

# Autopsy findings in miners – a cause for concern

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## ABSTRACT

The National Institute for Occupational Health (NIOH) annual report on autopsies in mine workers for the period January to December 2016 is in the public domain on the NIOH website; this article highlights aspects of the report. A total of 850 autopsy examinations were performed, of which 4.5% (n = 38) were women, most (71.1%) of whom had been exposed to asbestos. The annual number of autopsies performed continues to decline along with the numbers of people employed in mining. This highlights the problems of awareness and access to the compensation system, particularly amongst former black miners. The report reflects some success in tackling the pulmonary tuberculosis (PTB) epidemic with rates continuing to decrease since 2007. The current overall rate of 152 cases of PTB per 1000 autopsies, however, remains high. Of particular concern is the increasing trend in silicosis amongst black gold miners. There is an urgent need to prevent exposure of mine workers to dust, particularly silica dust, in the gold mining industry.

**Keywords:** tuberculosis, silicosis, occupational lung disease, PATHAUT, gold mining

## INTRODUCTION

To assist with the compensation for families of deceased persons who worked at a controlled mine or works, the Pathology Division of the National Institute for Occupational Health (NIOH) conducts autopsy examinations of their cardio-respiratory organs. With the consent of the deceased's family, these examinations are conducted as required by the Occupational Diseases in Mines and Works Act of 1973.<sup>1</sup> The pathologic findings of these autopsy examinations are taken into consideration by a panel of doctors at the Medical Bureau for Occupational Diseases to determine whether a compensable disease is present, and if so, the appropriate level of compensation.

Details of the macroscopic and microscopic autopsy examination of the heart and lungs, together with demographic data and occupational histories, are entered into a database. This database, known as PATHAUT, has been maintained by the NIOH since 1975, and as of December 2016 contains the records of 111 901 deceased mine workers. It is a valuable resource for the study of occupational lung diseases in the mining sector. Analysis of the PATHAUT database over the years has resulted in over 100 publications in peer-reviewed scientific Journals.

Every year the NIOH produces an annual report generated from the PATHAUT database. Annual reports from 1975 are in the public domain and are available on the NIOH website.<sup>2</sup> Although focused on the prevalence of lung disease, the routinely collected data in PATHAUT can be used for surveillance, and to describe time trends and associated risk factors for diseases.<sup>3</sup> Selected information from the latest report (January to December 2016) is highlighted in this article.

## DEMOGRAPHIC DATA

During 2016, a total of 850 cases were examined. Of these, 51.8% (n = 440) were ex-miners, 41.5% (n = 353) were current miners, and 6.7% (n = 57) cases could not be classified as either. Of the cases examined, 61.3% were black mine workers, 38.0% were white, and 0.7% were coloured. The mean age at autopsy of black mine workers was 52.0 years compared to 68.5 years for white mine workers.

Since 2010, the province from which the organs were sent has been recorded on the PATHAUT database; the majority of the cardio-respiratory organs have been received from the North West province since then. In 2016

most cases originated from the North West province (40.1%), followed by Gauteng province (25.1%) and the Northern Cape province (12.5%).

Most of the cases came from the gold (55.3%), platinum (21.6%), asbestos (9.6%), and coal (4.9%) mining industries. The proportion of autopsies from the platinum mining industry has increased over the years, from 8.3% in 1999 to 21.6% in 2016.

## Clinical cause of death

The clinical cause of death is not determined at the NIOH; it is reported as stated in the documents submitted together with the cardio-respiratory organs. The clinical cause of death was provided for 73.1% of all cases in 2016. Diseases of the respiratory system were the most frequent (22.6%), accounting for 20.5% of deaths in black mine workers, 25.1% in white mine workers, and 66.7% in coloured mine workers. Tuberculosis (TB) and pneumonia were the most frequently reported causes of death.

## PATHOLOGICAL FINDINGS

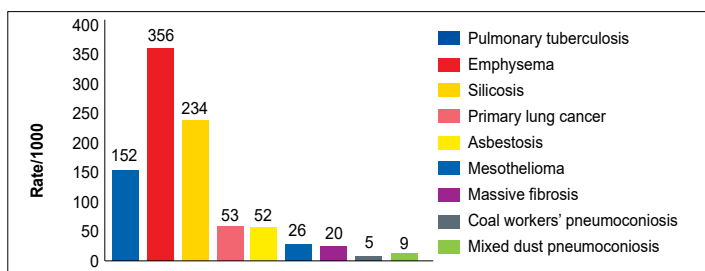
The overall disease rates for 2016 are shown in Figure 1.

## Active pulmonary tuberculosis (PTB)

Active PTB was diagnosed in 15.2% (n = 129) of all cases, where the lungs were extensively involved in most cases. A large percentage (82.9%) of PTB cases were from black mine workers. Most cases of active PTB (57.3%) were from the gold and platinum (24.0%) mining industries; the rates in black miners from the gold and platinum industries were 247/1000 and 189/1000 respectively. The rates of PTB per 1000 autopsies of black miners from 1975 to 2016 are shown in Figure 2. There is a downward trend in PTB in both the gold and platinum mining industries.

## Silicosis

Silicotic nodules were found in the lungs of 199 deceased miners (23.4% of all autopsies). Occasional silicotic nodules were found in 43.7% (n = 87) of these cases, a few nodules in 28.6% (n = 57), a moderate number in 24.1% (n = 48), and a large number in 3.5% (n = 7). The majority of these cases (82.9%) had been employed in the gold mining industry. Massive fibrosis was present in 2% (n = 17) of the cases examined, 16 of which were from the gold mining industry.



