NATIONAL INSTITUTE FOR OCCUPATIONAL HEALTH

Division of the National Health Laboratory Service

Pathology Division Surveillance Report

Demographic Data and Disease Rates for January to December 2023

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EXECUTIVE SUMMARY

The NIOH examined the cardiorespiratory organs of 450 deceased individuals in 2023, an increase of 9.7% from 2022 (n=410). Of the individuals examined, 59.1% were black, 40.9% were white. Of the cases submitted, 66.2% (n=298) were ex-miners, 26.9% (n=121) current miners and 6.9% (n=31) cases could not be classified.

The overall disease rates (per 1000 autopsies) for 2023 are shown in Figure 1.

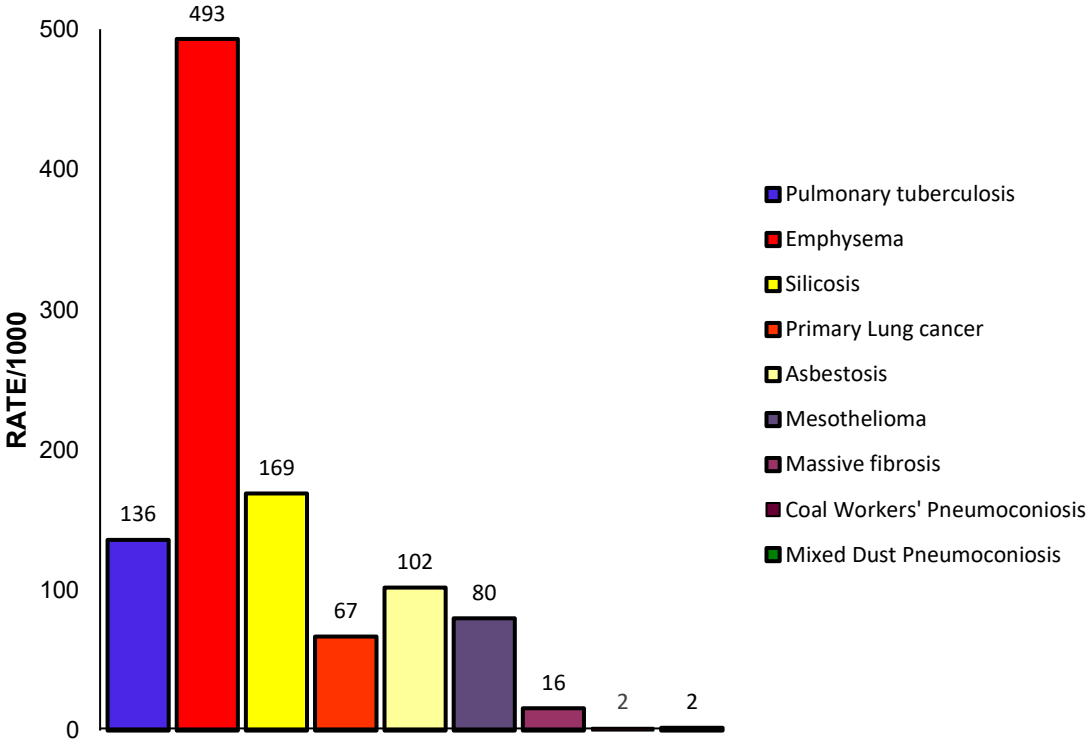


FIG. 1 OVERALL DISEASE RATES FOR 2023

The overall rate of pulmonary tuberculosis (PTB) remained stable from 137/1000 in 2021 to 132/1000 in 2022 and 136/1000 in 2023. The rate of PTB in black gold miners increased from 206/1000 in 2022 to 239/1000 in 2023 and also increased in platinum miners from 120/1000 in 2022 to 128/1000 in 2023 (Table 3-1).

The overall rate of silicosis decreased from 229/1000 in 2022 to 169/1000 in 2023. The rate of silicosis in black gold miners and white gold miners both decreased in 2023 compared to 2022(Table 4-1).

The organs of 33 women were submitted for examination, of which 12 (36.4%) had a history of employment in the gold mining industry, 14 (42.4%) in the asbestos industry and 2 (6.1%) in platinum mining. More women (n=12, 36.4%) had diseases related to asbestos exposure than in 2022 (n=9, 30.0%).

Some cases were received with incomplete exposure information. Continued active follow-up of cases received has improved the completeness of the information obtained. However, in 2023 information could not be obtained for the following: commodity (mine type) in 16 (3.6%), duration of service in 34 (7.6%) and last mine worked in 17 (3.8%).

Since 2010, the province or foreign country from which the organs were sent has been recorded on the PATHAUT database. Of note, the province is indicative of the province where the miner died, and not necessarily where he worked. Table 1-1 shows the distribution of cases by province and population group. Most cases originated from the Gauteng (26.9%), Northern Cape (22.7%), North West (22.2%) and Free State (18.4%) provinces. No cases were received from miners outside South Africa.

