third group of cases clinical signs were found indicating disease of both aortic and mitral valves, while in a fourth group only signs of aortic valvular disease could be found.

The number of cases in each group is given in Table 1.

TABLE 1 - Types of Valve Lesions Found.

| | | | Number of Cases. |
|---|---|---|---|
| Group | 1. | Mitral Regurgitation ... ... . | 25 |
| Group | 11. | Mitral Stenosis or Mitral Stenosis and Regurgitation . | 55 |
| Group | 111. | Combined Mitral and Aortic Disease... ... ... ... ... . | 17 |
| Group | 1V. | Aortic Disease only ... ... . | 3 |
| | | | 100 |

Group 1. In this group of 25 cases, one case gave a history of chorea, two cases a history of growing pains and the remaining 22 cases all gave a history of acute rheumatism.

Group 11. In the second group of 55 cases, 13 were cases of advanced stenosis with loud rough presystolic murmurs accompanied by a thrill. A systolic murmur was heard in 12 of these 13 cases of advanced stenosis, and in two cases a diastolic as well as a presystolic murmur was heard.

In the remaining 42 cases of this group diastolic murmurs of earlier stenosis were heard.

These were mid-diastolic or early diastolic in timing but became presystolic with a rapid pulse rate on exercise.

Group 111. Combined mitral and aortic valvular disease was shown by 17 cases. The aortic valve lesion was diagnosed in 11 cases by an aortic diastolic murmur and in 6 cases by aortic systolic and diastolic bruits.

The accompanying mitral valvular lesion was diagnosed by :

A mitral presystolic murmur ... ... ... 3 cases.

Mitral systolic and diastolic murmurs . 6 cases.

Mitral systolic murmur only ... ... ... 8 cases.

Group 1V. In 3 cases aortic valve disease alone was diagnosed, regurgitant aortic murmurs being

CARDIAC ENLARGMENT - 18 of the 100 cases clinically showed cardiac enlargment, divided among the four groups as follows :-

Group 11. Mitral stenosis or mitral stenosis and regurgitation ... ... 10 cases.

Group 111. Combined Mitral and Aortic lesions ... ... . ... ... 8 cases.

Groups 1 and 1V. ... ... ... . ... ... Nil.

NODULES - These were found in one case only although a careful examination was made for them in every case.

In Table II. a comparison is made between these cases and similarly classified cases of heart disease in children which have been reported by the Chief Medical Officer of the London County Council (1) and by Seham (2).

TABLE II.

| | Present Series 100 cases. | L.C.C. Series 555 cases. | Seham. 281 cases. |
|---|---|---|---|
| | Per Cent. | Per Cent. | Per Cent. |
| Mitral regurgitation ... ... | 25 | 42·5 | 45 |
| Mitral stenosis or Mitral Stenosis and regurgitation | 55 | 46 | 41 |
| Mitral and Aortic disease ... | 17 | 7·5 | 9 |
| Aortic disease only ... .... | 3 | 4 | 3 |
| Pericarditis ... ... ... ... | - | - | 2 |

In the series of cases under review fewer cases of mitral regurgitation have been included and this has resulted in a corresponding increase in the percentage of cases in other groups.

The limitations of a clinical diagnosis are seen by comparing these findings, with Poynton's report on 150 post-mortem examinations on children with rheumatic heart disease (3).

| | Poynton's Series. | Present Series. |
|---|---|---|
| Mitral valve lesions ... ... ... | 65 per cent. | 80 |
| Mitral and aortic valve lesions | 10 per cent. | 17 |
| Mitral, aortic and tricuspid lesions ... ... ... ... ... | 21 per cent. | ... |
| Mitral, aortic, tricuspid and pulmonary valve lesions ... | 4 per cent. | ... |
| Aortic valve lesions only .. ... | ... | 3 |

## The Relative Frequency of Arthritis, Chorea, Tonsillitis, Growing Pains and Scarlet Fever.

An investigation was made into the relative frequency of arthritis, chorea, tonsillitis, growing pains and scarlet fever in the histories of the 100 selected heart cases.

