THE PREVALENCE OF PULMONARY TUBERCULOSIS IN THE DURBAN CLOTHING INDUSTRY

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After an extensive mass X-ray survey of industrial workers in Durban in 1952,[1] it was noticed that there was a high prevalence of pulmonary tuberculosis amongst workers in the clothing industry. As a result of this finding, which was not unexpected in view of previous reports,[2] it was decided to make a thorough study of this section of industry. A survey was carried out in the latter part of 1953 during which more than 99% of 7,510 clothing workers in Durban were X-rayed on mass miniature film (70 mm.) with a follow-up of clinical investigation and 10″×15″ X-ray of cases discovered.

METHOD AND PROCEDURE

The object of this survey was to try, as far as possible, to X-ray all persons employed in the clothing industry within the Durban municipal area. The investigation was arranged through the representatives of the Industrial Council for the Clothing Industry, who acted as a direct liaison between the mass X-ray unit and the employer. The unit visited each factory in turn, and with the aid of complete factory employment lists all employees were checked as the X-raying took place. Particulars regarding name, sex, race, age and specific occupation were written on special numbered X-ray cards. An output of 100 radiographs per hour was maintained throughout the survey and this entailed little loss of working time for the individual employees. All films showing doubtful or suspicious lesions were noted and the individuals concerned were referred to the Durban Chest Clinic for further investigation. When the diagnosis had been established the case was referred to the local hospital or treated as an out-patient. All significant cases of tuberculosis were therefore placed under adequate medical supervision.

At the completion of the survey those who were absent at the time when the unit visited the factories were 'rounded-up' and X-rayed. In this manner a coverage of 99·28% was obtained.

RESULTS AND OBSERVATIONS

There are 72 clothing factories within the Durban municipal area, employing 7,510 individuals. Of this total 7,272 were X-rayed at the first attempt, leaving a 'residue' of 238 absentees. A subsequent visit resulted in a further 184 people being X-rayed. Fifty-four individuals (0·7% of the labour force) were therefore not X-rayed, and this group represented in the main those workers who had changed their occupation, had been dismissed or had left Durban.

Of the 7,456 persons X-rayed 414 were Europeans (5·5%), 1,665 Coloured (22·3%), 4,206 Asiatics (56·4%) and 1,171 Natives (15·7%). The race groups employed are therefore predominantly non-Europeans (94·5%).

Table I shows the distribution of the 7,456 workers

TABLE I. DISTRIBUTION OF WORKERS IN THE DURBAN CLOTHING INDUSTRY, BY RACE AND SEX (1953-54)

Number of Workers X-rayed: Age-group (years)	European M	European F	Coloured M	Coloured F	Asiatic M	Asiatic F	Native M	Native F	Eur.	Col.	As.	Nat.	M	F	Total
15-19	10	24	11	527	791	259	142	95	34	538	1,050	237	954	905	1,859
20-24	24	44	1	406	1,163	248	209	204	68	407	1,411	413	1,397	902	2,299
25-29	16	31	8	287	640	106	138	115	47	295	746	253	802	539	1,341
30-39	55	64	13	333	580	105	108	91	119	346	685	199	756	593	1,349
40-49	53	59	9	50	244	33	44	7	112	59	277	51	350	149	499
50-59	16	12		14	29	2	13	1	28	14	31	14	58	29	87
60+	5	1	2	4	6		4		6	6	6	4	17	5	22
Total	179	235	44	1,621	3,453	753	658	513	414	1,665	4,206	1,171	4,334	3,122	7,456
Number not X-rayed	3	6	1	8	19	6	4	7	9	9	25	11	27	27	54
Total number of employees	182	241	45	1,629	3,472	759	662	520	423	1,674	4,231	1,182	4,361	3,149	7,510
% X-rayed	98·35	97·51	97·77	99·44	99·45	99·20	97·86	98·65	97·87	99·46	99·40	99·15	99·38	99·14	99·28