TABLE 1-1 DISTRIBUTION OF AUTOPSY CASES BY PROVINCE AND POPULATION GROUP (2023)

Province	Black		White		Total	
	N	%	N	%	N	%
Eastern Cape	5	1.9	1	0.5	6	1.3
Free State	53	19.9	30	16.3	83	18.4
Gauteng	58	21.8	63	34.2	121	26.9
Kwazulu-Natal	0	-	7	3.8	7	1.6
Limpopo	2	0.8	4	2.2	6	1.3
Mpumalanga	6	2.3	16	8.7	22	4.9
North West	48	18.0	52	28.3	100	22.2
Northern Cape	93	35.0	9	4.9	102	22.7
Western Cape	1	0.4	2	1.1	3	0.7
Total	266	100	184	100	450	100

The Pathology division continued to provide educational engagements in 2023. These include training and demonstrations to occupational health units, students and occupational hygiene departments.

TABLE OF CONTENTS

EXECUTIVE SUMMARY iii

GLOSSARY vii

SECTION 1: BACKGROUND 1

SECTION 2: DEMOGRAPHIC DATA 2

SECTION 3: ACTIVE TUBERCULOSIS 8

SECTION 4: SILICOSIS 11

SECTION 5: OTHER PNEUMOCONIOSES
Massive Fibrosis 13
Coal Workers' Pneumoconiosis 13
Mixed Dust Pneumoconiosis 13
Asbestosis and pleural plaques 13

SECTION 6: EMPHYSEMA 14

SECTION 7: MESOTHELIOMA 16

SECTION 8: PRIMARY LUNG CANCER 17

SECTION 9: CLINICAL CAUSES OF DEATH 18

SECTION 10: AUTOPSY FINDINGS IN WOMEN 19

LIST OF TABLES

Table 1-1 Distribution of autopsy cases by province and population group (2023) iv
Table 2-1 Distribution of autopsies by year and population group (1975-2023) 2
Table 2-2 Number and proportion of autopsies by type and population group (2023) 3
Table 2-3 Number and proportion of autopsies by age and population group (2023) 4
Table 2-4 Number and proportion of autopsies by commodity and population group (2023) 5
Table 2-5 Number and proportion of autopsies by years of service and population group (2023) 6
Table 2-6 Mean age by commodity and population group (2023) 7
Table 2-7 Mean duration of service by commodity and population group (2023) 7
Table 3-1 Number of cases and prevalence of active PTB by commodity and population group (2023) 9
Table 3-2 Number of cases and prevalence of active PTB by age and population group (2023) 10
Table 4-1 Number of cases and prevalence of silicosis by commodity and population group (2023) 11
Table 4-2 Number of cases and prevalence of silicosis in the gold mining industry, by age and population group (2023) 12
Table 4-3 Number of cases and prevalence of silicosis in the gold mining industry, by years of service and population group (2023) 12

Table 5-1 Number of cases and prevalence of asbestosis by age and population group (2023) 13
Table 6-1 Number of cases and prevalence of emphysema by age and population group (2023) 14
Table 6-2 Number of cases and prevalence of emphysema by commodity and population group (2023) 15
Table 6-3 Number of cases and prevalence of emphysema by years of service and population group (2023) 15
Table 7-1 Number and proportion of mesothelioma cases by age and population group (2023) 16
Table 7-2 Number and proportion of mesothelioma cases by commodity and population group (2023) 16
Table 8-1 Number of cases and prevalence of primary lung cancer by age and population group (2023) 17
Table 8-2 Number of cases and prevalence of primary lung cancer by commodity and population group (2023) 17
Table 9-1 Clinical causes of death by population group (2023) 18
Table 10-1 Number and proportion of autopsies in women by age and population group (2023) 19
Table 10-2 Number and proportion of autopsies in women by commodity and population group (2023) 19
Table 10-3 Number and proportion of diseases in women (2023) 20

LIST OF FIGURES

Figure 1 Overall disease rates for 2023 iii
Figure 2-1 Distribution of autopsies by age and population group (2023) 4
Figure 2-2 Distribution of autopsies by commodity and population group (2023) 5
Figure 2-3 Distribution of autopsies by years of service and population group (2023) 6
Figure 3-1 Distribution of active TB by site (2023) 8
Figure 3-2 Active PTB rates in all black miners at autopsy (1975 to 2023) 9
Figure 4-1 Rate of silicosis in black gold miners (1975-2023) 11
Figure 9-1 Clinical cause of death as given by the clinicians who submit the organs to the NIOH (2023) 18

APPENDICES

Appendix 1: Distribution of autopsies according to the last mine where the deceased worked (2023) 21
Appendix 2: Publications and activities emanating from PATHAUT data or autopsy service (2023) 25

GLOSSARY

Asbestosis	Lung fibrosis caused by exposure to asbestos fibres
Coal workers' pneumoconiosis	Lung fibrosis caused by exposure to coal dust
Emphysema	Lung disease caused by the destruction of the alveolar walls
Environmental asbestos exposure	Non-occupational asbestos exposure. Cases with such exposure are examined by the NIOH but are not submitted to the MBOD for compensation
Massive fibrosis	Lung fibrosis caused by exposure to dust and measuring more than 1 cm in diameter
Mesothelioma	A malignant tumour of the mesothelial tissues of the lungs and/or heart
Miner	A person who has worked in a controlled mine or works
Mixed dust pneumoconiosis	Lung fibrosis caused by simultaneous exposure to multiple dust types
Prevalence	The number of cases in a defined population at a given time
Silicosis	Lung fibrosis caused by inhalation of silica dust; detected by the presence of silicotic nodules in the lung tissue
Standard deviation	Standard deviation (SD) is an indication of how widely scattered the data is in relation to the mean.
Surveillance	The ongoing and systematic collection, analysis, interpretation and dissemination of information related to adverse health outcomes for action

