THE EFFECTIVENESS OF ROUTINE EXAMINATION OF SCHOOLCHILDREN

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Most children are medically examined at least three times during their school life. This is a matter of routine, whether they are ill or not. The examinations, known as the "periodic medical inspections," are made by the School Health Service. Further, under the system of compulsory national service which has been in force since 1939, a large proportion of boys aged 18 are medically examined to determine their fitness for service with the armed Forces. The rejection rate because of physical and mental defects is about one in five. In view of this, it seemed interesting to try to relate the findings of these pre-service examinations to those of the school doctors, who usually make their last examination between three and four years earlier.

There was available from another study (Lee, 1957) copies of the records of a series of these medical examinations made before national service, and a group of these were matched with the records of the School Health Service dealing with the same individuals. It was at once clear that there were few important defects recorded by the school doctors that were not also noted at the pre-service examination. But there were many defects leading to rejection that were not mentioned on the records of the School Health Service. This disagreement was not limited to defects that might have been expected to arise for the first time between the medical examinations of school leavers—mostly during the fifteenth year—and the medical examinations before national service—mostly during the early months of the nineteenth year.

The findings of this pilot inquiry raised questions about the effectiveness of the periodic medical inspections as a means for the detection of important disease in schoolchildren. After consultation with the Ministry of Education, which is the central department responsible for the School Health Service in England and Wales, a further inquiry on similar lines and on a larger scale was undertaken. The number of men who are accepted for national service and then found to have serious defects is very low (*Brit. med. J.*, 1956), and as there was thus no reason to believe that many defects were missed at the pre-service examinations, the further studies were limited to those who were rejected for service on medical grounds.

School Medical Records of Men Rejected for National Service in 1953-4

From the original studies of National Service recruits there were available copies of the records of a representative sample numbering 7,416 men, of whom 1,358 had been found to be unfit. The school medical records of these unfit men were sought from the appropriate local authorities, only those few being ignored who had been to private schools or schools outside Britain. The school medical records of 450 of these 1,358 men were eventually obtained. This appears to be a very poor result. However, it should be noted that nearly all the records that could

not be traced belonged to authorities which, because of storage difficulties, destroyed all their records quite soon after the boys left school. In fact, the distribution of causes of rejection among the records that were satisfactorily paired off was similar to that among those which were not. There is no evidence that this loss of data from the comparison was selective in a way that would affect the result.

These 450 men suffered from 477 defects that caused rejection. Of these 477 defects present at the age of 18 or a little older, 238 (50%) were recorded at some time on the school medical records. An analysis of these defects by some of the more important causes is given in the Table.

Number of Defects Causing Rejection for Service and Number and Percentage Noted on School Medical Records

Type of Defect	National Service Men*			R.A.F. Boys		
	No. of Defects	Defects Noted on School Medical Records		No. of Defects	Defects Noted on School Medical Records	
		No.	%		No.	%
Defect of vision ..	45	37	82	88	88	100
Chronic otitis media	75	38		53	16	
Asthma	29	16		6	6	
Skin conditions ..	17	3		15	5	
Nocturnal enuresis	15	2	47	3	2	43
Cardiac defects	28	16		7	4	
Other defects ..	268	126		44	23	
All types of defect ..	477	238	50	218	144	66

* Throughout this study men examined before national service have been referred to as National Service men, although rejected. Similarly, boys examined for boy entry to the R.A.F. were referred to as R.A.F. boys, although rejected.

The proportion of defects noted varied widely from condition to condition. Thus very few men rejected because of defective vision had school records showing normal eyesight, while at the other extreme, as might be expected, very few of the men rejected because of tuberculosis had records of this on their school documents.

School Medical Records of Boys Rejected by the Royal Air Force in 1955-6

In addition to adults, the Services also recruit boys soon after leaving school for training as technicians in the Regular forces. These boys are also medically examined before acceptance. As these examinations are much closer to the final periodic medical inspections of the School Health Service a comparison between them would be interesting in view of the discrepancies found between the examinations before national service and the school ones. If the interval between school-leaving and national service is a period when there is an abrupt but so far unrecognized increase in the prevalence of defects in males, the agreement between school and pre-service examination should become closer as they become nearer in time. A comparison between the pre-service examinations of such boys with the periodic medical inspections has the further advantage that the boys are volunteers who want to make the Service their careers. There would thus be little likelihood of their making the most of trivial defects as some National Service men might.

