



Disease experience over one year of follow-up in a cohort of workers recently laid off from a South African gold mine: mortality, HIV and TB incidence, radiological change and lung function decline

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INTRODUCTION

Background: The current system of statutory surveillance and compensation for workers who develop silicosis and tuberculosis from working in South African gold mines is likely to miss those who have left their jobs. After returning to their home communities, ex-miners are reliant on local health care. Further, despite their statutory right to regular medical examinations at mining company health facilities, there is no active medical surveillance of ex-miners by mining companies or the state. This omission is particularly problematic since the most common diseases, tuberculosis and silicosis, may have long latent and/or sub-clinical periods before detection. The burden of occupational lung disease is thus passed on to the miners and their communities, in many cases without any statutory compensation.

Previous studies of ex-miners living in labour-sending communities in Botswana and the Eastern Cape Province of South Africa have shown a prevalence of silicosis as high or higher than in-service miners.¹⁻³ However, these cross-sectional studies may have captured prevalence of disease only among survivors. They may also be biased in the opposite direction by the concentration of workers who left their jobs for health reasons.

An opportunity to study ex-miners who left employment for reasons unrelated to their health arose in March, 1998, when a mine in the Free State Province of South Africa closed for economic reasons. Numerous studies have shown the heavy burden of HIV, tuberculosis, and silicosis in in-service miners, yet few have followed the progression of these inter-related diseases in miners once they have left employment and returned home.

Objective: To describe the experience of TB, mortality, deterioration of silicosis and lung function and incidence of HIV over a one-year period in a cohort of Basotho gold miners who returned home for reasons unrelated to their health.

METHODS

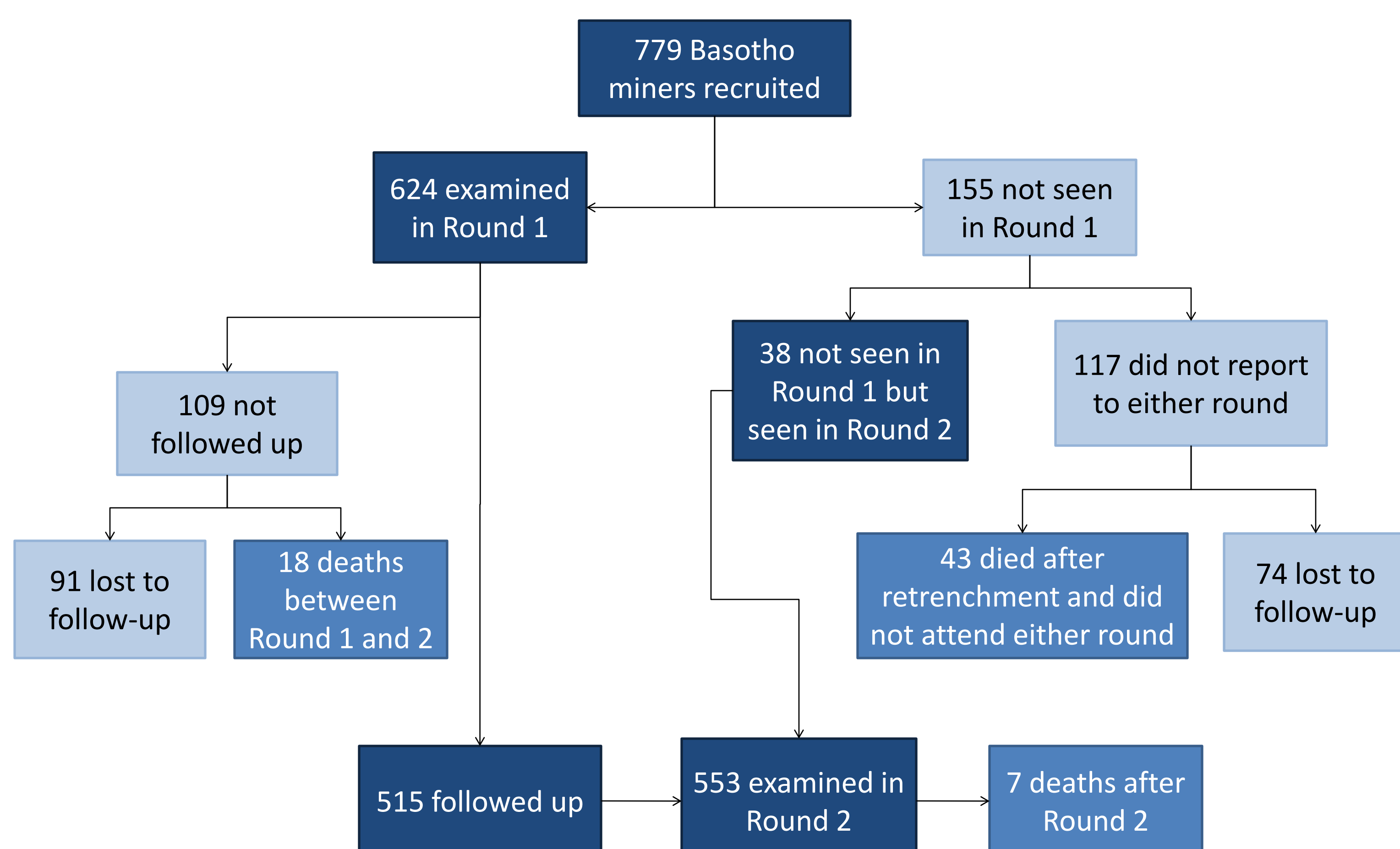
A cohort of 779 Basotho ex-miners was followed up 18 months after returning to Lesotho (Round 1) and again one year later (Round 2). In each round, participants were transported by bus to the mining company's hospital in the Free State Province, South Africa, where they were given a respiratory questionnaire and asked to submit a urine specimen for HIV testing. A physical examination, standard chest radiograph, and spirometry were also performed.