SECTION 1 – BACKGROUND

The Occupational Diseases in Mines and Works Act, 1973 (Act 78 of 1973) requires that the cardio- respiratory organs of a deceased person who has worked at a controlled mine or a controlled works be examined for the presence of occupational disease, regardless of the clinical cause of death and provided that the next of kin signs an informed consent. These examinations are performed by pathologists at the National Institute for Occupational Health (NIOH). A detailed report on each case examined is sent to the Medical Bureau for Occupational Diseases (MBOD). Cases certified as having a compensable disease are then referred to the Compensation Commissioner's office, where the payment for compensation is managed.

Since 1975, the pathological findings from the autopsy examinations have been recorded on the computerised PATHAUT database. PATHAUT comprises data from autopsy examinations and clinical files which include occupational histories. The database is unique and provides an important resource for both surveillance and research. This database contains comprehensive surveillance data on occupational lung disease in the South African mining industry. Approval to retrospectively review routinely collected autopsy data for reporting on disease prevalence's, time trends and associated factors was obtained from the Human Research Ethics Committee (Medical) at the University of the Witwatersrand (Clearance number M220564).

The data presented in this report summarises the PATHAUT system surveillance results, i.e. the results of the systematic collection, collation, and analysis of the pathology findings in the cardio-respiratory organs of mine workers. Data from PATHAUT are exported into, and analysed, using SAS Enterprise Guide v8.3. This report describes autopsy cases examined during the year 2023. This report along with previous reports can be accessed at https://www.nioh.ac.za/pathology-disease-surveillance-reports/

Since 2005, gender has been recorded on the PATHAUT database. The term 'miners' is used to account for both men and women throughout this report, with the exception of Section 10 which reports findings in women only.

Many of the cases had "mixed" exposures in that they had been employed in mining more than one commodity. For simplicity, cases are categorised according to the commodity in which most years of service were recorded, i.e. the commodity in which the miners had worked for the longest period. In Appendix 1, however, the cases are listed according to the most recent (last) mine at which the miners worked.

All disease rates reported in this document are expressed per 1000. In all calculations, the denominators used are the total numbers of autopsies in specific commodities, age groups or population groups. Some of these rates must be viewed with caution, as the denominators are very small. This applies, for example, to those commodities where few workers are employed (such as manganese mining), and to the older age groups in some instances.

SECTION 2 – DEMOGRAPHIC DATA

The numbers of autopsies performed annually since 1975 are presented in Table 2-1.

TABLE 2-1 DISTRIBUTION OF AUTOPSIES BY YEAR AND POPULATION GROUP (1975-2023)

Year of autopsy	Black		White		Coloured		Indian		Unknown		Total
	N	%	N	%	N	%	N	%	N	%	N
1975	2 190	71	854	28	32	1					3 076
1976	2 335	68	1 072	31	27	1					3 434
1977	2 351	69	1 039	30	33	1					3 423
1978	2 245	67	1 090	32	32	1					3 367
1979	2 118	66	1 026	33	45	1					3 189
1980	2 338	64	1 274	35	46	1					3 658
1981	2 209	66	1 117	33	33	1					3 359
1982	2 312	63	1 302	36	44	1			1		3 659
1983	2 096	65	1 109	34	41	1					3 246
1984	1 966	64	1 098	36	28	1					3 092
1985	2 275	64	1 200	34	66	2					3 541
1986	2 456	68	1 125	31	45	1					3 626
1987	2 594	68	1 168	30	78	2					3 840
1988	2 518	67	1 165	31	77	2					3 760
1989	2 138	65	1 090	33	60	2					3 288
1990	2 172	64	1 155	34	51	2					3 378
1991	2 143	65	1 080	33	66	2					3 289
1992	2 144	66	1 049	32	70	2					3 263
1993	1 863	65	956	33	65	2					2 884
1994	1 737	61	1 021	36	94	3					2 852
1995	2 830	71	1 062	27	99	2			12	0,3	4 003
1996	2 154	67	960	30	56	2			69	2,1	3 239
1997	2 223	69	897	28	70	2			18	0,6	3 208
1998	1 977	69	836	29	49	2	1		17	0,6	2 880
1999	1 656	65	832	33	29	1			12	0,5	2 529
2000	1 798	69	761	29	41	2			8	0,3	2 608
2001	1 690	67	813	32	13	1			13	0,5	2 529
2002	1 677	67	763	30	50	2			28	1,1	2 518
2003	1 536	66	745	32	23	1	1		13	0,6	2 318
2004	1 428	69	596	29	22	1	1		8	0,4	2 055
2005	1 274	68	562	30	22	1			18	1	1 876
2006	1 165	68	535	31	11	1			9	0,5	1 720
2007	1 144	66	539	31	21	1			20	1,2	1 724
2008	1 185	69	556	32	11	1			48	2,7	1 800
2009	1 138	68	500	29	16	1			8	0,5	1 662
2010	960	64	521	35	15	1			6	0,4	1 502
2011	847	64	453	34	11	1			18	1,4	1 329
2012	706	61	445	38	7	1			6	0,5	1 164
2013	744	63	421	35	7	1			16	1	1 188
2014	627	59	432	41	5	1	1		1		1 066
2015	539	59	358	39	9	1			3		909
2016	521	61	323	38	6	1					850
2017	473	59	313	39	9	1	1	0	5	1	801
2018	446	58	321	41	6	0.7			2	0.3	775
2019	445	59	307	40	5	1			2		759
2020	304	55	251	44	2	1					557
2021	303	55	241	44	2	1					546
2022	223	54	187	46							410
2023	266	59	184	41							450
Total	76 479		37704		1650		5		361		116 199

