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Comparison between Attenders and Non-Attenders at the Danish Mass Tuberculosis Campaign, 1950-52*

Tuberculosis Morbidity and General Mortality in the Two Groups during the First Four Years of Follow-up

OLE HORWITZ & JØRGEN KNUDSEN

A previous study by the Danish Tuberculosis Index reported the incidence of pulmonary tuberculosis among attenders at the Danish mass campaign in 1950-52 during the first four years after the campaign. Since it is important to know whether the attenders can be regarded as representative of the general population, from the point of view of case-finding surveys after mass campaigns, a further study was undertaken in which the attenders at the campaign were compared with the persons who were invited to attend, but failed to do so.

The first part of this study presents a comparison between attenders and non-attenders at the time of the mass campaign. Analysis according to sex, age, residence, occupation and previous vaccination with BCG showed a striking uniformity between attenders and non-attenders.

The second part compares the tuberculosis morbidity and general mortality in the two groups after the mass campaign. The incidence of tuberculosis in a follow-up period of four years was found to be lower among the attenders. This is largely due to the case-finding during the mass campaign and cannot be regarded as indicating that the non-attenders form a "high risk" group. During the follow-up period, the general mortality was also higher among the non-attenders.

INTRODUCTION

Since the Second World War, mass campaigns have found increasing application in the fight against tuberculosis. However, it is a common experience that some—and often many—of those invited do not attend for examination. It is of considerable importance to know whether these non-attenders form a special group from an epidemiological point of view. If, in fact, the tuberculosis morbidity is higher in that group than among the attenders, a great effort should be made to have them examined. A few studies have been published on this problem (Comstock & Burke, 1951; Fletcher et al., 1959), but definite conclusions could not be drawn because of the limited size of the groups studied.

The aim of the present study is to report an epidemiological comparison between attenders and non-attenders at the Danish mass tuberculosis campaign in 1950-52. The study falls into two parts. The first deals with the composition of the two groups according to sex, age, etc. at the time of the mass campaign. The second gives an account of the tuberculosis morbidity and general mortality in the two groups during the first four years after the mass campaign.

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MATERIAL AND METHODS

BASIC MATERIAL

During the years 1950 to 1952, a tuberculosis mass campaign was planned and conducted in Denmark as a combined service programme (case-finding and BCG vaccination) and a prospective research programme. It was carried out in the provinces, where three-quarters of the total population of Denmark live. All persons aged 1-6 years and 15-34 years were invited personally to attend for examination, and individual cards bearing detailed identification data were written out for all, *whether they attended or not.*[1] All these cards were assembled in a register (" study population register ") by the Danish Tuberculosis Index, which was thus in possession of information concerning almost all persons in the 15-34 age-group in the various counties concerned. (In a previous publication (Groth-Petersen, Knudsen & Wilbek, 1959) this register was designated " mass campaign roster ". As the present study deals with attenders as well as non-attenders, we prefer here to use the term " study population register ".) However, there is a deficit of about 4%, owing to the fact that cards were not issued for persons who had moved from a district where examinations had not taken place to one that had already been surveyed. (For further details concerning the mass campaign, compilation of the study population register, etc., see Groth-Petersen, Knudsen & Wilbek (1959) and Horwitz & Knudsen (to be published).)

The present study concerns those persons who were 15-34 years of age at the time of the mass campaign. Among the total of 784 903 persons in this age-group, there were 6829 who, according to the National Health Service Tuberculosis Register, had or had had pulmonary tuberculosis.[2] These persons were excluded from the analysis, the main aim of which was to study the incidence of tuberculosis in a population considered to be free from that disease. The present work thus includes 778 074 persons — 390 641 males and 387 433 females.

[1] The cards were issued on the basis of the records of the municipal registers to be found in all Danish parishes and boroughs (Act of 24 March 1924). These registers give a complete index of the local population, including removals by migration and deaths.

[2] Since 1921 all notifications of tuberculosis have been assembled in a nation-wide central register. By tracing the notifications in the register for the study population, the cases of tuberculosis diagnosed among them before the mass campaign could be excluded.

CASES OF TUBERCULOSIS IN THE STUDY POPULATION

Estimation of the incidence of tuberculosis is based on medical notifications of diagnosed cases of tuberculosis. These notifications, which are sent in to the Danish Tuberculosis Index, are on individual forms and give ample information for identification. The patients can therefore be traced in the study population register, and the morbidity rates can be calculated in relation to the data from the mass campaign—for example, according to attendance (attender/non-attender) and age.

Details concerning the Danish notification system and the tuberculosis control programme have been given in other publications (Groth-Petersen, 1955; Groth-Petersen & Wilbek, 1957; Horwitz & Iversen, 1955; Horwitz, Rossen & Wilbek, 1960). The main result of these studies is that a good indication of the incidence of the disease has been obtained.

DEATHS IN THE STUDY POPULATION

The Danish Tuberculosis Index receives from the Statistical Department notifications of all deaths in the cohorts studied. These notifications also state the cause of death, coded by the Medical Statistical Section of the National Health Service. As the forms bear complete information for identification, it is possible to trace the persons concerned in the study population register. The mortality can thus be calculated in relation to the data from the mass campaign (see above).