The records of a sample of 247 boys who had volunteered for Boy Service with the R.A.F., and been rejected, were obtained through the courtesy of the Air Ministry, and the corresponding school medical records were obtained for 210 of them. This represented a loss of 15%, compared with the 65% loss of the records of National Service men. Again, the distribution of defects among those records that were not matched with the school documents was closely similar to that among those that were. The 210 boys suffered from 218 defects that caused rejection. The proportion of school records that had on them a mention of the cause of rejection was 66% (see Table). This proportion is higher than in the National Service men (see above), where

it was 50%. This improvement was due to the greater proportion of the volunteer R.A.F. boys who were rejected because of defects of vision. These have been regarded as noted on the school records if any departure from the normal was recorded, because of the possibilities of rapid change of visual acuity at this age. When this convention is used, the agreement between the pre-service examinations and periodic medical inspections is almost complete.* If the defects of vision are removed from both series (see Table), the proportion of defects causing rejection that were noted on the school records becomes for the R.A.F. boys 43%, and the corresponding figure for the National Service men 47%.

The average interval between the medical examination of these boys by the R.A.F. and the last recorded periodic medical inspection of the School Health Service was 20 months. This period was greater in some boys because there was no record of their being examined as "school leavers" by the School Health Service. If the 25 boys who had no record of being seen by a school doctor after their thirteenth birthday† are excluded, the average interval between the examinations falls to 16 months, while the proportion of defects other than those of vision noted on the school medical records of these boys remains at 42%.†

As the R.A.F. boys had selected themselves for the examination by volunteering for the Service, the distribution of defects among them was different from that among National Service men. Thus there were fewer cases of asthma, enuresis, cardiac defects, or low intelligence, although there were proportionately more cases of eye defects and chronic otitis media. Of the 55 boys rejected because of chronic otitis media, 16 had the condition noted on their school medical records. The R.A.F. standards are higher than those for national service, but of the 16 cases that were active at the time of the pre-service examination only 6 were recorded by school doctors. Of 10 rejections because of other E.N.T. conditions, such as deafness due to other causes or chronic sinusitis, 2 were noted on the school medical records. As with the National Service men, the proportion of skin defects noted on the school records was not high. There were six asthmatics in the R.A.F. sample, and all of them were noted by school doctors, as were two out of the three enuretics.

Cardiac Defects

Cardiac defects are particularly interesting because of their importance to the individual; because of the accessibility of some to surgery; and because the examination of the chest by hand and eye and with a stethoscope is part of most "periodic medical inspections." All of the boys rejected because of cardiac defects had signs that were found by non-specialist doctors, and all were subsequently confirmed by a consultant. Thus even those defects of small immediate consequence can be used as indicators of the effectiveness of the "periodic medical inspections" which the boy had undergone. Of course, not all the possible cardiac defects referred to consultants from the initial R.A.F. examination were confirmed.

Of the 28 National Service men who were rejected because of cardiac lesions, 12 had no note of the condition on their school medical records. Four of the lesions not noted were described as congenital in origin. The following records are illustrative. In the second one, and in all the subsequent ones, the quotations are from the reports of consultants to whom the men were referred at the pre-service examination.

*Here the long interval between the school examination and that before national service is important, as seven of the men rejected because of defective vision without anything being noted on the school records had either lost an eye by trauma or suffered from choroiditis.

†In these studies 13% of the National Service men and 12% of the R.A.F. boys had no record of being examined by a school doctor after their thirteenth birthday. Curiously, this apparent omission made little difference to the proportion of defects diagnosed.

1. As a pre-school child he was in hospital for one year with rheumatism. In a letter from the authority it was stated that "he was examined at the routine medical inspection in March, 1949 (that is, aged 13 years and 5 months), and there is nothing on the card to indicate that the boy was not a normal boy." Subsequently, while still at school, he was discovered by his family doctor to have "severe morbus cordis." At the time of his examination before national service he suffered from severe aortic valvular disease, with an apical diastolic bruit and Corrigan's pulse.

2. "Heart enlarged to sixth space; systolic and diastolic bruit at base; aortic sounds almost absent. E.C.G. right axis shift. Congenital heart." This man was seen by a school doctor at four periodic medical inspections, the last at the age of 14 years 7 months. At this he was passed fit for any kind of work. At no time was there any note of any cardiac abnormality. The school and National Service records agree on name and date of birth, and give addresses in the same small village.

In the sample of R.A.F. boys, seven were rejected because of cardiac defects. On the school medical records three had no lesion noted. The information on the clinical condition is more detailed for the R.A.F. boys than it is for the National Service men. This information for the three whose condition was not noted is given below.

3. "Systolic thrill at aortic area. Loud systolic murmur at aortic area. B.P. 130/80. No history of rheumatic fever. I think he has aortic stenosis. It is difficult to be absolutely certain. The B.P. is against a coarctation." There is no note of this lesion on his school cards, but according to the record he was last examined in 1951, at the age of 11 years 4 months. The R.A.F. examination took place at the age of 15 years 6 months. The R.A.F. and school records agree on name, school, and year of birth.