There is a lower autopsy rate for black miners who have left employment at the mines, whereas the majority of white miners autopsied are ex-miners. The number of autopsies has decreased steadily over the years, probably reflecting the concomitant decrease in the number of miners employed in the industry. In 1994, there were around 344 000 people employed in the gold mining industry compared to approximately 93,909 in 2023 (Minerals Council South Africa, https://www.mineralscouncil.org.za/industry-news/publications/facts-and-figures).

The pathologists at the NIOH perform two types of autopsy examinations. For miners dying distant from Johannesburg, the cardio-respiratory organs are removed locally, preserved in formalin and sent to the NIOH. Full autopsies may be undertaken on miners who die close to Johannesburg.

Table 2-2 shows the distribution of autopsies by population group for 2023. The vast majority (97.6%) of autopsy examinations were performed on the cardio-respiratory organs only.

TABLE 2-2 NUMBER AND PROPORTION OF AUTOPSIES BY TYPE AND POPULATION GROUP (2023)

Autopsy type	Black		White		Total	
	N	%	N	%	N	%
Cardio-respiratory organs only	265	99.6	174	94.6	439	97.6
Full autopsy	1	0.4	10	5.4	11	2.4
Total	266	100	184	100	450	100

The age distribution of cases for 2023 is shown in Table 2-3 and presented graphically in Figure 2-1. The mean age at autopsy of black miners was 58.7 years in 2023, similar to that in 2022 (57.9 years). The mean age of white miners at autopsy was 72 years in 2023, also similar to that of the previous year (71.6 years). A slight increase in the number of cases in black miners between 40 through to the 69-year age groups was seen and a decrease in white miners from 70 to 79 years. No cases were received for any young miners aged 20 to 29 years.

TABLE 2-3 NUMBER AND PROPORTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2023)

Age group (years)	Black		White		Total	
	N	%	N	%	N	%
20-29	0	-	0	-	0	-
30-39	16	6.0	0	-	16	3.6
40-49	60	22.6	6	3.3	66	14.7
50-59	61	22.9	13	7.1	74	16.4
60-69	69	25.8	60	32.5	129	28.6
70-79	43	16.2	52	28.3	95	21.1
80+	17	6.4	53	28.8	70	15.6
Total	266	100	184	100	450	100