DEFICIT IN TRACING CASES IN THE STUDY POPULATION REGISTER

The study population register comprises, as already mentioned, almost 800 000 cards. It is reasonable to assume that tracing the tuberculosis and death notifications must be unsuccessful occasionally. The frequency of failure was examined in respect of the tuberculosis notifications for the years 1950 to 1956. During this period 1286 notifications were received of cases of tuberculosis which, according to the existing information supplied by municipal registers, had occurred in the study population. It was possible to trace the corresponding cards in the study population register in all except 12% of

these cases. The same process was carried out in respect of the 1325 deaths reported for the period 1950 to 1952; here there was a deficit of 11%.

One of the explanations for the deficit is that mistakes may be made in punching the index cards and in filing them. Evaluated on the basis of special examinations, however, this source of error may be assumed to be without numerical significance. Another source of error is lack of cards in the study population register owing to incomplete writing-out of examination cards. However, according to the population figures obtained at the census in 1950, cards are lacking for only a small percentage of the actual population; thus this error can explain only a minor part of the deficit. The main cause of the deficit is probably discrepancies between the identification information on the notifications and that on the registry cards—for example, in the dates of birth.

The deficit is presumably somewhat lower for attenders than for non-attenders. In the identification data supplied by the municipal registers there were some errors, but these were corrected for the attenders at the campaign.

RESULTS

I. COMPARISON BETWEEN ATTENDERS AND NON-ATTENDERS AT THE TIME OF THE MASS CAMPAIGN

In this section the attenders and non-attenders at the time the mass campaign was carried out are compared with the object of finding out whether there are differences between the two groups in respect of factors which are, or might be, of significance with regard to tuberculosis morbidity.

Differences in the *composition* of the two groups indicate that the *rate of attendance* is not the same, for example, for the two sexes, the various age-groups, etc. It might, for instance, be of sociological interest to analyse the rate of attendance, but this has not been done since it is considered to be outside the scope of the present study.

Sex, residence, age, and occupation

The number of persons in the age-group 15-34 years invited to attend the mass campaign was 778 074, excluding the 6829 who had or had had tuberculosis. Of these, 508 783 (65%) attended [1] and 269 291 (35%) failed to attend.

Of the attenders, 47% were males and 53% females, while the corresponding figures for the non-attenders were 55% and 45% (see Table 1). As the tuberculosis morbidity in the age-group in question is higher among females than among males, the difference in the sex composition will mean that the crude morbidity rate is highest for the attenders, *ceteris paribus*. This is one of the reasons why it has been necessary to report all rates by sex.

TABLE 1

POPULATION AGED 15-34 YEARS, IN THE PROVINCES,[a] DIVIDED INTO THOSE ATTENDING AND THOSE NOT ATTENDING THE MASS CAMPAIGN

	Attenders	Non-attenders	Total
Males	241 371	149 270	390 641
Females	267 412	120 021	387 433
Total	508 783	269 291	778 074

[a] 6829 persons notified as suffering from pulmonary tuberculosis prior to the mass campaign are not included.

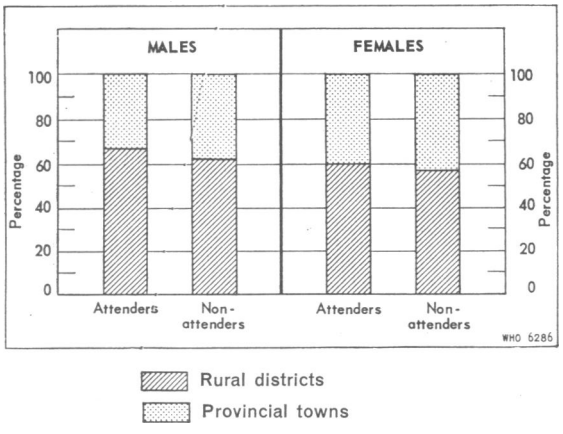
There are relatively more country dwellers among the attenders than among the non-attenders, and this applies both to females and to males (see Fig. 1 and Appendix Table 1). This difference will cause a trend in the opposite direction to that mentioned above, since the tuberculosis morbidity is somewhat higher in provincial towns than in rural districts (Horwitz & Iversen, 1955).

The tuberculosis morbidity has been slightly higher in the western and central districts of Denmark than in the eastern, but the difference has shown a tendency to become less in recent years (Horwitz & Iversen, 1955). An examination was made, therefore, to ascertain whether there were differences between attenders and non-attenders as regards the geographical aspect. The number of

[1] In the previous study (Groth-Petersen, Knudsen & Wilbek, 1959) 31 333 persons, aged 15-34 years, were excluded from the attenders—namely, 15 558 not previously vaccinated and whose tuberculin reaction was not read, 15 463 whose vaccination status at the time of the mass campaign was unknown, and 312 in whom pulmonary tuberculosis was diagnosed during the mass campaign. These groups have been included in the present study for the sake of comparability between attenders and non-attenders.