4. "Grade 3 systolic murmur is maximal at pulmonary base. More marked when lying down and in full expiration. The cause of his systolic murmur is obscure, but in view of its intensity I think it is of significance." The boy underwent three periodic medical inspections, the last at the age of 13 years 8 months, 22 months before the R.A.F. examination. There was no mention of any cardiac abnormality on the school medical records. The R.A.F. and school records agree on name, school, and year of birth.

5. "Exercise pulsation neck—collateral arteries palpable and can be seen between shoulder-blades. Absent arterial pulsation lower limbs. Loud long systolic murmur, maximal left upper sternum—left shoulder and back. No diastolic element. Heart screening. Left ventricle slightly prominent. Abnormally small aortic knuckle. This boy has coarctation of the aorta." The boy was medically examined four times in the course of his school career, the last time at the age of 15, 14 months before the R.A.F. examination. There was no note of any cardiac lesion on the school medical records. The R.A.F. and school records agree on name, school, and year of birth.

In order to obtain more information about the diagnosis of cardiac lesions at the school periodic medical inspections, the records of boys rejected for this reason were extracted from yet a further series of pre-service R.A.F. examinations. There were six boys with cardiac defects in this series, and three had no note of the condition on their school medical documents. The details of these are given below.

6. "There is a blowing systolic murmur at the base, and a blowing diastolic murmur over the second and third left inter-spaces. Probably rheumatic, although patent ductus is not excluded." This boy was examined twice during his school career, the last time at the age of 8. The R.A.F. examination was at the age of 15. There was no note of a cardiac defect on the school medical records. The R.A.F. and school records agree on name and year of birth. There is no note on the school medical record of the name of the last school.

7. "Heart not enlarged clinically. Mitral systolic murmur more marked in full expiration. A localized low-pitched diastolic murmur is present in the mitral area also. Screening shows a normal cardiac outline. I think he has an early mitral stenosis." This boy was examined twice during his school career, the last time at the age of 15, six months before the R.A.F. examination. There was no note of a cardiac abnormality. The R.A.F. and school records agree on name, school, and year of birth.

8. "Heart sounds—1 and 2 normal. In addition there is a third heart sound in mid-diastole. There is a loud blowing systolic murmur audible all over the praecordium, and a mid-

diastolic murmur locally audible after exercise at the apex. Suggestive of rheumatic cardiac disease." This boy was examined four times, the last time at the age of 14 years 2 months, 2 years and 10 months before the R.A.F. examination. There was no note of a cardiac abnormality. The R.A.F. and school records agree on name, year of birth, and town. The name of the school is not given by the R.A.F.

Discussion

In the comparisons between the recorded findings of the examinations of men before entry into the Services and the recorded findings of the School Health Service it has been found that little more than half the defects that caused rejection were mentioned on the school medical records. While for some types of defect—for example, defective vision—there was good agreement that some variation from the normal existed, for others—for example, chronic otitis media—there was not. Some of the defects that caused rejection, such as congenital defects of the heart, had been present since birth, and some, like nocturnal enuresis, had probably been present for many years. The proportion of these noted on the school medical records was no higher than that of other types of defect, such as chronic otitis media, that *could* have developed for the first time between the two examinations. However, if the development of new defects between the two examinations did account for a large proportion of the discrepancies, there would have to be a very great increase in the prevalence of, for example, chronic otitis media in the months after school-leaving.

Following the communication of the results to them, the Ministry of Education made a "Special Inquiry" into the diagnosis of defects at the "periodic medical inspections." This was limited to otitis media and to school-leavers. The results have not yet been published in detail, but in three county boroughs it was found that about 1% of school-leavers had active otitis media (Henderson, 1957). The figures for children of all ages in these towns before the Special Inquiry was about 0.4%, and the national average is 0.3% (Ministry of Education, 1957). The prevalence of the disease is lower in older children (L.C.C., 1955), so that the figures from the Special Inquiry should be lower than the ones for all ages if the methods of case-finding were equally effective. Thus the special examination in these three towns resulted in between two and three times as many cases being found as ordinarily. There is no evidence that the position in these three areas is in any way unusual.

There are very large differences between the prevalences of disease among schoolchildren reported to the Ministry of Education by different local authorities. Thus in a series of county boroughs whose records had been collected for another purpose the number of children reported as having active otitis media ranged from 0.4 to 9.8 per 1,000. The real prevalence of otitis media does vary from place to place (Lee, 1957), but a factor of 24 in a small series not selected with this in mind is difficult to relate wholly to variations in the disease or to legitimate differences in interpretation. Similar thirty-fold variations have been reported recently for squint, and fifteen-fold ones for cardiac defects (Henderson, 1957).

