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# OCCUPATIONAL LUNG DISEASES AMONG FORMER GOLDMINERS IN TWO LABOUR SENDING AREAS

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*Objectives.* To compare and contrast the prevalence of pneumoconiosis in two groups of former migrant mineworkers in southern Africa, and to examine the effectiveness of the South African compensation system for occupational lung diseases.

*Design.* Comparison of two cross-sectional studies and follow-up data on compensation results.

*Setting.* The village of Thamaga, Botswana and the rural area of Libode, Eastern Cape, South Africa.

*Subjects.* Two hundred and thirty-four former underground mineworkers in Thamaga, and 238 in Libode.

*Main outcome measures.* Prevalence and severity of pneumoconiosis, prevalence of radiological signs of tuberculosis (TB), Medical Bureau for Occupational Diseases (MBOD) certification committee decisions, and compensation results.

*Results.* Prevalence of pneumoconiosis ≥ 2/1 was 15.4% in Libode and 13.6% in Thamaga. Significantly more Libode than Thamaga subjects (51.1% versus 29.0%) reported past TB treatment. Radiological signs of pulmonary TB were also more prevalent in Libode (33.3% v. 23.9%). Twenty-six per cent of Libode men and 16.1% of Thamaga men were certified with compensable disease. Libode payments were finalised within 30 months, whereas Thamaga cases only began receiving payments 52 months after medical

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examination, with 11 cases still pending 66 months after medical examination.

*Conclusion*. There was a high prevalence of pneumoconiosis in both study groups. Many men were eligible for compensation but were previously uncompensated. The higher rate of compensable disease in the Libode group may relate to the higher prevalence of TB, as well as more active follow-up by the study group, including a large number of appeals. Socio-political changes in South Africa between 1994 and 1996 may also have influenced compensation results.

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Deep-level goldmining is an activity with inherent and well-defined health hazards. The respiratory diseases associated with occupational exposure to respirable silica in goldmining include silicosis,[1] tuberculosis (TB)[2,3] and chronic obstructive airways disease.[4,5] The 1994 Leon Commission of Enquiry into Safety and Health in the Mining Industry discussed these hazards and found no evidence of any improvement in exposure to respirable silica dust over the last 40 years.[6] The Leon Commission also noted that while South Africa can draw on over six decades of research on mining-related occupational lung disease, this research has concentrated on in-service workers, with a bias towards white workers. It was noted that the only data pertaining to the prevalence of occupational lung disease in black, former gold mineworkers were collected in the early 1930s.[7]

The lack of occupational health data pertaining to black, former gold mineworkers can in part be ascribed to the migrant labour system. Migrant labour remains a central feature of employment for black gold mineworkers in southern Africa. In 1985 there were approximately 500 000 migrant mineworkers.[8] Since then the industry has contracted and by 1996 this figure had dropped to 340 000.[9] Historically, migrant mineworkers have come to South Africa from surrounding territories, extending as far north as Angola and Tanzania. This oscillating labour migration results in the movement of workers, without their families, between rural and urban areas. The majority of occupational lung diseases have a long latency period between time of exposure to risk factors on the mines and the development of disease, as a result of which mineworkers often manifest occupational disease in the areas to which they return after leaving mine employment.[10] Occupational health surveillance facilities are very limited in the rural areas to which the majority of mineworkers return after leaving mine employment.

There are only two modern studies of occupational lung disease in black, ex-migrant gold mineworkers. The first study was conducted in Thamaga village, Botswana in 1994[11] and the second in Libode district, South Africa in 1996.[12]

The Occupational Diseases in Mines and Works Act (ODMWA) of 1973, amended in 1993, applies to all people who have performed risk work at a controlled mine or works in South Africa. The ODMWA is a 'no fault' compensation system that makes provision for compensation for the following diseases: pneumoconiosis, pneumoconiosis together with TB, permanent obstruction of airways, progressive systemic sclerosis and any other permanent disease of the cardio-respiratory organs attributable to risk work. Provision is made under the ODMWA for the level of risk in each controlled mine and works to be assessed by means of periodic gavimetric dust sampling, and on the basis of this assessment a levy is raised from each employer. The levy is paid into a central fund against which mineworkers can claim compensation. Three institutions within the Department of Health provide services required for the ODMWA compensation system, namely the Medical Bureau for Occupational Diseases (MBOD), the office of the Compensation Commissioner for Occupational Diseases (CCOD) and the Pathology Division of the National Centre for Occupational Health. The ODMWA has established a Medical Certification Committee to determine whether or not an occupational lung disease is present. The ODMWA defines disability due to compensable disease according to two degrees. First-degree disability is defined as one of the scheduled diseases resulting in a permanent disability of more than 10% but less than 40%. Second-degree disability is defined as either two or more compensable diseases occurring simultaneously (e.g. pneumoconiosis and TB), or a single disease producing a permanent disability of greater than 40%.