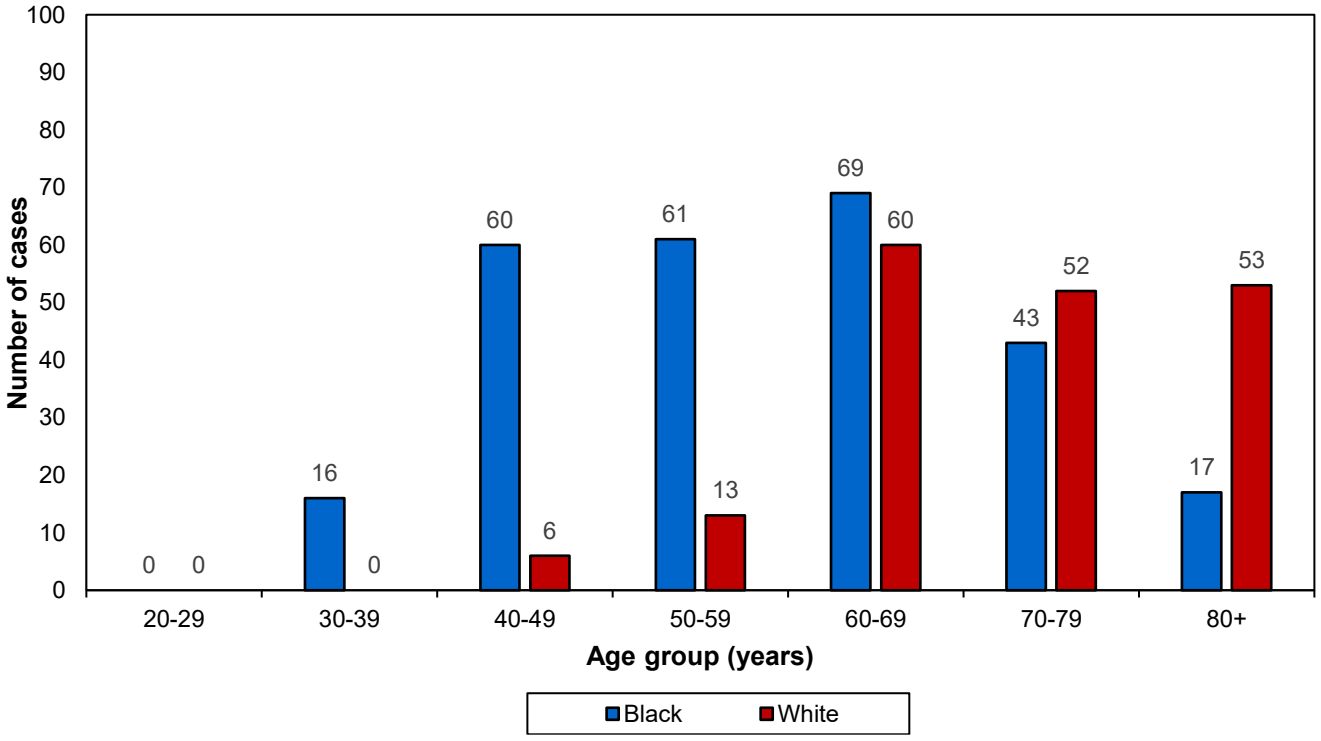


FIG 2-1 DISTRIBUTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2023)

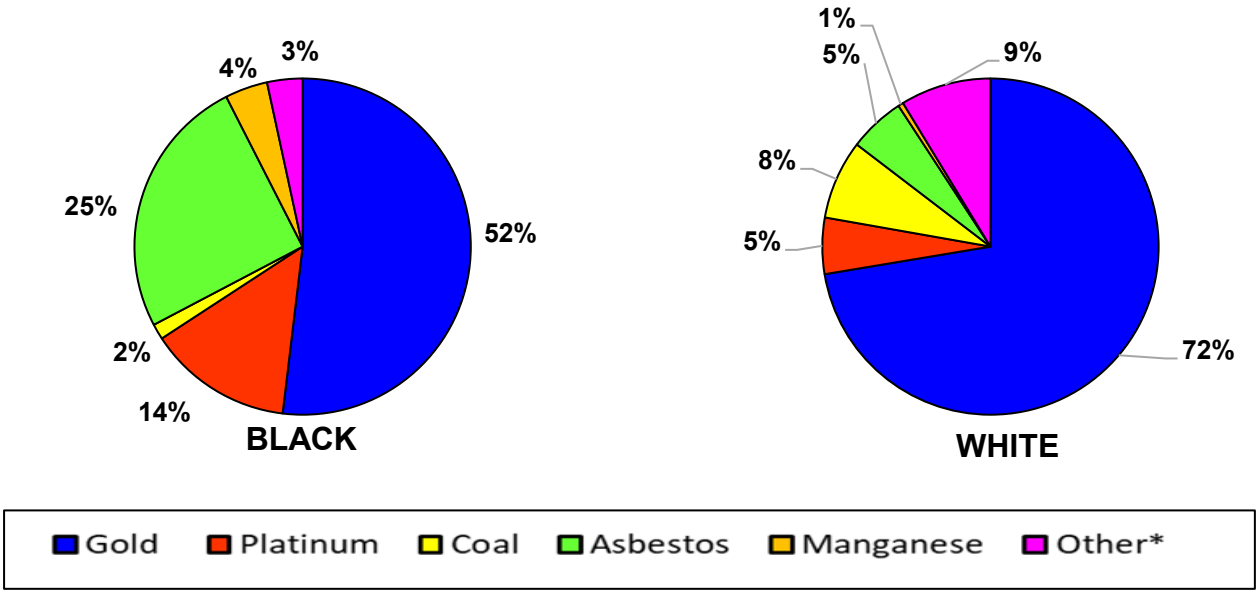
There are miners who worked in a number of different mining commodities during their lifetimes and had “mixed” exposures. This was not taken into account in the analysis of exposure type (commodity). Cases were placed in categories according to the commodity in which they had worked for the longest duration (most exposure).

Table 2-4 and Figure 2-2 show the distributions of autopsies by commodity and population group for 2023. The majority of autopsies (60.2%) were on miners from the gold mining industry, which is similar to 2021 (61.7%) and 2022 (62.9%). The proportion of autopsies from the platinum mining industry is 10.4% in 2023, a decline to that seen in 2022(14.4%). There was an increase in the proportion of autopsies from the asbestos mining industry from 11.7% in 2022 to 17.1% in 2023.

TABLE 2-4 NUMBER AND PROPORTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black		White		Total	
	N	%	N	%	N	%
Gold	138	51.9	133	72.3	271	60.2
Platinum	37	13.9	10	5.4	47	10.4
Coal	4	1.5	14	7.6	18	4.0
Asbestos	67	25.2	10	5.4	77	17.1
Copper	0	-	1	0.5	1	0.2
Manganese	11	4.1	1	0.5	12	2.7
Other*	5	1.9	4	2.2	9	2.0
Unknown	4	1.5	11	6.0	15	3.3
Total	266	100	184	100	450	100

***** Environmental asbestos, chrome, minerals, construction, Eskom, diamond and SA Railways



*Includes copper, environmental asbestos, chrome, minerals, construction, Eskom, diamond and SA railways as well as cases where service histories could not be obtained

FIG 2-2 DISTRIBUTION OF AUTOPSIES BY COMMODITY AND POPULATION 2023)

Detailed information about the years in mining service by population group is shown in Table 2-5 and displayed graphically in Figure 2-3. In 2023, the duration of service was obtained for all cases except for 7.5% (n=34).