TABLE II. PREVALENCE OF PULMONARY TUBERCULOSIS IN 7,456 CLOTHING WORKERS

(*Active* cases in 'bold' type, *all* cases in normal type)

Age-group (years)	Number of Cases: European M	European F	Coloured M	Coloured F	Asiatic M	Asiatic F	Native M	Native F	Total	Percentage: European M	European F	Coloured M	Coloured F	Asiatic M	Asiatic F	Native M	Native F	Total
15-19				**4**	**3**	**2**	**1**		**10**				**0·76**	**0·38**	**0·77**	**0·70**		**0·548**
				6	7	2	1		16				1·14	0·88	0·77	0·70		0·861
20-24	**1**			**7**	**17**	**1**	**1**	**5**	**32**	**4·17**			**1·72**	**1·46**	**0·40**	**0·48**	**2·45**	**1·392**
	1			10	29	4	4	6	54	4·17			2·46	2·49	1·61	1·91	2·94	2·349
25-29				**3**	**8**	**3**	**5**	**3**	**22**				**1·05**	**1·25**	**2·83**	**3·62**	**2·61**	**1·641**
				8	29	4	6	5	52				2·79	4·53	3·77	4·35	4·35	3·878
30-39	**1**			**6**	**6**	**3**	**5**	**2**	**23**	**1·82**			**1·81**	**1·03**	**2·86**	**4·63**	**2·20**	**1·705**
	1	1		10	27	6	6	2	53	1·82	1·56		3·00	4·66	5·71	5·56	2·20	3·929
40-49			**1**	**1**	**6**		**2**		**10**			**11·1**	**2·00**	**2·46**		**4·55**		**2·004**
	1	1	1	4	10		2		19	1·89	1·69	11·1	8·00	4·10		4·55		3·808
50-59	**1**								**1**	**6·25**								**1·149**
	3				1				4	18·7				3·45				4·598
60+					**1**		**1**		**2**					**16·7**		**25·00**		**9·091**
					1		1		2					16·7		25·00		9·091
Totals	**3**		**1**	**21**	**41**	**9**	**15**	**10**	**100**	**1·67**		**2·27**	**1·29**	**1·19**	**1·20**	**2·28**	**1·95**	**1·341**
	6	2	1	38	104	16	20	13	200	3·35	0·85	2·27	2·34	3·01	2·12	3·04	2·53	2·682

X-rayed by age, sex and race. Most non-European workers are under the age of 30 and only a small proportion appear to be engaged in this type of work after that age. This proportion is reversed in the Europeans, among whom the majority are found in the older age-groups. In his survey on employment in the South African Clothing Industry, Routh [3] found a similar distribution in workers in the Transvaal, where the average age of White employees was considerably higher than that of the non-Europeans.

It is noted that the males predominate, and that the majority of these male workers are Asiatics while the Coloureds form the largest group of female employees.

The prevalence of active and apparently healed pulmonary tuberculosis is shown in Table II and the radiological extent of these lesions in Table III. The definitions used in these tables conform to the standard laid down by the National Tuberculosis Association.[4]

TABLE III. DISTRIBUTION AND EXTENT OF PULMONARY TUBERCULOSIS LESIONS

Extent of Lesion	European	Coloured	Asiatic	Native	Total
Minimal	4	25	88	22	139
Moderately Advanced	4	8	22	6	40
Extensive		6	10	5	21
Total	8	39	120	33	200

In analysing these results a 'null hypothesis' is set up, that there is no difference in liability to the disease among the various groups. If this is so we take the average over-all percentage as an estimate of the liability. Since 100 cases of active tuberculosis were found in 7,456 cases examined this proportion is $100/7{,}456 = 1{\cdot}341\%$.

It was further assumed that the figure would follow a Poisson distribution,[5] and each individual figure was tested against the standard figure of 1·341%.