Until 1998, there were no statutory regulations governing the work of the Medical Certification Committee of the MBOD. Specific regulations were proposed in July 1998;[13] all cases reported on in this paper were finalised before the introduction of these regulations. The regulations are intended to standardise decisions of the MBOD Certification Committee and to assist referring doctors in assessing the probability of eligibility. For the purposes of this paper the regulations of interest pertain to first- and second-degree silicosis. The regulations state that first-degree silicosis can be certified as such if there is International Labour Office (ILO) Radiological Classification of Pneumoconioses profusion category $\geq 1/1$ plus moderate restrictive or obstructive lung function abnormality (i.e forced expiratory volume in 1 second ($FEV_1$) or forced vital capacity (FVC) 65 - 52% of predicted value or $FEV_1/FVC$ ratio < 65). In the absence of pulmonary function tests, first-degree silicosis is certified as such if the chest radiograph is read as $\geq 2/2$. Second-degree silicosis is classified as $\geq 1/1$ plus severe lung function abnormality (i.e. $FEV_1$ or FVC < 51% of predicted value or $FEV_1/FVC$ ratio < 55). As noted above, silicosis with TB should also be classified as second degree. The regulations are expected to be gazetted during the year 2000 (A Banyini — personal communication).

Before the 1993 amendment to the ODMWA, compensation payments were based on race and favoured whites over blacks. Furthermore, while white workers underwent bi-annual, state-funded medical surveillance, black workers were excluded from state occupational disease surveillance systems at the MBOD.[14] Given the historical legacy of the ODMWA, it is not surprising that there is a low level of awareness of and compliance with the provisions of the ODMWA by rural health workers with regard to former mineworkers in mine labour sending areas.

## Study objectives

The objectives of the original studies in Thamaga and Libode were threefold. Firstly, to conduct cross-sectional prevalence studies of occupational lung disease in the study group. Secondly, to examine likely relationships between occupational lung disease and length of service. Thirdly, to establish if any of the mineworkers in the sample groups might be eligible for compensation and to help them claim such compensation.

The objectives of this paper are twofold. Firstly, to compare the radiological, spirometric, occupational, respiratory symptom and compensation history data for the two groups. Secondly, to evaluate the experiences of the two study groups in their efforts to obtain compensation. This comparative analysis will allow us to assess the burden of disease externalised by the South African mining industry and the ability of the compensation services to serve the majority of former mineworkers.

## Subjects and methods

Both Thamaga and Libode were selected for study because they represent typical rural mine labour sending areas, with a long history of labour recruitment. While the study areas are similar in many ways, Thamaga study subjects had greater access to clean drinking water, pit latrines, electricity and health care services. The two study areas also differ climatically; Libode has an average rainfall of 750 mm, almost double that of Thamaga's 450 mm. Detailed descriptions of the study areas and methodologies are available elsewhere.[11,12]

The study in Thamaga included a random sample of former mineworkers, identified by a household survey of the village, and also an open access, volunteer arm. While the Thamaga subjects were not all randomly selected, there were no significant differences in the volunteers and the random sample with regard to medical or occupational histories. Two hundred and thirty-four former underground gold mineworkers participated in this study. Ethical approval was obtained from the Health Research Unit, Botswana Ministry of Health.[10]

The study in Libode was a survivor cohort study comprising 238 former gold mineworkers identified by random sampling of mine recruitment records between 1969 and 1980 for the Libode district. Ethical approval was obtained for the study from the Ethics Committee for Research on Human Subjects, University of the Witwatersrand, South Africa.[11]

In both Thamaga and Libode, all study subjects underwent a medical examination including spirometry and radiography. An identical occupational history questionnaire and a similar respiratory symptoms questionnaire were used for all study subjects. The chest radiographs were subsequently read into the ILO classification of the pneumoconioses[15] by two readers in the Thamaga study and three in Libode. One of the readers (NW) is common to both data sets and all subsequent radiological comparative analysis presented in this paper is based on this reading.

In Thamaga, compensation claims were made on a selective basis, with no claim being made unless the referring doctors or the radiological reader suspected pneumoconiosis or other compensable disease. Of the 234 former underground goldminers, claims were made for 143 study subjects (61%). No initial attempt was made to follow these claims up actively. When it became apparent that significant delays were occurring, the health workers and researchers associated with the study undertook a more active case follow-up. Thirteen appeals were made to the MBOD in 1997.