TABLE 2-5 NUMBER AND PROPORTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2023)

Years of service	Black		White		Total	
	N	%	N	%	N	%
<1	22	8.3	3	1.6	25	5.6
1-5	49	18.4	16	8.7	65	14.4
6-10	28	10.5	15	8.2	43	9.6
11-15	36	13.5	20	10.9	56	12.4
16-20	47	17.7	25	13.6	72	16.1
21-25	23	8.6	33	17.8	56	12.4
26-30	25	9.4	20	10.9	45	10.0
31-35	13	4.9	20	10.9	33	7.3
36-40	5	1.9	10	5.4	15	3.3
41+	2	0.8	4	2.2	6	1.3
Unknown	16	6.0	18	9.8	34	7.6
Total	266	100	184	100	450	100

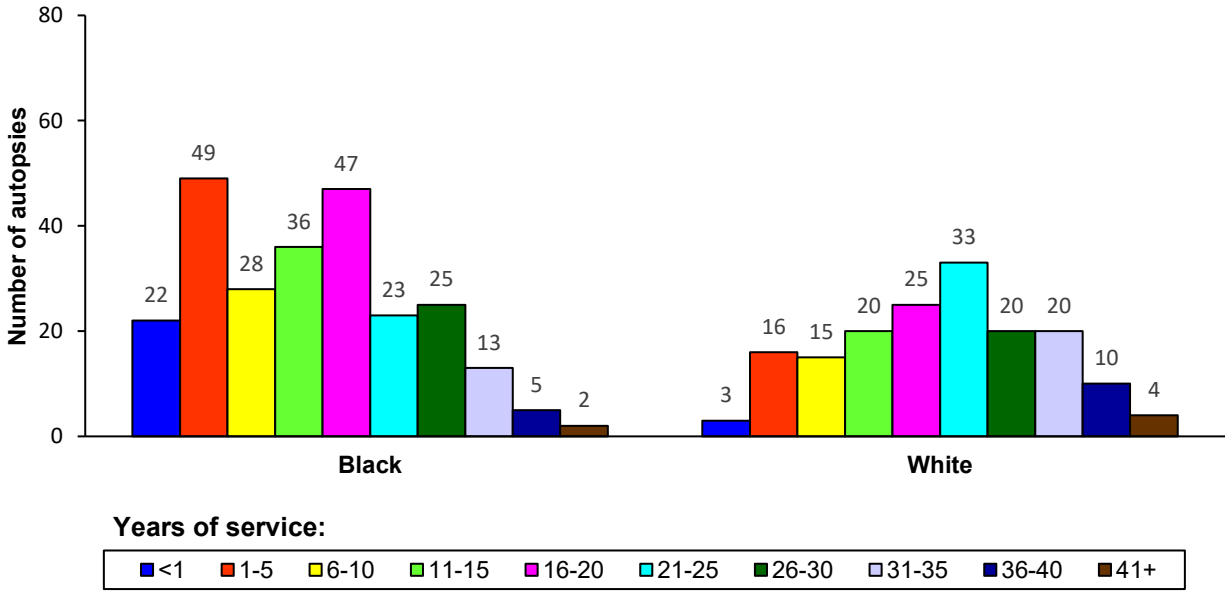


FIG 2-3 DISTRIBUTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2023)

The mean age and duration of service by commodity and population group are shown in Tables 2-6 and 2-7.

TABLE 2-6 MEAN AGE BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black			White		
	N	Mean (Years)	SD*	N	Mean (Years)	SD*
Gold	138	52	11	133	72	11
Platinum	37	55	10	10	63	18
Coal	4	46	11	14	75	10
Asbestos	67	73	10	10	75	11
Manganese	11	68	10	1	69	-
Copper	-	-	-	1	85	-
Other	5	63	13	4	66	8
Unknown	4	62	7	11	80	8
Total	266	59	14	184	72	11

SD (Standard deviation)

TABLE 2-7 MEAN DURATION OF SERVICE BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black			White		
	N	Mean (Years)	SD	N	Mean (Years)	SD*
Gold	134	19	9	131	23	10
Platinum	37	19	10	10	14	10
Coal	3	6	6	11	19	11
Asbestos	62	4	5	9	12	13
Copper	0	-	-	1	35	-
Manganese	11	11	11	0	-	-
Other	3	15	6	3	14	12
Total	250	15	10	165	21	11

SD (Standard deviation)

SECTION 3 – ACTIVE TUBERCULOSIS

The distribution of active tuberculosis (TB) by anatomical site is presented in Figure 3-1 (n=83). Active pulmonary TB (PTB) was diagnosed in 13.6% (n=61) of all autopsies in 2023, similar to 13.2% (n=54) in 2022. Most of the miners with PTB were black (n=47; 77.0%) and 14 (23.0%) were white miners.