A modified version of the American Thoracic Society respiratory questionnaire, translated into Sesotho, was used to assess respiratory symptoms and history including past TB and smoking. At both rounds, all urine specimens were first screened using the immunoglobulin G (IgG) antibody capture particle adherence test (GACPAT). The IgG antibody capture enzyme-linked immunosorbent assay (GACELISA) was used to confirm positive or equivocal GACPAT results. Full standard posterior-anterior chest radiographs were taken at each round. Four readers examined the radiographs according to the International Labour Organization (ILO) classification system. Each reader was blind to the other readers' classifications, to the participant's previous medical history, and in Round 2, to the radiograph results of Round 1. Spirometry was performed identically at both rounds using a Hans Rudolph pneumotachograph (Flowscan; Electromedical Systems Inc., South Africa).

In Round 1, participants who had symptoms or a chest radiograph suggestive of TB were referred for further evaluation including submission of three sputum samples for smear, culture, and susceptibility testing. In Round 2, active case finding was not performed owing to budgetary constraints. Only the prevalence of participants on TB treatment at the time of Round 2 and the number of people who completed TB treatment between rounds are reported. Assuming a steady state, the pulmonary "TB treatment incidence rate" was calculated from the prevalence and duration of TB treatment (treatment incidence = prevalence on treatment/mean duration of treatment). To calculate mean duration of treatment, we assumed an eight-month course of treatment for those with a previous history of tuberculosis and a six-month course for those without. Because the number of those who completed treatment between retrenchment and Round 1 were unknown, the incidence of treatment calculated for both rounds was based only on prevalence of those on treatment at the time of the examination to ensure comparability.

This study was approved by the ethics committees of the Faculty of Health Sciences at the University of Cape Town and AngloGold Health Services. Informed consent forms were translated into Sesotho and written consent was obtained from all study participants.