It has been postulated that a large part of the discrepancies observed in the comparisons between pre-service examinations and periodic medical inspections are due to defects being recorded by school doctors on loose slips of paper which are subsequently lost. When the records of the R.A.F. boys were asked for, a special request was made that they should be complete. This did not substantially alter the findings. If the average standard of record-keeping is such that a major part of the discrepancies found in these studies were in fact produced in this way, the consequences for the children are likely to matter as much as if they were the results of any other type of flaw in the system. It has also been postulated that these discrepancies are the result of the carelessness of a few doctors. The records used refer to large numbers of examinations made in nearly every area of the country, and this seems an unlikely explanation.

Similarly, "observer error" as usually understood does not seem likely to be an important source of these discrepancies. The conditions under which the pre-service examinations and the examinations of the Ministry's Special Inquiry were made were all more advantageous than those usually present when periodic medical inspections are made. These advantages do not invalidate the comparisons, for if the periodic medical inspections did in fact lead to the discovery of a high proportion of the important defects that the children suffered from, there would be few discrepancies, however elaborate the other examination.

Studies of the working of the School Health Service's system of periodic medical inspections are relevant to the general problems of the use of routine medical examinations. They also touch on some aspects of the wider problem of the assessment of the quality of medical care (Morris, 1957). In the routine medical examination the usual links between doctor and sick patient are not present, or at least are highly modified. There are indications from the comparisons that have been made that the diagnosis at the periodic medical inspections of some conditions where the history is important is not very reliable. This appears to apply to some cases of asthma, to epilepsy, and to enuresis. It is apparently confirmed by the difference that exists between the proportion of children known to the School Health Service to suffer from epilepsy (1.2 per 1,000) (Henderson, 1953) and the proportion of young men rejected for military service because of this (5.4 per 1,000) (Ledebor, 1949; Ministry of Labour and National Service, 1954; Lee, 1955). The contrast is even greater between the 1.6 per 1,000 children found by the School Health Service to need help because of problems of "psychological stability" (Ministry of Education, 1956) and the 80 per 1,000 found by the surveys of the official Committee on the Maladjusted Child (Ministry of Education, 1955).

Routine medical examinations do not provide the same satisfactions to many doctors that therapeutic work does, and it is possible that these examinations can only be made with full efficiency for a limited time. The Ministry's Special Inquiry suggests that this may be a real problem. In this doctors changed over from their previous practice of examining with an auriscope only those children with suggestive histories to examining them all with this instrument. Many more cases were found, and this improvement has been confidently ascribed to the change in technique. However, in other centres where all children have been examined in this way for years, the number of cases found is not far from the national average. It thus seems possible that the stimulus of taking part in the Special Inquiry was important.

Routine examinations provide those making them with much less information about their success or comparative failure than does the ordinary practice of clinical medicine. It is thus difficult to design a system of routine examinations unless special studies of the problem are made. It is even more difficult to keep such a system closely adapted to a rapidly altering situation without them. It is necessary to have reasonably accurate information about the present, and likely future, distribution of the defects that the examinations are designed to detect; and good evidence that the examinations will, as actually performed, detect a high proportion of them. Neither of these conditions is met by the mere existence of a system of routine examinations, and neither has been fulfilled for the system of periodic medical inspections of the School Health Service. Routine medical examinations may be the best answer to a health problem, but they do require careful planning and evaluation.

No adequate studies have been made to establish the facts of the situation at the present time. There is extremely little information about the number of important defects that exist in the child population to-day, undiagnosed by other means, and no direct studies have been made of the proportion of these that can be detected by present-day school doctors working under present conditions. It is appropriate

to compare the information available about the place of these examinations, and their effectiveness, with that available about two other topics of comparable importance to the health of children—the effectiveness of whooping-cough vaccine (Medical Research Council, 1951) and poliomyelitis vaccine (Poliomyelitis Vaccine Evaluation Center, 1955; Medical Research Council, 1957).

Summary

Only about 60% of the medical defects that cause the rejection of young men for military service are recorded on the documents of the School Health Service. This proportion is largely independent of the interval between the examinations at school and the pre-service examinations, and the discrepancies between the records are not limited to defects that might have developed in this interval. There is little information available about the effectiveness of the "periodic medical inspections" of the School Health Service, and there is need for their reassessment.