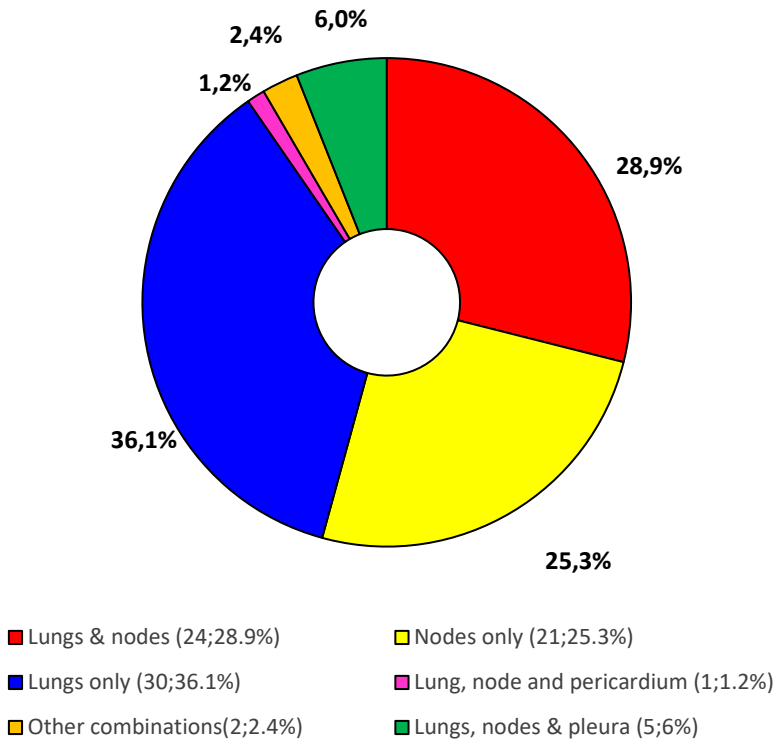


FIG 3-1 DISTRIBUTION OF ACTIVE TB BY SITE (2023)

Disease rates in subsequent tables and figures are expressed per 1000 miners. In 2023, the overall rate of PTB was 136/1000. In black miners, the rate of PTB increased slightly in 2023 to 177/1000 (Fig 3-2). The overall rate in white miners was lower than that in black miners at 76/1000 (2023), and was lower than the rate in 2022 (107/1000).

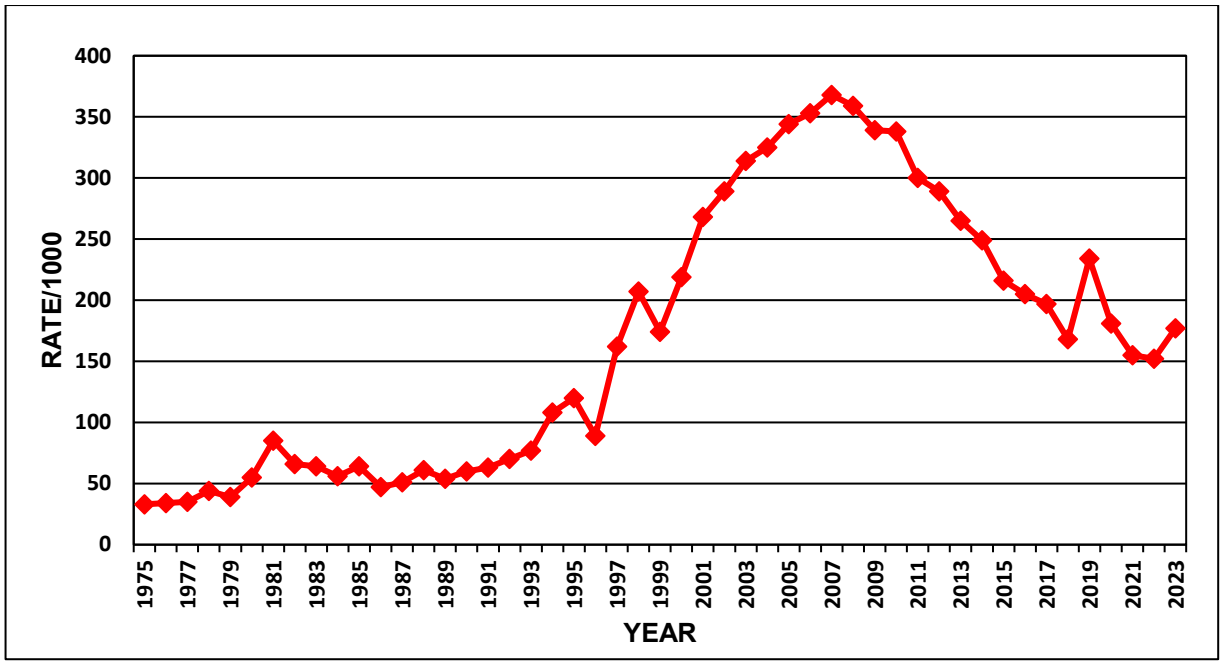


FIG 3-2 ACTIVE PTB RATES IN BLACK MINERS AT AUTOPSY (1975-2023)

The distribution of active PTB cases by commodity is shown in Table 3-1. Most cases of active PTB (75.4%) were from gold (60.2% of all autopsy cases came from that commodity) followed by the asbestos (11.5% of cases) and the platinum (9.8% of cases) mining industries. However, the overall rate of PTB was higher in platinum miners (128/1000) compared to asbestos miners (91/1000).