A history in regard to arthritis was found to be much more reliable than a history of any of the other manifestations of rheumatism. In nearly all cases, after an attack of arthritis the parent gave a satisfactory account of the joints involved, the presence or absence of swelling and redness, the persistence of pain in the joints and the time spent in bed. There was little difficulty in distinguishing cases of sub-acute rheumatism from those with growing pains.

A history of chorea was found to be much less reliable than a history of arthritis owing to its confusion with habit spasm, while a history of tonsillitis was found to be the least reliable of all, as any type of sore throat was likely to be classed as tonsillitis. Fortunately the history in many cases could be confirmed or otherwise from School Medical Records.

No attempt was made to define 'growing pains' exactly. Pains in the limbs, or less commonly the trunk, which could not be ascribed to fatigue, injury, or any definite disease were classified as growing pains. Fatigue pains were expected in debilitated children with flabby muscles, or in children after prolonged or unusual exercise.

In Table III. below, the numbers of cases showing these various manifestations are grouped together. Rheumatism + means that the cases in this group showed other manifestations besides rheumatism, such as chorea or tonsillitis. The various combinations of these conditions are given in detail at the end of the table.

TABLE III.

Aetiology of Heart Disease.

| | | |
|---|---|---|
| Rheumatism ... ... ... ... ... | 29 | 74 |
| Rheumatism + ... ... ... | 45 | |
| Chorea .. ... ... ... ... ... | 4 | 16 |
| Chorea + ... ... ... ... | 12 | |
| Growing Pains ... ... ... ... | 5 | 40 |
| Growing pains + . ... ... | 35 | |
| Tonsillitis .. ... ... ... ... | 2 | 32 |
| Tonsillitis + .. ... ... | 30 | |
| Scarlet Fever ... ... ... ... | 0 | 7 |
| Scarlet Fever + . ... ... | 7 | |
| No history of any of these ... | 5 | |

| | | | |
|---|---|---|---|
| R + C ..... | 1 | R + G + T ..... | 9 |
| R + G ..... | 15 | R + G + C ..... | 2 |
| R + T ..... | 11 | R + C + T ..... | 1 |
| R + S ..... | 4 | G + C + T ..... | 1 |
| G + T ..... | 1 | G + S + T ..... | 1 |
| C + T ..... | 3 | R + S + T + G ... | 2 |
| G + C ..... | 3 | R + C + T + G ... | 1 |

R = Rheumatic Arthritis, G = Rheumatic pains,

T = Tonsillitis, S = Scarlet Fever, C = Chorea.

Rheumatic arthritis was given in the histories of 74 cases, either alone or combined with the other manifestations of rheumatism. Chorea, growing pains, tonsillitis and scarlet fever were much less common either alone, combined with rheumatism, or with one another.

The same fact was commented upon by Cabot (4) in an analysis of 93 post-mortems upon rheumatic heart disease cases in children. The frequency of these symptoms was given by him as follows :

| | |
|---|---|
| Rheumatic arthritis ... ... | 78 per cent of cases. |
| Chorea ... ... ... ... ... | 6 per cent. |
| Tonsillitis ... ... ... ... | 7 per cent. |
| No evidence of these ... ... | 9 per cent. |

Rheumatic Arthritis.

The majority of the 78 cases giving a history of Arthritis had a sub-acute type of disease and not the acute rheumatic fever so common years ago.

Nearly all these cases had a history of long standing. In three-quarters of the total number there was a history of rheumatism for two years or more before heart disease was discovered.

The ages of onset of rheumatism were very characteristic as seen below in Table IV.

TABLE IV.

| Age of onset in years. | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 & over | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of cases. | 0 | 2 | 5 | 11 | 13 | 14 | 9 | 13 | 8 | 3 | 0 | TOTAL 78. |

This table shows that rheumatism developed most frequently at 7 and 8 years of age, and that there was a sharp drop in the number of cases occurring after 12 years of age. This drop is exaggerated in the above table as most of the children left school at 14 years of age and were not available for examination.

The figures given correspond closely to those published by Poynton (5) in a series of 172 cases of acute rheumatism in children.