FIG. 1

ATTENDERS AND NON-ATTENDERS DISTRIBUTED ACCORDING TO RESIDENCE (URBAN/RURAL) AT THE TIME OF THE MASS CAMPAIGN

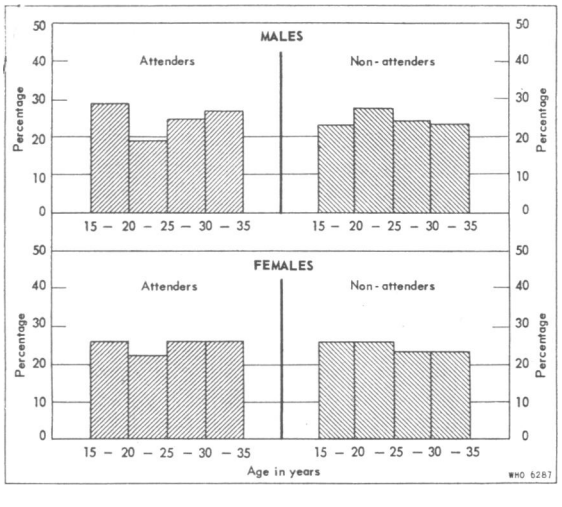


persons from the western and central districts was relatively greater among the attenders than among the non-attenders. However, the difference was so small that it cannot be considered to be of any particular significance for the crude morbidity rate.

It will be seen from Fig. 2 and Appendix Table 1 that there is some difference in the age composition; there are relatively fewer in the 20-24 age-group among the attenders than among the non-attenders. As the tuberculosis morbidity and general mortality are dependent on age, the different age composition will mean that the crude rate calculated for the whole 15-34 age-group will be different for the attenders and non-attenders, *ceteris paribus*. *Age-standardized rates*, calculated on the basis of the rates in 5-year age-groups, have therefore been used throughout this study.[1]

FIG. 2

ATTENDERS AND NON-ATTENDERS DISTRIBUTED ACCORDING TO AGE AT THE TIME OF THE MASS CAMPAIGN



In unpublished special studies of males, it has been found that the tuberculosis morbidity and the general mortality depend on—or rather are related to—occupation and social position, even when using the present rough classification. For instance, the incidence of tuberculosis was lower in the agricultural industry than in other industries, and the general mortality was higher among wage-earners than among the self-employed (Horwitz & Knudsen, to be published). It is therefore important to examine the distribution according to occupation and social group among the attenders and non-attenders. It will be seen from Table 2 that the relative composition was the same.

Information concerning occupation and social group was obtained from the cards in the municipal registers. If the information was faulty, the persons were classified as " not stated ". This was the case in 2% of the attenders and in 10% of the non-attenders. The higher frequency among the non-attenders is due to the fact that it was not possible to obtain supplementary information from them as could be done in the case of the attenders. It is reasonable to assume that the faulty information concerning occupation and social group was mainly accidental. This assumption is supported by the studies of the tuberculosis morbidity and general mortality in occupational groups carried out by Horwitz & Knudsen (to be published). The group " not stated " has therefore been omitted from the percentage distributions in Table 2.

BCG vaccination before the mass campaign

BCG vaccination has been used increasingly since the end of the 1940's and, at the time of the mass campaign in 1950-52, over a fifth of the young adults had already been vaccinated. According to the experience from previous campaigns in smaller areas, it could be anticipated that the vaccinated would attend at the mass campaign to a greater extent

[1] The age distribution of the total study population, divided into 5-year age-groups, was used as the standard. The percentages were: 15-19 years, 26.3%; 20-24 years, 22.9%; 25-29 years, 25.0%; 30-34 years, 25.8%; totalling 100.0%.

TABLE 2

ATTENDERS AND NON-ATTENDERS DISTRIBUTED ACCORDING TO OCCUPATION AND SOCIAL POSITION

Occupation and social group [a]		Males				Females			
		Number		Percentage		Number		Percentage	
		Attenders	Non-attenders	Attenders	Non-attenders	Attenders	Non-attenders	Attenders	Non-attenders
Agricultural industry	I	18 089	9 918	7	7	27 006	11 556	10	11
	III	64 212	34 049	27	26	7 316	3 721	3	3
	Total	82 301	43 967	34	33	34 322	15 277	13	14
Other industries	I	16 819	7 754	7	6	22 924	7 840	9	7
	II	36 644	19 370	15	15	49 805	21 707	19	20
	III	97 021	55 842	41	42	153 307	61 074	57	55
	Total	150 484	82 966	63	63	226 036	90 621	85	82
Not gainfully employed		6 202	5 979	3	4	5 459	4 277	2	4
Not stated		2 384	16 358	[b]	[b]	1 595	9 846	[b]	[b]
Total		241 371	149 270	100	100	267 412	120 021	100	100

[a] Social group I: Self-employed—for example, shopkeepers, farmers.
" " II: Salaried employees—for example, public servants.
" " III: Wage-earners.

[b] Excluded from percentages.

than the non-vaccinated; this would mean that the attenders would have a lower crude morbidity rate than the non-attenders. It was therefore important to ascertain the frequency of previously vaccinated persons among the attenders and non-attenders.