**Figure 1. Overall disease rates (2016)**

There has been an upward trend in the rate of silicosis in black gold miners from the year 1975; this trend has been more striking since 2000 (Figure 3). In black miners, 83.3% of silicosis was noted in the 30 to 59-year age group, while 88.4% of silicosis in white miners was seen after 60 years of age.

### Emphysema

There were 303 cases of emphysema, the severity of which was mild in 64.0% (n = 194), moderate in 28.7% (n = 87), and marked in 7.3% (n = 22) of cases. The overall rate of emphysema increased from 250/1000 in 2010 to 319/1000 in 2015, and to 356/1000 in 2016.

### Asbestos-related diseases

There were 44 cases of asbestosis. Of these, 59.1% (n = 26) had slight, 27.3% (n = 12) had moderate, and 13.6% (n = 6) had marked fibrosis. Forty-one (93.2%) of those with asbestosis had worked in the asbestos mining industry and one (2.3%) had been exposed to asbestos in the environment. There were 22 cases of mesothelioma, of which 68.2% (n = 15) had worked in asbestos mines at some stage in their career.

### Primary lung cancer

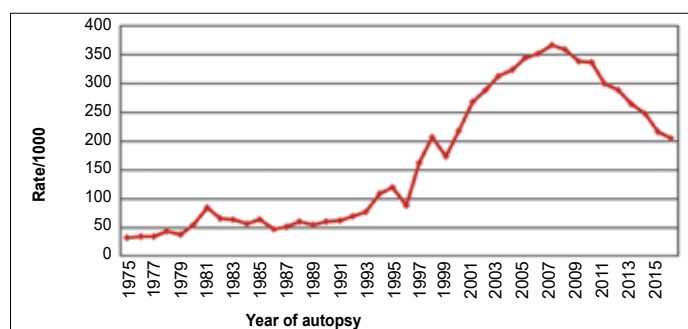
Forty-five cases of primary lung cancer were found at autopsy, 37.8% (n = 17) of which were in black mine workers, and 62.2% (n = 28) in white mine workers. Most of the cancers were adenocarcinoma (n = 24; 53.3%), followed by squamous carcinoma (n = 9; 20.0%), small cell carcinoma (n = 7; 15.6%), and large cell carcinoma (n = 5; 11.1%). Most (n = 28; 62.2%) of the primary lung cancer cases were from the gold mining industry.

### Autopsy findings in women

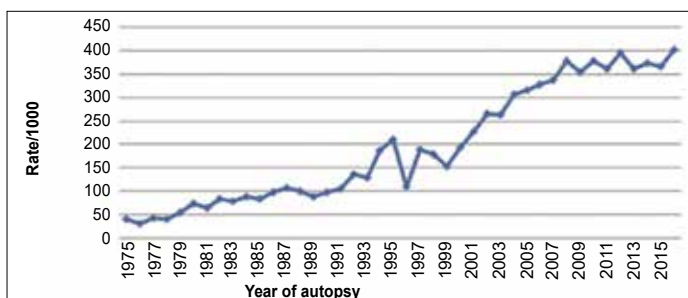
Thirty-eight (4.5%) of the 850 cases examined in 2016 were women. There were 92.1% (n = 35) black, 2.6% (n = 1) white and 5.3% (n = 2) coloured women. On average, the women were older than the men at autopsy (62.9 years and 58.1 years, respectively). Most of the women (71.1%; n = 27), had been exposed to asbestos, with 68.4% (n = 26) exposed on the mines, and 2.6% (n = 1) with environmental exposure. Thirteen women (34.2%), had asbestos-related diseases: 69.2% (n = 9) had asbestosis and 30.8% (n = 4) had mesothelioma.

## DISCUSSION

There has been a decline in the number of cardio-respiratory organs submitted to the NIOH for autopsy; this could be a reflection of the declining number of miners employed in the industry. In 1994, there were around 344 000 people employed in the gold mining industry compared to approximately 115 822 in 2016.<sup>4</sup> The average age of white mine workers at autopsy was 16.5 years higher than that of black miners. This is due to referral bias with respect to the utilisation of the autopsy service. The cardio-respiratory organs of black miners who die in service are more likely to be submitted for autopsy examination.<sup>5</sup> However, when miners leave the service or retire, fewer organs are received from black miners. The barriers for black former miners to access



**Figure 2. Rates of PTB in black miners (1975-2016)**



**Figure 3. Rates of silicosis in black gold miners (1975-2016)**

the compensation system have been recognised for some time.<sup>6</sup> This situation needs to be addressed urgently, to improve awareness and facilitate access to the compensation system.

The decreasing number of PTB cases since 2007 is encouraging, and reflects the decrease in the total number of TB cases notified nationally, according to annual WHO Global TB reports.<sup>7</sup> This reflects the deployment of anti-tuberculous and anti-retroviral treatment programmes nationally and by the mining industry. Nevertheless, the current overall rate of 152 cases of PTB per 1000 autopsies is still high.

The trend for silicosis amongst black gold miners is of particular concern. Dust-related disease continues to plague the South African mining industry,<sup>8</sup> suggesting that measures to suppress dust in the mines have been ineffective.

Mining remains important to the economy of South Africa. However, the data from the 2016 PATHAUT report reflects high rates of diseases and emphasises the urgent need to prevent the exposure of mine workers to dust.

## ACKNOWLEDGEMENTS

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