Example: Of 108 Native males in the 30-39 age-groups, 5 were found to have active tuberculosis. (This is 4·63%). Tables of Poisson distribution [5] give for a parameter of 1·4 a probability of ·014253 of a value of 5 or more occurring, and for a parameter of 1·5, a probability of ·018576. Rough interpolation gives a probability of about ·016 or 1·6%, which is 'significant at the 5% level'. This means that our null hypothesis is probably not true, and that the high number of tuberculosis cases in this group is probably due to a greater liability to the disease among members of this group.

Every group was tested in this way, as were many combinations of groups. The groups shown in Table IV

TABLE IV. ACTIVE CASES OF TUBERCULOSIS

	Number in Group	Number of Cases	% of Cases	Probability and Significance	
Asiatic Males (15-19)	791	3	0·38	·007	† (Low)
Native Males (25-29)	138	5	3·62	·04	* (High)
Native Males (30-39)	108	5	4·63	·016	* (High)
European Females	235	0	0	·043	* (Low)
Native Males	658	15	2·28	·035	* (High)
Natives, both sexes	1,171	25	2·135	·018	* (High)
All Races, both sexes (15-19)	1,859	10	0·548	·0002	‡ (Low)
All Races, both sexes (60-69)	22	2	9·091	·036	* (High)

* Denotes significance at 5% level (just significant)
† Denotes significance at 1% level
‡ Denotes significance at 0·1% level (very significant)

TABLE V. ALL FORMS OF TUBERCULOSIS

	Number in Group	Number of Cases	% of Cases	Probability and Significance	
Asiatic Males (15-19)	791	7	0·88	0·0004	‡ (Low)
Asiatic Females (15-19)	259	2	0·77	0·3	† (Low)
Asiatic Males (25-29)	640	29	4·53	0·006	† (High)
Asiatic Males (30-39)	580	27	4·66	0·005	† (High)
Coloured Females (40-49)	50	4	8·00	0·048	* (High)
European Males (50-59)	16	3	18·7	0·009	† (High)
European Females	235	2	0·85	0·05	† (Low)
All Races, both sexes (15-19)	1,859	16	0·861	$<10^{-5}$	† (Low)
All Races, both sexes (25-29)	1,341	52	3·878	0·007	† (High)
All Races, both sexes (30-39)	1,349	53	3·929	0·005	† (High)

Average rate of incidence = 200/7,456 = 2·682%

(*active* cases only) gave significant variations from the normal. The results of a similar analysis of the distribution of *all forms* of tuberculosis in the workers are shown in Table V.

It was suggested that the size of the factory might have an effect on the incidence of tuberculosis. The factories were therefore grouped into 4 classes according to the number employed, as indicated in Table VI.

TABLE VI

Size of Factory	Number of Factories	Total X-rayed	% Tuberculosis Active	% Tuberculosis All Cases
50-100	15	1,011	1·48	2·77
101-200	15	2,041	1·08	2·20
201-300	4	975	1·23	2·66
Over 300	5	2,528	1·34	2·49

There was found to be *no significant difference* between the percentages for these 4 groups. This will be referred to again under 'Discussion'.

It is emphasized that the above figures should not be taken uncritically, but the following conjectures are supported by them.

(1) Active tuberculosis is more prevalent among Natives than other racial groups. The percentage of all cases (2·818) is also higher than the average rate (2·682), but the difference is not statistically significant, having a probability value of 0·38.

(2) The prevalence increases with age. There are significantly low values in the 15-19 age-groups, and significantly high values for the older groups. This is also supported by a steady increase in percentage with age in active cases, and a somewhat similar trend for all cases (Table VII).

(3) Pulmonary tuberculosis may be more prevalent in males than in females.

Note: The above figures apply *only* to workers in the Durban Clothing Industry, and these workers are certainly *not* a random sample of the population of Durban. Our conclusions, therefore, should not be considered as applying to the whole population of Durban and *a fortiori* do not apply to any larger population. They are chiefly of value for comparison with similar figures from other industries, or the same industry in a different location or at a different time.