The extent of vaccination was evaluated by tracing the attenders and non-attenders in a special register for BCG-vaccinated persons kept at the Danish Tuberculosis Index. However, attenders are also registered as vaccinated on presentation of their certificate of previous BCG vaccination.

Table 3 shows that attenders and non-attenders were vaccinated before the mass campaign to the same extent—namely, 22%. This, on the whole, applied also to the individual age-groups, though in the 15-19 age-group the percentage of previously vaccinated persons was higher among the attenders.

The extent of vaccination was somewhat greater than is indicated by the present investigation. Among the attenders there were 49 900 persons (10%) for whom it could not be verified whether they had been vaccinated prior to the mass campaign or for whom no information was available. These cases have therefore been classified as " non-vaccinated ". On the assumption that half of

TABLE 3

EXTENT OF BCG VACCINATION PRIOR TO MASS CAMPAIGN AMONG ATTENDERS AND NON-ATTENDERS

	Age at time of mass campaign (years)	Number		Percentage [a]	
		Attenders	Non-attenders	Attenders	Non-attenders
Males	15-19	24 513	9 853	35	28
	20-24	13 708	14 612	31	35
	25-29	13 859	7 454	23	20
	30-34	5 206	2 977	8	8
	Total	57 286	34 896	24	23
Females	15-19	25 458	8 953	37	29
	20-24	14 342	8 215	24	26
	25-29	10 349	4 736	15	16
	30-34	6 668	2 995	10	10
	Total	56 817	24 899	21	21

[a] The percentage is calculated in relation to the total number of persons in the respective age-groups.

them were in fact vaccinated, the percentage of vaccinated persons among the attenders would be 27. As mentioned above, the extent of vaccination among the non-attenders is based solely on the vaccination register at the Danish Tuberculosis Index. However, here there is a deficit of 20%, evaluated on the basis of a special study of attenders. If a correction is made for this deficit, the percentage of vaccinated persons among the non-attenders would be 28. Though there is thus some uncertainty in the present analysis, the extent of vaccination among attenders and non-attenders can be considered to be approximately equal.

II. COMPARISON OF TUBERCULOSIS MORBIDITY AND GENERAL MORTALITY IN ATTENDERS AND NON-ATTENDERS DURING THE FIRST FOUR YEARS AFTER THE MASS CAMPAIGN

Morbidity from respiratory tuberculosis [1]

This section gives an account of the morbidity from respiratory tuberculosis among attenders and non-attenders in the first four years after the mass campaign.[2]

A brief description of the *diagnosed cases* will be given first.

There were 888 cases of respiratory tuberculosis (including cases found in the mass campaign) among the attenders and 523 among the non-attenders. Tubercle bacilli were demonstrated in 86% and 88%, respectively. The diagnosis can therefore be regarded as certain in the majority of the cases.

Of the 888 cases among the attenders, there were 781 (88%) with pulmonary tuberculosis, 80 (9%) with pleural tuberculosis and 27 (3%) with no or unstated pulmonary lesions. Among the non-attenders, the distribution is very similar: of the 523 cases of respiratory tuberculosis, there were 458 (88%) with pulmonary tuberculosis, 45 (9%) with pleural tuberculosis and 20 (4%) with no or unstated pulmonary lesions (see Appendix Table 2). The cases of pulmonary tuberculosis among the attenders and non-attenders were of equal severity. The percentage of pulmonary cases with unilateral lesions was almost the same in the two groups (67% and 70%, respectively). The percentage of pulmonary cases with definite cavitation was 23% among the attenders and slightly higher (28%) among the non-attenders (see Appendix Table 2).

It should be mentioned that the cases diagnosed among the attenders during the mass campaign were somewhat different in type from those diagnosed during the follow-up period (see Appendix Table 2). Of the cases discovered in the mass campaign, there were only 2% with pleural tuberculosis, as against 13% in the follow-up period. This difference is presumably due to the fact that patients with pleural tuberculosis are often acutely ill and such patients would therefore have been unable to attend the mass campaign. There were relatively fewer patients with cavitary pulmonary tuberculosis among the cases diagnosed at the mass campaign than among those diagnosed during the follow-up period (18% and 26%, respectively). There was, however, no appreciable difference with regard to unilateral and bilateral cases.

Of the 888 cases of respiratory tuberculosis diagnosed among the attenders, 312 (35%) were found as a direct result of the mass campaign [3] and the remaining 576 were discovered in the follow-up period. Of the follow-up cases, 63% were diagnosed on the basis of symptoms, 13% were discovered as a result of the examination of contacts by the tuberculosis dispensaries, and most of the remainder were found during routine examinations at the tuberculosis dispensaries. The 523 cases of respiratory tuberculosis among the non-attenders showed a similar distribution in respect of the way in which they were discovered.

When comparing the frequency of tuberculosis in attenders and non-attenders, it must be taken into consideration that for the attenders two different rates can be calculated: (*a*) the incidence in the follow-up period *after* the mass campaign, and (*b*) the total morbidity rate—that is, the rate obtained when the cases diagnosed during the mass campaign are also included. For the non-attenders there is only one rate—namely, that calculated from the number of cases diagnosed in the follow-up period.