In Libode, medical benefit forms were completed for all study subjects and forwarded to the compensation authorities. Once at the compensation authorities, there was active follow up of all cases, including the employment of a former mineworker as a compensation officer. This fieldworker assisted workers in processing documentation from the compensation authorities. In addition, the principal investigator invested several hours per week for the 2 years following the study to ensure that cases were finalised. Sixty-seven appeals were made.

All cases from Libode and Thamaga were considered by the MBOD Medical Certification Committee panel, with the same chairman presiding in all cases.

Outcomes in the two groups were evaluated by first comparing the demographics of the two groups and the actual decisions of the MBOD Certification Committee. Based on clinical history, radiological findings and spirometry, each case in both series was then evaluated in terms of the published proposed regulations in order to standardise the decisions of the MBOD Certification Committee.[13] Time taken for compensation to be paid was also evaluated.

Data were analysed using epidemiological software (Epi-info version 6.0, Centers for Disease Control, Atlanta, USA). Chi-square tests and *t*-tests were used for significance testing, with results reported as 95% confidence intervals (CIs).

## RESULTS

Table I shows that the Thamaga subjects were older (55.8 v. 52.8 years), had more years of service and longer time since last employment (i.e. since last exposure). There were no significant differences in mining occupational category, with the majority of workers being involved in high-dust occupations (data not shown). Prevalences of smoking, productive cough and dyspnoea were significantly higher in Libode than in Thamaga. Also, significantly more Libode study subjects reported previous TB treatment.

Forty-three per cent of Libode study subjects and 24% of Thamaga cases recorded readings of $FEV_1/FVC < 75$, a difference of 18.5% (95% CI 10.2 - 27.2). However, there were no significant differences with regard to prevalence of moderate and severe airflow limitation ($FEV_1/FVC < 65$).

Table II compares the ILO readings of the two study groups. The prevalence of ILO profusion ≥ 1/0 was 36.5% in Libode and 31.1% in Thamaga. ILO readings showed moderate to severe profusion (> 2/1) in 15.4% of Libode cases and 13.6% of Thamaga cases, the difference being non-significant. There was a significant difference in the prevalence of radiological evidence of TB between the two groups (33.3% in Libode and 23.9% in Thamaga).

As shown in Table III, 26.4% of Libode cases were found by the MBOD Certification Committee to have first- or second-degree compensable disease compared with 16.1% of Thamaga cases, a difference of 10.3%. The proportion of Libode cases certified with second-degree disease (15.1%) was more than double that of the Thamaga cases (7.0%). While there is a difference in certifications over the whole spectrum of radiological changes, the difference is particularly high in those cases where the independent reader found profusion 1/0, 1/1 or 1/2, as shown in Fig. 1.

Table IV shows projected (hypothetical) MBOD certifications based on the independent reader's ILO classifications as well as spirometry results, and applying the ODMWA and the proposed 1998 regulations. In terms of this analysis, there are no significant differences between the two groups.

The first payment to Libode random sample cases was made in August 1996, 5 months after the medical examinations. Sixty-three study subjects received compensation, with amounts ranging from R16 869 to R64 667 (South African Rands). The mean compensation payment for first-degree disability was R22 387, and for second-degree disability R39 555. All findings resulting from the original Certification Committee decisions

**Table II. ILO readings pertaining to former mineworkers in Thamaga, Botswana and Libode, South Africa (%)**

| ILO readings | Thamaga ($N$ = 227)* | Libode ($N$ = 228)† |
|---|---|---|
| 0/0 - 0/1 | 68.2 | 63.6 |
| 1/0 - 1/2 | 18.1 | 21.1 |
| 2/1 - 2/2 | 10.1 | 14.5 |
| 3/2 - 3/3 | 3.5 | 0.9 |
| Signs of TB | 23.9 | 33.3 |

* Seven Thamaga radiographs were unreadable.
† Ten Libode radiographs were unreadable.

**Table III. Actual MBOD Certification Committee decisions for Thamaga, Botswana and Libode, South Africa**

| Committee decision | Thamaga ($N$ = 143)* | Libode ($N$ = 238) |
|---|---|---|
| Compensable, 1st degree (%) | 9.1 | 10.9 |
| Compensable, 2nd degree (%) | 7.0 | 15.1 |
| TB cannot antedate (%) | 24.4 | 24.0 |
| No compensable disease (%) | 55.2 | 50.0 |
| Unable to find case at MBOD (%) | 4.2 | 0 |

* Claims were not submitted for 91 of the 234 workers.
MBOD = Medical Bureau for Occupational Diseases.