COVERAGE

In the original survey, out of 7,510 workers, all but 238 were X-rayed. If a considerable number of these

TABLE VII

Age	15-19	20-24	25-29	30-39	40-49	50 *and over*
Active	0·548%	1·392%	1·641%	1·705%	2·004%	2·751%
All Cases	0·861%	2·349%	3·878%	3·929%	3·808%	5·505%

had been absent *because* they had tuberculosis, the results could have been completely misleading, since 238/7,510 is 3·17%, and only 2·682% of cases were found. However, 184 of these absentees were subsequently X-rayed, and, except in the case of European males, there was no reason to suspect that this was the case. The 54 persons not X-rayed, whom it was not possible to trace, were almost certainly a random sample from the whole group, and it is therefore almost certain that their inclusion would not have affected the results.

DISCUSSION

South African industry has grown enormously since 1939. This has been markedly so in the case of the clothing industry. According to Routh the working force of this industry increased by 152% between 1935 and 1952.[3] A feature of this increase has been the steady replacement of White by non-White labour at most of the bench jobs. In 1938 Whites constituted 61·2% of the workers in the clothing industry, whereas in 1952 though their total numbers had increased they supplied only 29·4% of the workers in this industry in South Africa. In Durban this drop was from 20·4% with 373 employed in 1938 to 5·5% with 423 employed in 1953.[6]

The population of this industry in Durban consists of all 4 races living in South Africa, i.e. White, Asiatic, Coloured and Native. The Whites constitute the smallest portion of the group, and are employed mainly as directors, secretaries, engineers, clerks and typists, with only an occasional machine operator. The Asiatic and Coloured group operate predominantly as machinists, and occasionally as directors and clerks. In the Native group the females are employed as machinists, and the males work as cleaners, packers and delivery hands.

Clothing workers in Durban work 42½ hours over a 5 day week, and any overtime is paid for at the rate of 'time and a half'. Their benefits include an annual 3 weeks' holiday and they may receive sick-pay for a period of 8 weeks during the year. They enjoy a free medical service which includes medicines.[6]

In the clothing industry we do not know of any substance in the atmosphere which is injurious to the lungs, thereby making clothing workers more susceptible to tuberculosis. Infection, however, is likely to spread more easily from the acute and chronic cases, owing to the fact that the workers are in close and continuous contact with one another throughout the working day.

Our material shows a significantly higher prevalence of active pulmonary tuberculosis amongst the Native than in the White, Asiatic and Coloured populations. In the Native, whose general resistance in Natal at present would appear to be lower than that of the other 3 racial groups surveyed, active pulmonary tuberculosis is not an unexpected finding in view of the relatively higher incidence of the disease locally. Higher mortality rates are also reported in this racial group,[7] where the socio-economic factors are weighed against them and their cultural and dietary habits are not yet suited to urbanization.

There is a definite increase of tuberculosis with age, which is seen in Table VII, where the probabilities of the material have been significant. This appears to compare with previous reports.[4] The prevalence of tuberculosis amongst the males of the whole group is higher than for the females. The difference is significant at the 5% level (using the standard error of a proportion) for *all cases*, but is *not* significant for active cases only. There appears to be two possible causes for this difference: (*a*) there is a larger proportion of males in the higher age-groups, and (*b*) of the cases found, 22·8% of the males and 10·1% of the females were previously-known diagnosed cases (Table VIII). With

TABLE VIII. PULMONARY TUBERCULOSIS CASES 'KNOWN' BEFORE SURVEY

	European	*Coloured*	*Asiatic*	*Native*	*Total*
Male	—	—	29	1	30
Female	—	6	—	1	7
Total	—	6	29	2	37

regard to (*a*) it can be shown that the effect is so slight as to be negligible. In case (*b*) the high percentage of known male cases is probably explained by the facts that (1) the clothing industry is a comparatively light and suitable occupation for treated tuberculosis cases and chronic cases, and (2) the males are in the main the primary breadwinners, and therefore return to work more often, and many who are diagnosed refuse to be hospitalized or stop work. The female, who usually supplements the home earnings, can afford to report sick early and stop working more easily. Thus *the higher percentage of cases known before the survey* may account for the higher prevalence of pulmonary tuberculosis in males.