All adults were X-rayed (photofluorography) during the mass campaign. By this means some cases of tuberculosis were found at an earlier stage than usual. After the mass campaign the frequency of tuberculosis among the attenders will therefore be lower than "normal". Assuming that the frequency was the same among attenders and non-attenders at the time of the mass campaign, the lowest rate would thus be found among the attenders in the period after the campaign. Hence

[1] Respiratory tuberculosis comprises the following diseases: Respiratory tuberculosis with mention of occupational disease of lung (001); Pulmonary tuberculosis (002); Pleural tuberculosis (003); Primary tuberculosis complex with symptoms (004); Tracheobronchial glandular tuberculosis with symptoms (005); Other respiratory tuberculosis (007). (The figures in parentheses are the code numbers in the *International Classification of Diseases* (World Health Organization, 1957).) The majority of the cases notified, 88%, are pulmonary tuberculosis (002).

[2] The follow-up period was dated from the time the mass campaign was carried out in the individual counties. It should be stressed that the period was identical for attenders and non-attenders.

[3] The cases diagnosed during the mass campaign and those found during the first six months after it in the course of a check-up on those persons who had "suspicious pulmonary findings" at the campaign.

TABLE 4

INCIDENCE OF RESPIRATORY TUBERCULOSIS AMONG ATTENDERS AND NON-ATTENDERS IN THE INDIVIDUAL YEARS OF THE FOLLOW-UP PERIOD

	Age at time of mass campaign (years)	Attenders					Non-attenders				
		Year in follow-up period				Total	Year in follow-up period				Total
		1st[a]	2nd	3rd	4th		1st	2nd	3rd	4th	
Males	No. of cases 15-19	12	17	21	8	58	13	12	10	5	40
	20-24	19	25	6	8	58	30	16	16	11	73
	25-29	14	17	17	18	66	20	18	13	13	64
	30-34	16	15	10	20	61	17	18	14	13	62
	Total	61	74	54	54	243	80	64	53	42	239
	Annual rate per 100 000 (age-standardized)	26	32	22	22	26	52	43	35	28	40
Females	No. of cases 15-19	11	21	19	22	73	25	16	19	9	69
	20-24	19	24	26	17	86	25	19	22	16	82
	25-29	25	22	21	17	85	24	27	16	14	81
	30-34	13	29	26	21	89	14	15	10	13	52
	Total	68	96	92	77	333	88	77	67	52	284
	Annual rate per 100 000 (age-standardized)	25	36	34	29	31	73	64	55	43	59

[a] Cases diagnosed at mass campaign are *not* included.

the rate for the follow-up period alone is not sufficient to indicate the tuberculosis problem among the attenders. As mentioned above, the total morbidity rate includes cases diagnosed during the mass campaign. Some of these cases would possibly not have been diagnosed without the mass campaign—a factor which will give rise to an artificial increase in the rate.

The *incidence rate during the follow-up period* was 26 per 100 000 for the male attenders and 40 per 100 000 for the male non-attenders. The corresponding rates for the females were 31 per 100 000 and 59 per 100 000 (see Table 4). The incidence of tuberculosis among the non-attenders was thus 1.6-1.9 times higher than that among the attenders. The difference was greatest during the first year after the mass campaign, when the incidence among non-attenders was 2-3 times higher than among the attenders. During the following year, the difference was less, but in the fourth year the rate for the non-attenders was still 1.3-1.5 times higher (see Table 4 and Fig. 3).

FIG. 3

INCIDENCE OF RESPIRATORY TUBERCULOSIS AMONG ATTENDERS AND NON-ATTENDERS IN THE FOLLOW-UP PERIOD

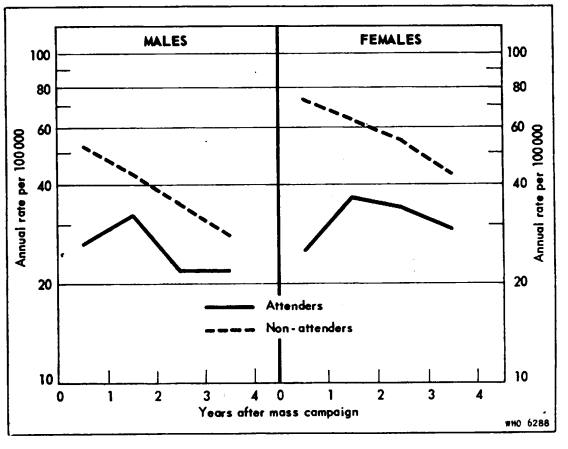


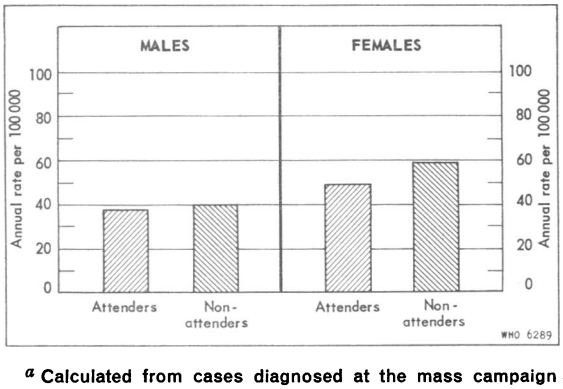
TABLE 5
TOTAL MORBIDITY FROM RESPIRATORY TUBERCULOSIS AMONG ATTENDERS

Age at time of mass campaign (years)		Males			Females		
		Mass campaign	Follow-up period (4-year)	Total	Mass campaign	Follow-up period (4-year)	Total
No. of cases	15-19	21	58	79	20	73	93
	20-24	21	58	79	41	86	127
	25-29	29	66	95	58	85	143
	30-34	48	61	109	74	89	163
	Total	119	243	362	193	333	526
Annual rate per 100 000 (age-standardized)		.	26	38	.	31	49