RESULTS



RESULTS

HIV Prevalence (Round 1)	HIV Prevalence (Round 2)	One-Year HIV Incidence
93/472 (19.7%)	107/472 (22.7%)	5.43 cases/100 PY (95% CI: 3.39, 8.18)

TB: Since active case finding was not carried out at Round 2, only the incidence of TB treatment can be reported as a "minimum" incidence.

Minimum incidence Round 1: 2833 cases/100,000/yr
Round 2: 3025 cases/100,000/yr

Silicosis and radiological change:

Distribution of ILO profusion scores (n=508)

	Normal (0/0)	Borderline (0/1, 1/0)	Grade I (1/1, 1/2)	Grade II (2/1, 2/2, 2/3)	Grade III (3/2, 3/3)
Round 1	301 (59.2%)	72 (14.2%)	67 (13.2%)	62 (12.2%)	6 (1.2%)
Round 2	293 (57.7%)	78 (15.3%)	54 (10.6%)	75 (14.8%)	8 (1.6%)

Silicosis (ILO score $\geq 1/1$) prevalence Round 1: 26.6%, Round 2: 27.0%

The distribution of silicosis at follow-up did not differ significantly from baseline.

Logistic regression was performed with any worsening of profusion score as a binary outcome. Out of age, length of employment in underground mine, smoking, past TB, active TB at baseline, and HIV, only active TB at baseline predicted a worse ILO profusion score at Round 2 (OR=2.25, 95% CI: 1.11-4.54).

Lung Function: The miners recorded a mean 91 ml drop in FEV1 (95% CI 67 - 116 ml) between rounds. The FEV1/FVC ratio also showed a mean two percentage point decline. There was no change in FVC. FEV1 is the most robust of the lung function parameters since FVC is easily truncated during spirometric tests. Therefore, difference in FEV1 between rounds was used as the outcome variable in modelling lung function decline. Years of employment, past TB, active TB at Round 1, and silicosis at Round 1 were included in the model. Only active TB at Round 1 was associated with a meaningful decline in FEV1 of 132 ml (95% CI 39 - 226 ml) between rounds.

Body Mass Index: BMI declined on average 0.58 kg/m² in all participants. The decline was statistically significant in those with HIV, silicosis, or TB in Round 1, as well in those ex-miners with neither HIV infection nor silicosis and not on TB treatment between rounds.

Mortality: 41 ex-miners died between retrenchment and Round 1. Of those that attended at least one round, 18 died between Rounds 1 and 2, and 7 died after being seen in Round 2. Two others who did not attend either round were confirmed to have died during the course of the study. Total confirmed deaths were 68. Of the 12 participants who were known to have died within one year of Round 1, nine (75%) were HIV positive. Ten out of the 12 exhibited a chest or respiratory problem, including three confirmed cases of TB. The other two died of complications from diabetes mellitus, or dehydration/diarrhoea.

CONCLUSION

This study demonstrates that Basotho miners not only carry a large burden of tuberculosis, silicosis, and HIV infection but that incidence of HIV and TB does not decline upon returning home to their communities. This in turn has adverse effects on lung function and progression of silicosis.

HIV incidence is high, even after the migratory cycle ends. Likewise, this study shows no abatement of tuberculosis rates after leaving the mining environment. Though active case finding was not done at follow-up, the TB estimates based on prevalence of treatment can only be an underestimate of the true incidence. Given that active TB at baseline was a strong predictor of both silicosis progression and lung function decline, improved HIV and TB prevention and treatment programs for both miners and ex-miners are imperative.

The recent rollout of antiretroviral treatment by mining companies is laudable, but miners and their families at home still lack access to adequate health care. A collaboration between mining companies and health systems in labour-sending areas is needed to prevent HIV treatment lapses (and where relevant TB treatment interruption) in returning miners and to strengthen treatment services for those who are diagnosed in the community. Such a partnership also needs to put in place some sort of active surveillance for tuberculosis and silicosis in this high risk population. This surveillance needs to be combined with a drastically improved compensation process both in regard to certification and payment of miners to mitigate some of the burden transferred from the industry to the poorest regions of the subcontinent.

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