The most common age of onset in Poynton's cases was 7 years of age.

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Rheumatic Pains.

A comparison was made between the incidence of growing pains in the heart cases and their incidence in 600 of the general child population.

Two hundred children who had never suffered acute rheumatism were examined at each of the ages 5 years, 8 years and 12 years of age, and a history of growing pains was given by the parents in 9 per cent, 17 per cent, and 32 per cent of cases. The percentage of children with a history of growing pains over all three age groups was 19 per cent.

This is a lower figure than the 40 per cent of cases with rheumatic heart disease who gave a history of growing pains, and would seem to indicate that growing pains are commoner in cases of rheumatic heart disease, and are of some importance in the etiology of rheumatism. It is doubtful, however, whether any reliable conclusions can be drawn from a comparison between two sets of histories of growing pains, as there is a very large source of error through obtaining inaccurate histories.

An account of growing pains is not always correct in the case of children who have been in bed for weeks with rheumatism, and who are particularly prone to suffer from fatigue pains in their wasted, flabby and unused muscles.

The difference in the incidence of growing pains between the rheumatic heart cases and the control cases is therefore not so significant as it at first appears.

In 92 children who were examined when they were considered by their parents or their teachers to be suffering from growing pains several were suffering from obvious injuries to the muscles or joints, some were suffering from aching pains in their muscles after excessive or unusual exercise and others had aching limbs due to tonsillitis or other febrile illnesses.

Among the true growing pains cases it was noted that more than half of the cases had pains in the muscles of the front of the thighs, about 15 per cent had pains in the hamstring tendons, and that the remainder had pains in the calves of the leg, biceps, intercostals, pectorals or anterior tibial muscles. Frequently two or more groups of muscles were affected at the same time.

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Tonsillitis.

A history of sore throats was obtained in 31 of the 100 heart cases. It was thought that a history of sore throat would prove very unreliable, but comparison with other authorities shows a remarkable similarity in the percentages quoted. Miller (6) found this symptom in 33 per cent of cases, Bertram (7) in 28 per cent, and Poynton (8) in 31 per cent of cases.

An examination of the throats of the hundred heart cases was carried out, the results being given below in Table V.

TABLE V. - Condition of the throats examined.

| | |
|---|---|
| Number of cases with tonsils removed ..... | 25 |
| Number of cases with enlarged or septic tonsils | 32 |
| Number of cases with apparently healthy tonsils | 43 |
| | 100 |

In this examination cases showing tonsils with any suggestion of enlargement or sepsis, cases with enlarged tonsillar glands, and cases with redness of the anterior pillar overlying the tonsils were all included in the group of 32 cases.

Miller (9) found a much higher percentage (80 to 90 per cent) with septic tonsils in rheumatic children and stated that his diagnosis did not require revision in 5 per cent of cases.

Mackie (10) found infected tonsils in 58·8 per cent of his rheumatic fever patients.

The Results of Tonsillectomy in Preventing Rheumatism.

An analysis was made of the 25 cases who had had their tonsils and adenoids removed by operation. In 13 cases the symptoms of rheumatism first appeared after the tonsils and adenoids had been removed, in 8 cases there was rheumatism before tonsillectomy with a recurrence after this operation, while in only 4 cases was there no recurrence of rheumatism after the operation.

In the first group of 13 cases in whom rheumatism, chorea or rheumatic pains developed for the first time after tonsillectomy, the time at which symptoms appeared was as follows :-

Rheumatism.

| | | | |
|---|---|---|---|
| Onset | 6 months | after tonsillectomy ... | 1 case |
| " | one year | " " ... | 3 cases |
| " | three years | " " ... | 3 " |
| " | four years | " " ... | 3 " |
| | | | 10 cases |

Rheumatic pains.

Onset 2 years after tonsillectomy ..... 1 case.

Chorea.

Onset 3½ years after tonsillectomy ..... 1 case

" 7 years " " ..... 1 case.

In the third group of cases, i.e. those who had freedom from rheumatism after tonsillectomy, the periods of freedom from symptoms were 8 months, 9 months, 2 years and 5 years.