The *total morbidity rate* among the male attenders was 38 per 100 000; for the male non-attenders the total morbidity rate in the same period was the same as the incidence rate—i.e., 40 per 100 000. The corresponding figures for females were 49 per 100 000 and 59 per 100 000 (see Table 5 and Fig. 4). Thus, the non-attenders also had the higher morbidity rate, although the relative difference (1.1-1.2 times) was not great.

Tuberculosis thus seems to have occurred more frequently among the non-attenders. This may be due to the fact that, as mentioned above, the two study populations were not equal as regards residence. A special examination, in which the study population was divided according to residence (urban/rural), showed, however, that this can explain only part of the difference observed in the morbidity rates. Another reason might be that, while there was no particular difference in the extent of vaccination among the attenders and non-attenders *before* the mass campaign, there was a difference *after* the campaign. In addition to being a case-finding programme, the Danish mass campaign was also a mass BCG-vaccination service, and a very large number of the attenders were vaccinated. During the follow-up period, only a small percentage of the non-attenders was vaccinated. As a result, the total percentage of vaccinated persons among the non-attenders was only about half that among the attenders.[1] The higher percentage of vaccinated persons among the attenders might explain the fact that the tuberculosis morbidity was lower in that group, since some studies have provided evidence that the tuberculosis morbidity is reduced as a result of *mass* vaccination.

FIG. 4
COMPARISON OF TOTAL MORBIDITY[a] FROM RESPIRATORY TUBERCULOSIS AMONG ATTENDERS WITH INCIDENCE OF RESPIRATORY TUBERCULOSIS AMONG NON-ATTENDERS IN THE FOLLOW-UP PERIOD



[a] Calculated from cases diagnosed at the mass campaign plus those diagnosed in the follow-up period.

[1] As mentioned earlier, about a fifth of the attenders had already been vaccinated when the mass campaign was held. Of the remaining 394 700 persons, 175 400 were tuberculin reactors and 153 800 non-reactors, while 65 500 could not be classified (15 600 because the tuberculin test was not read and 49 900 because their status as regards BCG vaccination could not be determined with certainty). All the non-reactors except 7600 were vaccinated during the mass campaign. Among the attenders there were then some 260 300 known to be vaccinated—i.e., 51%. About a fifth of the non-attenders had also been vaccinated before the mass campaign was undertaken. Of the remaining 209 500, about 5% were vaccinated during the years 1953-58, the percentage being estimated on the basis of a representative sample. The total percentage of vaccinated non-attenders was thus about half that of the attenders.

TABLE 6

MORTALITY (ALL CAUSES) AMONG ATTENDERS AND NON-ATTENDERS IN THE INDIVIDUAL YEARS OF THE FOLLOW-UP PERIOD

	Age at time of mass campaign (years)	Attenders					Non-attenders				
		Year in follow-up period				Total	Year in follow-up period				Total
		1st	2nd	3rd	4th		1st	2nd	3rd	4th	
Males	No. of deaths 15-19	30	47	67	58	202	41	29	29	48	147
	20-24	39	49	46	47	181	53	48	50	42	193
	25-29	50	58	56	60	224	55	54	40	49	198
	30-34	65	63	65	62	255	60	54	62	43	219
	Total	184	217	234	227	862	209	185	181	182	757
	Annual rate per 100 000 (age-standardized)	77	91	97	95	90	140	124	121	124	127
Females	No. of deaths 15-19	20	29	25	18	92	16	12	16	9	53
	20-24	38	21	22	24	105	26	27	17	21	91
	25-29	41	38	46	54	179	37	26	28	23	114
	30-34	33	46	56	67	202	53	38	46	35	172
	Total	132	134	149	163	578	132	103	107	88	430
	Annual rate per 100 000 (age-standardized)	48	50	55	60	54	112	86	91	74	91

General mortality in the follow-up period

During the follow-up period, 862 of the male attenders and 757 of the male non-attenders died. The corresponding age-standardized mortality rates were 90 per 100 000 and 127 per 100 000, respectively. Among the females, the numbers of deaths were 578 and 430, and the age-standardized rates were 54 per 100 000 and 91 per 100 000 (see Table 6). Thus, the mortality among the non-attenders was, on the average, 1.4-1.7 times higher than that among the attenders. The difference was most marked in the first year, when the rates differed by a ratio of 1.8-2.3. In the course of time this ratio decreased, being only 1.2-1.3 in the fourth year (see Table 6 and Fig. 5). The higher mortality among the non-attenders and the time trend observed are presumably due to the fact that a number of non-attenders did not report at the mass campaign because they were ill, either acutely or chronically. The mortality among these persons would be higher than among the general population (see Horwitz, 1960, Chapter