This study was made possible by the generosity with which principal school medical officers of very many local authorities lent their records. The Ministry of Education gave the inquiries its support, and members of its staff have given many hours for the discussion of the material. The Ministry of Labour and National Service and the Royal Air Force made the original records available. I am most grateful to Professor J. M. Mackintosh, without whose encouragement the project would never have been started, and to Dr. J. N. Morris, Director of the Social Medicine Research Unit, for much valuable criticism.

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VIRUS RESEARCH SUPPORTED BY THE ROCKEFELLER FOUNDATION

This year the Rockefeller Foundation will spend over a million dollars on its virus research programme, \$150,000 more than last year. The money will be shared between the Foundation's central virus laboratories in New York, professional field staff, and the five "co-operative" field laboratories in India, South Africa, Trinidad, Brazil, and California which the Foundation helps maintain.

A good example of the value of these field laboratories was provided last year during the outbreak of Kyasanur Forest disease in Mysore. A rumour reached the laboratory in Poona in March that numbers of monkeys were dying in Kyasanur Forest. Could this mean that yellow fever had spread to India? A virus team went at once to Mysore to investigate. It soon established that the epidemic, which affected men as well as monkeys, was not yellow fever but was caused by a hitherto unknown virus carried by ticks. The epidemic eventually involved several hundred square miles of forest, with at least 500 known human cases and over 70 fatalities, before it died down with the arrival of the monsoon. A vaccine against Kyasanur Forest disease was prepared in the United States, and this year the Indian Government, aided by a grant of \$100,000 from the Rockefeller Foundation, is able to offer vaccination to those in the infected area.

Programme of Research

In its latest quarterly report* the Rockefeller Foundation discusses its programme of virus research. Work is being concentrated on viruses carried by arthropods. Most of these viruses, states the report, fall into two well-defined groups, known as A and B. All the members of group B, the group most intensively studied, have some relationship to each other, and within the group there are families of very closely related viruses. The new Kyasanur Forest virus from India, for instance, is chemically so like the viruses which cause Russian Spring-Summer encephalitis and Omsk haemorrhagic fever that only the most delicate tests will differentiate them; the virus of Japanese B encephalitis, which is encountered periodically in California, and West Nile fever virus belong to another such complex. These close relationships assist in the rapid identification of unknown viruses, for representative group-B viruses can be used to test in a single operation whether an unknown virus belongs to the group or not. They also pose interesting epidemiological questions. For instance, a man in the Amazon basin who recovers from an attack of Ilhéus virus fever develops antibodies which give him a fairly high degree of immunity to West Nile virus, a virus he is most unlikely to encounter. There is also the curious fact that yellow fever has never spread to Egypt, the Middle East, or the Far East. Perhaps this may be due to some immunity conferred by infections with milder relatives of the yellow fever virus, the report suggests.

All the Foundation's field laboratories conduct systematic and widespread antibody surveys to gather data for the solution of these epidemiological puzzles. Their professional and technical teams are always ready to investigate outbreaks of fever-like diseases among humans or animals in their areas. In South Africa last spring, for example, the prompt response to reports of a strange disease among sheep in the Middelburg region of Cape Province resulted in the isolation and identification of a new group-A virus and in the formulation of control measures for the future.

The Virus Laboratories

The work of the five field laboratories is co-ordinated and complemented by that of the central laboratory in New York. To it field isolations and specimens are sent for definitive study. The central staff devote a good deal of time to improving the methods and technique for handling specimens in the field laboratories, but their main interests are the relationships among the arthropod-borne viruses as a group and basic scientific studies concerning their nature and functioning. The field stations are all conducted co-operatively by the Foundation and local government or research agencies. The virus research centre in Poona functions as a unit of the Indian Council of Medical Research, and it is financed jointly by the I.C.M.R., the Rockefeller Foundation, and to a certain extent by the government of Bombay State. In Johannesburg the South African Institute for Medical Research and the Council for Scientific and Industrial Research co-operate in contributing to the budget for personnel and operating expenses, while the Poliomyelitis Research Foundation provides laboratory space, services, and maintenance. In Brazil, the virus laboratory is conducted in co-operation with the Ministry of Health. The land and laboratory buildings of the Trinidad regional virus laboratory in Port-of-Spain are provided by the Government of Trinidad and Tobago, which with the Colonial Development and Welfare Fund also pays most of the salaries of the local personnel. In Berkeley, California, a Foundation staff member handles special studies on insect-borne viruses, using laboratory space provided by the State of California.

The Rockefeller Foundation also collaborates informally with other virus laboratories in Nigeria, Uganda, Israel, Malaya, Australia, and Japan.

*Rockefeller Foundation Grants, 1957, 8, No. 4.