Mackie (10) found that only 57 per cent of the first recurrences of rheumatism developed within a period of 4 years following the first attack of rheumatic fever. In none of these four cases, therefore, could it be said that tonsillectomy had definitely ruled out any chance of the recurrence of rheumatism.

The number of cases given is not sufficiently large to make any general statement regarding the value of tonsillectomy. It can only be said that tonsillectomy did not prevent 21 cases from developing manifestations of rheumatism, although the operation was satisfactorily carried out by Ear, Nose and Throat Specialists in a large General Hospital.

Nutrition.

The nutrition of the heart cases was assessed by comparing their heights and weights with the standard heights and weights in the table published by the Chief Medical Officer to the Board of Education (11).

Fourteen children were subnormal in nutrition. These were either 15 per cent below the weight proportionate to their height, or their general tone was so poor that they could not be classified as having normal nutrition. The combined heights and weights of the hundred heart cases were found to be slightly below the average. These children were on an average 0·21 inch smaller and 0·67 lb. lighter than ordinary children.

These differences were so trifling that they might be explained by the accidental inclusion of a few undersized children in the heart diseases group. No real difference could therefore be found in the group of children with rheumatic heart disease when they were compared with normal children in regard to nutrition.

## The Incidence of Rheumatism and Heart Disease in Other Members of the Family.

An enquiry was made into the incidence of Rheumatism and Heart Disease among the brothers and sisters of the selected heart disease cases. Particulars were obtained in regard to 170 brothers and 178 sisters, the results being given below :-

TABLE VI. - Incidence of Rheumatism among Brothers and Sisters.

| | 170 Brothers | 178 Sisters | 348 Both Sexes |
|---|---|---|---|
| Acute rheumatism | 7 | 8 | 15 or 4·3 per cent. |
| Cardiac disease | 3 | 5 | 8 or 2·2 per cent. |
| Number dead from rheumatism. | 3 | 1 | 4 |

In an investigation carried out at St. Thomas's Hospital (12) among 614 brothers and sisters of rheumatism patients, the percentages of brothers and sisters found to have had rheumatism were 3.3 per cent, and with heart disease 3·1 per cent.

The incidence of rheumatism and heart disease in the two control series was carefully investigated. In the first series of 600 children from the same schools and same types of homes as the rheumatic heart cases, 23 children or 3·8 per cent were found to have had acute rheumatism, and another 5 cases or 0·8 per cent to have had rheumatic

heart disease. These rates are rather less than in the case of the brothers and sisters of the heart disease cases.

In the examination of the second group of controls, namely 500 boys at a public school in the City, a history of acute rheumatism was obtained in only 3 cases, two of whom had marked signs of rheumatic heart disease. It is particularly interesting to note that all the boys at this school were day scholars, that the home circumstances of two of the three rheumatism cases were below the average for the school, and that the third boy developed rheumatism after scarlet fever.

This investigation shows that similar rheumatism rates are to be found in the brothers and sisters of rheumatism cases as in children living in the same surroundings and in the same class of society, but that the rates of rheumatism and rheumatic heart disease are much lower in better-class children.

In this investigation it was also noted that the incidence-rates of scarlet fever, diphtheria, measles, chicken-pox and mumps were much less in the public school boys than in children of the other two groups.

## The Incidence of Rheumatism among the Parents of the Rheumatic Children.

The history of rheumatism in the parents of the rheumatic heart disease children was obtained from the mother. In 19 cases where the children were adopted, or illegitimate, or where the father or mother was dead, no satisfactory history could be obtained.

Of the remaining 181 parents, 9 were said to have had acute rheumatism, 5 to have had rheumatic heart disease and 2 to have died of rheumatic heart disease.

These figures cannot be considered reliable, firstly, as it was not possible to examine any of these parents, and secondly, as no distinction could be drawn between acute and 'chronic' rheumatism or between rheumatic and other types of heart disease.

of certain food elements.

No conclusive results were obtained regarding the influence of diet upon rheumatism, but the number of children receiving irregular and unsuitable meals was surprisingly large. It was considered that the recording of the child's diet was a very excellent method of directing the parent's attention to the proper feeding of the child.