FIG. 5

MORTALITY (ALL CAUSES) AMONG ATTENDERS AND NON-ATTENDERS IN THE FOLLOW-UP PERIOD

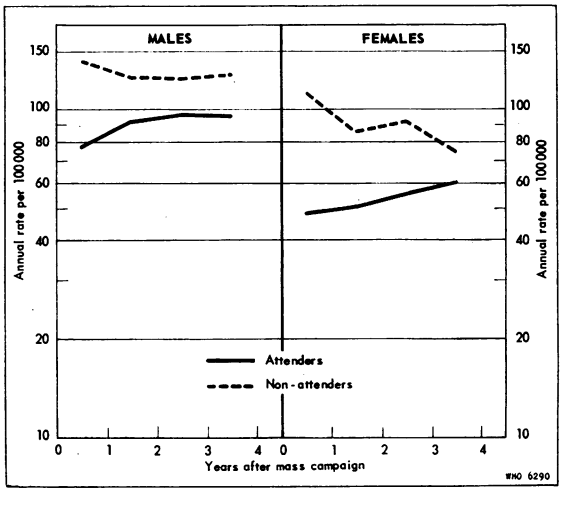


TABLE 7

MORTALITY ACCORDING TO CAUSE OF DEATH AMONG ATTENDERS AND NON-ATTENDERS DURING 4-YEAR FOLLOW-UP PERIOD

	Cause of death (group) [a]		Tuberculosis (001-019)	Other infective and parasitic diseases (020-138)	Neoplasms (140-205)	Diseases of the respiratory system (470-527)	Ill-defined causes (780-795)	Accidents, poisonings and violence (800-999)	All other causes (remaining code numbers)	Total
Males	No. of deaths	Attenders	—	34	135	7	5	470	211	862
		Non-attenders	8	30	110	27	9	356	217	757
	Annual rate per 100 000	Attenders	—	4	14	1	1	49	22	89
		Non-attenders	1	5	18	5	2	60	36	127
Females	No. of deaths	Attenders	6	33	162	14	5	129	229	578
		Non-attenders	21	16	99	20	4	79	191	430
	Annual rate per 100 000	Attenders	1	3	15	1	0	12	21	54
		Non-attenders	4	3	21	4	1	16	40	90

[a] The figures in parentheses are the code numbers in the *International Classification of Diseases* (World Health Organization 1957).

10), and as a result the mortality would be higher among all the non-attenders than among the attenders. The difference between the mortality in the diseased and that in the general population will decrease gradually, so that the mortality rate for the non-attenders will approach that for the attenders.

It was considered of some interest to investigate whether any particular diseases caused the higher mortality among the non-attenders. A detailed analysis of the individual causes of death has not been compiled, partly because the number of deaths was too small. The various causes of death have therefore been assembled in broad groups (see Table 7). It will be seen that the mortality in all groups was higher among the non-attenders. Thus the higher mortality among the non-attenders was not connected with a special group of diseases—a finding that is in accordance with the hypothesis put forward above. Table 7 shows that among the non-attenders there was also a higher mortality from accidents, poisonings, and violence. This might be because the psychological pattern in the non-attenders was different from that in the attenders—for example, that the former were more reckless or thoughtless than the latter. However, it might also be due to deaths among those persons who did not attend the campaign because they were, for example, in hospital as a result of traffic accidents. If such a person died from his lesions or their sequelae, the cause of death would be registered as " traffic accident "—i.e., " violent death "—irrespective of the length of time since the accident.

DISCUSSION

The present study has demonstrated that *after* a mass campaign the tuberculosis incidence is higher among the non-attenders than among the attenders. It would therefore be profitable to carry out a case-finding programme among the non-attenders.

It was wondered whether the reason for the higher tuberculosis morbidity among the non-attenders in the follow-up period might be that non-attenders are a " high risk " group. Against this hypothesis, however, is the fact that the composition of the non-attenders and the attenders was similar in respect of a number of important factors. On the other hand, the non-attenders differed from the attenders not only with regard to tuberculosis morbidity, but also with

regard to general mortality. However, the higher mortality among the non-attenders can simply be explained by the probability that a small group of them had a particularly high mortality—namely, those who did not attend at the mass campaign because of illness. The uniformity demonstrated between attenders and non-attenders justifies the assumption that the tuberculosis risk in the two groups was the same at the time of the mass campaign. The difference in the incidence of tuberculosis in the follow-up period is therefore most probably the result of the mass campaign. In other words, had the non-attenders participated in the mass campaign, the incidence in that group in the follow-up period would probably have been the same as that among the attenders. If it is assumed that the tuberculosis risk was equal, then the mass campaign proved to be an effective tool in tuberculosis control, in that it resulted in a great decrease in incidence in the follow-up period among the attenders as compared with the non-attenders. This effect must be interpreted as a consequence of case-finding plus mass vaccination, but a numerical evaluation of the individual contribution of these two procedures cannot be made. However, reduction in tuberculosis incidence is considered to be mainly the result of case-finding. The infection rate is now small, and therefore only few of the non-reactors who were vaccinated would gain benefit from the immunization acquired.