**Table IV. Projected MBOD certifications, applying ODMWA and proposed 1998 regulations**

| Projected certification | Thamaga ($N$ = 227) | Libode ($N$ = 228) |
|---|---|---|
| Compensable, 1st degree (%) | 4.8 | 9.2 |
| Compensable, 2nd degree (%) | 15.9 | 15.8 |
| NCD/TB cannot antedate (%) | 79.3 | 75.0 |

MBOD = Medical Bureau for Occupational Diseases; ODMWA = Occupational Diseases in Mines and Works Act; NCD = no compensable disease.

**Table I. Descriptive data pertaining to former mineworkers in Thamaga, Botswana and Libode, South Africa**

| Category | Thamaga ($N$ = 234) | Libode ($N$ = 238) | Difference (95% CI) |
|---|---|---|---|
| Age (SD) | 55.8 (12.6) | 52.8 (10.5) | 3.0 (0.9 - 5.1) |
| Years in mining (SD) | 14.6 (8.0) | 12.2 (7.0) | 2.4 (1.0 - 3.8) |
| Years since last service (SD) | 15.7 (10.2) | 11.9 (8.2) | 3.8 (2.1 - 5.5) |
| Current smoker (%) | 42.3 | 52.9 | 10.6 (1.6 - 19.6) |
| Chronic productive cough (%) | 36.3 | 51.6 | 15.3 (6.5 - 24.1) |
| Current dyspnoea (%) | 7.7 | 27.7 | 20.0 (13.3 - 26.6) |
| Previous TB treatment (%) | 29.0 | 51.1 | 22.1 (13.5 - 30.7) |

SD = standard deviation.

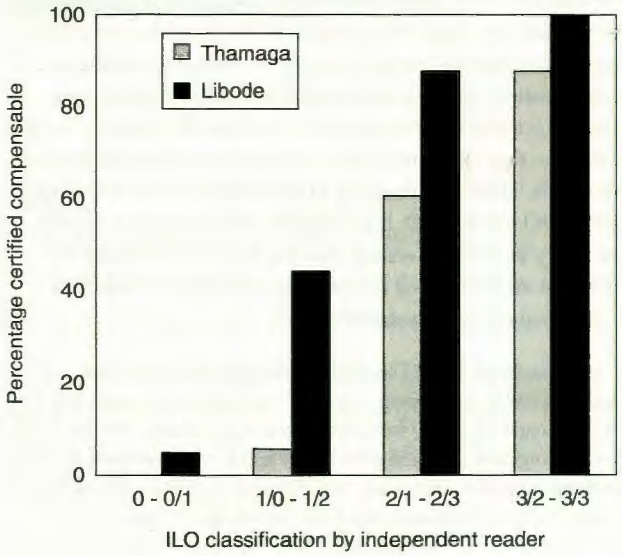


*Fig. 1. Percentage of men certified with compensable disease by the MBOD, using ILO grades.*

were finalised between August 1996 and May 1998. Of those with compensable disease, only one man was found to have been paid in full for first-degree pneumoconiosis and hence was not eligible for further compensation. All other study subjects were eligible for compensation either for the first time or as a result of disease progression.

The first payments to Thamaga men were made in October 1998, 52 months after the medical examinations. Payments so far have ranged from R12 404 to R39 316. The average amount awarded to Thamaga first-degree cases is R16 508, and to second-degree cases R26 838. Two men with first-degree disease were found to have been compensated earlier. Two eligible men were not compensated because they died during the compensation process, and there was no widow, or dependant under the age of 21 years.

By November 1999, 11 Thamaga cases were still awaiting payment by the CCOD. In four of the pending cases, the miner was dead and the widow was claiming. The main delays in finalising the Thamaga cases have resulted from problems pertaining to filling in compensation forms from the CCOD, as almost all the Thamaga cases were finalised by the MBOD before the end of 1994.

## Discussion

The data presented above show that the Thamaga men are older, have a longer mining exposure and a greater time since last exposure than the Libode group. Given these data, as well as the selective claims strategy, one would expect that the Thamaga group would show a higher prevalence of radiological and compensable lung disease. However, the radiological findings with regard to small opacity profusion are very similar. In addition, the Libode study subjects manifested significantly more radiological evidence of TB than the Thamaga study group. This finding fitted with the significantly higher reported history of previous treatment for TB in Libode, and with older data showing higher TB morbidity rates in workers from the Transkei than from any other labour-providing territory.[16] Botswana has had a good TB control programme for many years, which might also explain some of the differences with regard to radiological evidence of TB.