Family Circumstances.

The family circumstances were considered unsatisfactory in 26 of the 100 heart cases. In these 26 cases the father was unemployed, in very irregular employment, dead, or on Parish Relief and there was no other satisfactory source of income available for the support of the family. The family budget for a week was obtained from the parent in all these cases, and a complete statement was received of the various sources of income upon which the family depended. The mother was frequently unable to state the exact amount earned by her husband, but she could always give the amount of money available for food, clothing, and upkeep of the children, which were the facts of importance in this inquiry.

Among 600 control children, none of whom had suffered rheumatism, the family circumstances were considered unsatisfactory in 174 cases or 29 per cent. This is a slightly higher percentage than that found in the rheumatism cases, probably due to the enquiries into the family circumstances being less searching in the control cases.

The conclusions drawn from this enquiry were that rheumatism in childhood could not be explained by poverty alone, as three-quarters of the cases examined were above the border-line of want, and as the proportion

of poor children among the rheumatism cases was very similar to the proportion of poor children found in the general population.

Dampness of Houses.

Reports upon the dampness of the houses of the rheumatism cases were obtained from their parents. In 31 cases a complaint of dampness of the house was made, and in 7 cases the house was stated to be exceptionally damp.

This method of investigation was not considered to be a very suitable one for the purpose and no enquiries were made in regard to the housing of the control cases, but it is interesting to note that the percentage of damp houses in the rheumatism cases approximated closely to that found in the Bristol Investigation (13), carried out with the aid of Sanitary Inspectors.

Diet.

The diets of the rheumatic heart disease children were recorded by their parents for one week. In an examination of the diet sheets returned by the parents it was found that a number of the children were intolerant to fats, that a few had perversions of appetite, and that in other cases the children were receiving insufficient food, or insufficient quantities

Distribution of Cases.

A spot map was made with indicators showing the houses in which the heart disease children first showed manifestations of rheumatism. There was no indication whatever that proximity to the sea or to the river had any influence upon the distribution of these cases.

Confusing factors such as differences in altitude, variations in the type of houses and concentration of poorer dwellings along the river were all absent.

The city is situated on flat land. All the houses are built on clay soil, and three quarters of them are of the four-roomed terrace type.

There was a very even distribution of cases in all wards of the City except in the residential areas, where very few cases were found. A surprisingly large number of cases were found attending a school in one of the large Corporation Housing Estates, but on careful inquiry it was found that all of these cases had developed rheumatism in other quarters of the town. Some of the families had moved their homes to that outlying suburb to benefit the health of their children with rheumatism, and in the other cases the families had been removed as the result of slum-clearance schemes.

Discussion.

In planning this Thesis, it was intended that a study should be made of the factors of importance in the etiology of rheumatism. It was proposed that the incidence of these predisposing factors should be compared in the rheumatism and control cases.

A preliminary examination carried out along these lines gave such exceedingly unreliable results that this project was abandoned.

An explanation of these unreliable results might be obtained if rheumatism is an infectious disease due to a streptococcus, and dependant for its onset upon two main factors, a lowering of the patient's resistance towards infection, on the one hand, and massive infection by the streptococcus on the other.

Lowering of the patient's resistance towards infection might be due to a vast number of different causes.

Overcrowding, dampness of the dwelling-house, lack of sunshine, poor ventilation, smoky atmospheres, lack of sanitation and cleanliness, chronic ill-health, chronic respiratory and alimentary catarrhs, septic tonsils, nervous strain, less sleep and relaxation, irregular meals, poor and unsuitable food, vitamin deficiencies, hereditary predisposition or acute illnesses, all would have to be considered as

predisposing causes of rheumatism. The futility of trying to explain the occurrence of every case of rheumatism by the presence of septic tonsils or by the dampness of the house, becomes evident. As a corollary might be mentioned the impracticability of preventing rheumatism by removing the tonsils. Favourable results from this operation could only be hoped for in a few cases.

The higher incidence of rheumatism among poorer children might readily be explained by comparing rheumatism with infectious diseases such as diptheria and tuberculosis, in which poorer children are more frequently infected than better-class children.