Case-finding in a mass campaign means both earlier diagnosis of the disease and the tracing of sources of infection which otherwise might not have been found. As a result, the spread of infection in the community will be decreased. It is often emphasized that many of the cases found in a mass campaign are not of clinical or epidemiological significance. This, however, was not the case in the present study.

RÉSUMÉ

Cette étude, effectuée par le bureau d'étude de la tuberculose au Danemark (Dansk Tuberkulose Index), avait pour but de déterminer si les personnes examinées au cours de la campagne de masse qui s'est déroulée de 1950 à 1952 sur le territoire danois pouvaient être considérées comme représentatives de l'ensemble de la population. Pour ce faire, on a comparé le groupe des « participants » avec celui des « non-participants », c'est-à-dire les personnes qui n'avaient pas pris part à la campagne. L'étude a porté sur les sujets des provinces danoises, qui avaient de 15 à 34 ans au moment de la campagne, soit 778 074 personnes. Sur ce nombre, 508 783 (65%) y avaient pris part, tandis que 269 291 (35%) y étaient restées étrangères.

La répartition selon l'âge, la résidence, le sexe, la profession, et la vaccination au BCG avant la campagne, étaient la même pour les deux groupes, de façon même surprenante.

Parmi les sujets ayant pris part à la campagne, on a relevé 888 cas de tuberculose respiratoire, soit 312 durant la campagne et 576 pendant les 4 années de surveillance qui suivirent. Au cours de cette période, les cas diagnostiqués parmi les non-participants étaient au nombre de 523. Dans les deux groupes, les cas étaient uniformément répartis, du point de vue gravité et diagnostic.

Chez les hommes, la fréquence des nouveaux cas a été de 25 pour 100 000 durant la période de surveillance de 4 ans, et la morbidité totale (y compris les cas dépistés durant la campagne) de 37 pour 100 000. Le taux était plus élevé (40 pour 100 000) chez les sujets masculins non participants. Les chiffres correspondants pour les femmes, étaient 31 et 49 pour 100 000. Chez les femmes du groupe non-participant, la fréquence des nouveaux cas durant la période de surveillance de 4 ans, était plus élevée aussi (59 pour 100 000). Durant la période de surveillance, les différences entre les taux des groupes participant et non-participant tendaient à diminuer.

La mortalité générale, durant la période de surveillance, fut de 90 pour 100 000 pour les hommes participants, et un peu plus élevée, soit 127 pour 100 000 chez les non-participants. Pour les femmes les taux respectifs étaient de 54 et 91 pour 100 000. Là aussi les différences entre les deux groupes tendaient à s'abaisser, durant la période de surveillance. La mortalité plus élevée chez les non-participants et sa répartition dans le temps, peut s'expliquer par le fait que la mortalité parmi les personnes qui étaient malades au moment de la campagne — et qui pour cette raison même n'y participèrent pas — était plus élevée que dans l'ensemble de la population. Cette mortalité supérieure dans le groupe non-participant ne peut être attribuée à aucune cause de décès particulière.

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APPENDIX TABLE 1

ATTENDERS AND NON-ATTENDERS DISTRIBUTED ACCORDING TO RESIDENCE AND AGE

	Age at time of mass campaign (years)	Attenders			Non-attenders		
		Provincial towns	Rural districts	Total	Provincial towns	Rural districts	Total
Males	15-19	20 316	50 642	70 958	11 897	22 793	34 690
	20-24	14 199	30 725	44 924	15 276	26 496	41 772
	25-29	21 435	38 670	60 105	14 445	22 305	36 750
	30-34	23 542	41 842	65 384	14 803	21 255	36 058
	Total	79 492	161 879	241 371	56 421	92 849	149 270
Females	15-19	24 200	44 114	68 314	11 885	18 941	30 826
	20-24	25 700	34 406	60 106	14 505	16 978	31 483
	25-29	28 604	40 264	68 868	12 787	16 248	29 035
	30-34	28 895	41 229	70 124	12 369	16 308	28 677
	Total	107 399	160 013	267 412	51 546	68 475	120 021

APPENDIX TABLE 2

RESPIRATORY TUBERCULOSIS DIAGNOSED AMONG ATTENDERS AND NON-ATTENDERS, DISTRIBUTED ACCORDING TO DIAGNOSIS AND SEVERITY OF LESIONS AT TIME OF NOTIFICATION

		Pulmonary tuberculosis									Pleural tuberculosis without pulmonary lesions	No or unstated findings in lungs	Total number of cases
		Lesions in one lung				Lesions in both lungs				Total number			
		With cavity	Suspected cavity	No cavity	Total	With cavity in one or both lungs	Suspected cavity in one or both lungs	No cavity	Total				
Attenders	Mass campaign	27	8	154	189	26	12	73	111	300	5	7	312
	Follow-up period	79	37	215	331	47	11	92	150	481	75	20	576
	Total	106	45	369	520	73	23	165	261	781	80	27	888
Non-attenders		62	40	217	319	68	13	58	139	458	45	20	523