There are several reasons that may explain why the Libode study subjects report more chronic productive cough and dyspnoea than the Thamaga study subjects. The higher reported smoking rate, the higher prevalence of previous TB, and the cool, wet climatic conditions in Libode may all predispose to the reported respiratory symptoms.

Comparison of the decisions of the MBOD Certification Committee shows that while there is no significant difference in the findings with regard to first-degree certification, there are significantly more second-degree certifications in the Libode group. As discussed above, in Libode all study subjects were submitted to the MBOD regardless of the opinion of the sending doctor, whereas in Thamaga the research workers undertook a pre-screening exercise and only submitted cases that they thought showed significant radiological and spirometric evidence of occupational lung disease. One might have thought that this pre-screening in Thamaga would bias the compensation data, relative to the Libode cases, in favour of cases with a strong probability of being certified compensable. We suggest that the greater number of second-degree certifications among the Libode group are due to the greater prevalence of TB, and a larger number of appeals.

However, we do not believe that this provides a full explanation. As shown in Fig. 1, frequency of certifications was higher in Libode than Thamaga across the whole spectrum of radiological disease severity. We suggest that the background of socio-political events in South Africa in the mid 1990s may be a factor to be considered. The Thamaga cases were evaluated in June 1994, immediately after the first democratic elections in South Africa and hence before transformation of the South African health services. The Libode cases were evaluated 2 years later, in the aftermath of the Leon Commission, and in a period in which a new mine health and safety legislation was in the process of being drafted. The committee was therefore operating in a significantly different socio-political context.

We believe that our data show a strong need for transparent procedures and formal adoption of standardised evaluation of cases by the MBOD Certification Committee.

The long delays with the CCOD experienced by the Thamaga group is not a new finding.[14] It should be noted that

the Thamaga study group undertook all that is required under the ODMWA, i.e. they undertook a thorough medical examination and submitted cases promptly to the MBOD. However, the more active follow-up strategy pursued by the Libode team, particularly the use of a community-based ex-mineworker as a fieldworker to assist with compensation claims, certainly facilitated the efficient settling of their cases.

One apparent reason for the delays experienced in the Thamaga group is simply that the CCOD is understaffed and was not computerised. Furthermore, while we are aware that the Compensation Commission deals with large monetary awards and requires systems to protect itself and individual beneficiaries against fraud, it is clear that the completing of compensation forms under the ODMWA requires a level of literacy beyond that of the majority of former mineworkers. It also requires access to a photocopying machine and familiarity with legal processes (such as certifying the validity of documents) that is rare in rural communities. The CCOD provides a 'help desk' in Johannesburg where claimants are assisted in completing the relevant documentation. This service is only within the reach of ex-mineworkers with the means to travel to Johannesburg, or to make long distance telephone calls. There is a need to provide clear instructions for completion of CCOD forms and to decentralise the CCOD 'help desk' so as to provide such a service in all the major labour sending areas of South and southern Africa. It has been suggested that existing structures such as The Employment Bureau of Africa (TEBA) facilities could be utilised for this purpose.[6] Alternatively, there is a need to train rural health workers, and to advise office workers, trade unionists, civic structures, traditional leaders and church groups as to the workings of the CCOD.

We are unable to explain why average compensation payments in Thamaga were more than 25% lower than those made to people from Libode, given that both groups were evaluated under the same statute, over the same time period and did very similar jobs while in the mining industry. The amounts paid as lump sum benefits are modest relative to the cost of living in the region. Even with wise investment, the kind of benefits being paid for second-degree disability would never provide a disabled person with the same security as a regular pension. The ILO is of the view that all compensation payments should be in the form of pensions. Such a provision would bring compensation payments under the ODMWA in line with payments under the Compensation of Occupational Injuries and Diseases Act of 1993.

## CONCLUSION

The high levels of previously undiagnosed occupational lung disease in both areas highlight the need for occupational health surveillance in rural labour sending communities. The different outcomes with regard to compensation in the two studies may be explained by a higher prevalence of TB in one community, but political events in post-apartheid South Africa may also have influenced the certification authorities. Processing of compensation claims under the ODMWA is complex, and requires active follow-up on the part of health workers in order to ensure that ex-mineworkers with pneumoconiosis receive payments. There is a need for improvement in the workings of the MBOD and CCOD. Education of stakeholders is clearly necessary in order to ensure that the legal rights under the ODMWA are translated into *de facto* service provision and finalisation of compensation claims.

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