Many fallacies become evident in the method mentioned above when it is used in an investigation of the etiology of rheumatism.

In making a comparison of rheumatism and control cases, two points should be considered :-

(1) The occurrence of a particular etiological factor in either the rheumatism or the control group may be accidental in a certain number of cases, that is, in only a percentage of the cases in which it is found, could it actually cause rheumatism.

(2) There may be so many factors of importance in the causation of rheumatism that each individual factor may influence only a small number of cases. This may not increase the incidence of any particular factor in the rheumatism group to a significant extent.

Two examples given below may illustrate a few of the fallacies which occur in applying this method to an investigation of the etiology of rheumatism.

In two of the hundred heart cases rheumatism followed the extraction of carious teeth. Comparison between the rheumatism and the control group showed that many more of the control cases had had extraction of carious teeth. No conclusive results could be expected from such an enquiry.

In comparing the occurrence of enlarged and septic tonsils in the rheumatism and control groups the sources of error are very great. The first complication encountered is the fact that variable numbers of cases in each group have had their tonsils and adenoids removed by operation, and that there is no exact information as to the condition of the tonsils before operation in these cases. Another difficulty encountered is that of making an exact diagnosis of septic or healthy tonsils. Apart altogether from the very variable appearance of the tonsils, the examiner may be subconsciously influenced in his diagnosis, if he knows which cases are rheumatic and which cases are controls.

When, finally, the cases have been divided into groups with enlarged or healthy tonsils, a comparison has to be made between :-

Rheumatism Cases with

(1) Tonsils enlarged and septic and which have actually caused rheumatism.

(2) Tonsils enlarged and septic but of no importance in the causation of rheumatism.

Control Cases with

(3) Tonsils enlarged and septic and of no importance in the causation of rheumatism.

(4) Tonsils enlarged and septic and which would have caused rheumatism but for the resistance of the patient.

Variation in any of these four groups will alter very considerably the results obtained. This method is therefore not a reliable one to adopt in studying the influence of septic tonsils upon rheumatism.

One is also driven to the conclusion that this method of comparing controls with rheumatism cases is not a satisfactory method of studying the etiology of rheumatism, if rheumatism is due to infection by a streptococcus.

Summary.

1. One hundred rheumatic heart disease cases in children were collected and classified.

2. Rheumatic arthritis of an acute or subacute type was found in the history of 74 per cent of cases. Arthritis developed most commonly at 7 or 8 years of age and its onset after 12 years of age was much less frequent.

3. Rheumatic pains were found to be twice as common in the heart disease cases as in the controls.

4. A number of control cases were observed while actually suffering from rheumatic pains. The muscles in front of the thigh were affected in 55 per cent of cases and the hamstrings in 15 per cent. Frequently more than one group of muscles were affected at a time.

5. Histories of sore throats were obtained in 31 per cent of cases. Of the 100 cases of heart disease, 32 cases had septic tonsils and 43 cases had apparently healthy throats.

6. Tonsillectomy failed to prevent the onset or the recurrence of rheumatism in 21 out of 25 cases.

7. The incidence of rheumatism was more frequent in the brothers and sisters of the heart disease cases than in two control groups. In the second control group of better-class children rheumatism was strikingly

less frequent. It was noted that infectious diseases were also much less frequent in better-class children.

8. The nutrition of the heart disease cases was not appreciably different from that of ordinary children and the percentage of children in poor circumstances was much the same as in the first control group.

9. A third of the children were living in damp houses.

10. The distribution of cases in the City was definitely not affected by their proximity to the river or sea. The cases were evenly distributed in all wards of the City except the residential areas, where cases were very infrequent.

11. The method of comparing rheumatism cases with controls gave very fallacious results when applied to an investigation of the causative conditions of acute rheumatism.

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I have pleasure in acknowledging the very valuable help received from Dr. D. C. Muir, Senior Physician, Hull Royal Infirmary in the diagnosis of rheumatic heart disease in several of the cases used in this Thesis.

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In all other respects this Thesis is my own unaided work.

(Signed)