Stewart and Hughes,[8, 9] reporting on their survey of the Boot and Shoe Industry, have observed that acute undiagnosed cases usually occurred in association with chronic cases (previously notified or undiagnosed cases) and that the proportion of acute to chronic disease steadily increased with the increase of factory size. They show that pulmonary tuberculosis in boot and shoe factories employing more than 600 workers was 3 times as great as in factories with fewer than 100 operatives, and factories of intermediate size show a steady gradation between these two. They noticed this in the clothing industry as well.

When we investigated the prevalence of pulmonary tuberculosis in groups of factories of varying size (Table VI), it was found that there was no significant difference as reported by Stewart and Hughes; our findings would indicate that factory size was not as important as grouping of workers, i.e. the amount of floor space allowed for each worker. This, to our way of thinking, is a more reasonable explanation of the high prevalence in all factories, both small and large, where the factory laws provide a minimum of 25 sq. ft. per person. In the clothing factories surveyed it would appear that the larger the factory, the more floor space was allowed per worker, whereas the smaller factories allowed the minimum of floor space. It may be that the more crowded conditions of the small factories

compensated for the small working unit, and the larger floor space compensated for the larger working units; so that factory size is not shown to be a controlling factor here as in the Boot and Shoe Industry. The density of our workers, as mentioned above, decreases as the factory gets larger, contrary to what was shown in the Boot and Shoe Industry.

In our survey we have not noticed any difference in the prevalence of pulmonary tuberculosis in the more modern factories, as compared with the older factories where the machinists are placed face-to-face. The modern factories have their workers working one behind the other with the goods moving down the lines from the back forward, and one is tempted to think that these methods are preferable.

The prevalence of pulmonary tuberculosis is higher in this industry than has been found in industry as a whole in Durban,[1] and this might possibly be due to the continuous close contact resulting from the working conditions of this industry, which favours the spread of any infectious disease.

As previously stated, it is considered by most workers to be a suitable employment for ex-tuberculosis patients. The majority of the workers are non-Whites, who are not always particular whether they have treatment or not, as long as they can hold a job and earn a living. In other industries the workers are rarely grouped so closely together throughout the working day, and tuberculous cases deteriorate more rapidly and so have to stop working sooner, with the result that they possibly infect fewer of their fellow workers.

Stage of Disease. The extent of pulmonary involvement shows that 69·5% of the cases were minimal, 20% moderately advanced and 10·5% far advanced (Table III). It is interesting to note that the extent of the disease present in the various races does not show any significant differences. It is also to be noted that the group of 184 workers caught up in the second attempt did not make any difference to the original results, and could not therefore be considered as a group who defaulted purposely.

CONCLUSIONS

This 99·28% mass X-ray survey of the workers in the clothing industry has shown that with the co-operation of the Industrial Council and the management of the industry a complete survey is possible in Durban.

The prevalence of pulmonary tuberculosis is high in the clothing industry at present compared with other industries in Durban.

Active pulmonary tuberculosis is more prevalent amongst the Natives than other races.

There is a definite increase of pulmonary tuberculosis with age.

Pulmonary tuberculosis may be more prevalent in males than in females.

There appears to be no relation between the size of a factory and the prevalence of pulmonary tuberculosis.

SUMMARY

A survey of the clothing industry in Durban is described in which 7,456 workers were X-rayed out of a total group of 7,510 (99·28% coverage).

The material consisted of workers in 4 different races, all age-groups and both sexes.

The material is presented in charts and tables, with conclusions drawn from the statistically significant data.

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