TABLE 3-1 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black		White		Total	
	N	Rate	N	Rate	N	Rate
Gold	33	239	13	98	46	170
Platinum	5	-	1	-	6	128
Coal	0	-	0	-	0	-
Asbestos	7	104	0	-	7	91
Copper	0	-	0	-	0	-
Iscor	0	-	0	-	0	-
Other	1	-	0	-	1	-
Unknown	1	-	0	-	1	-
Total	47	177	14	76	61	136

Note: rates have not been calculated where there are fewer than 6 cases

The age distribution of cases with active PTB is shown in Table 3-2. Most of the PTB cases (n=23; 37.7%) were in the age group 60-69 years, followed by those in the 50-59 years age group (n=18; 29.5%). The highest rate was seen in black miners aged 50-59 (262/1000).

TABLE 3-2 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY AGE AND POPULATION GROUP (2023)

Age group	Black		White		Total	
(years)	N	Rate	N	Rate	N	Rate
20-29	0	-	0	-	0	-
30-39	2	-	0	-	2	-
40-49	8	133	0	-	8	121
50-59	16	262	2	-	18	243
60-69	17	246	6	100	23	178
70-79	2	-	3	-	5	-
80+	2	-	3	-	5	-
Total	47	177	14	76	61	136

*Note: rates have not been calculated where there are fewer than 6 cases

SECTION 4 – SILICOSIS

Silicotic nodules were found in the lungs of 76 cases (16.9% of all autopsies), 86.8% of which came from the gold mining industry. Of all cases with silicosis, occasional silicotic nodules were found in 38 (50.0%), a few in 14 (18.4%), a moderate number in 16 (21.1%) and a large number in 8 (10.5%) cases. The distribution of cases with silicosis by commodity and population group is presented in Table 4-1.

TABLE 4-1 NUMBER OF CASES AND PREVALENCE OF SILICOSIS BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black		White		Total	
	N	Rate	N	Rate	N	Rate
Gold	41	297	25	188	66	244
Platinum	1	-	3	-	4	-
Coal	0	-	0	-	0	-
Asbestos	4	-	0	-	4	-
Copper	0	-	0	-	0	-
Unknown	0	-	2	-	2	-
Total	46	173	30	163	76	169

Note: rates have not been calculated where there are fewer than 6 cases

The rate of silicosis in black gold miners is presented in Fig 4-1. The rate of silicosis in black gold miners increased from 39/1000 in 1975, peaked at 403/1000 in 2016 and is now 297/1000. The rate in white gold miners also increased since 1997 from 176/1000 to 328/1000 in 2020. However, a subsequent decline in the rate of silicosis has been noted in white miners, and is now 188/1000 in 2023, a decrease compared to 2022 (301/1000).

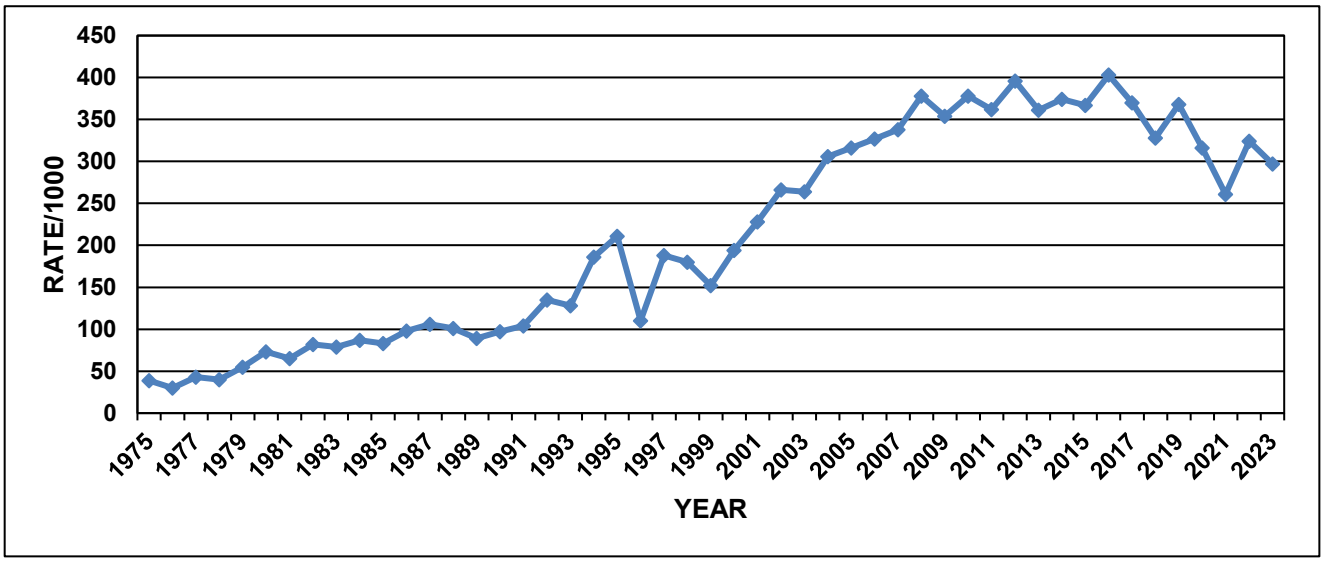


FIG 4-1 SILICOSIS IN BLACK MINERS AT AUTOPSY (1975-2023)

Silicosis in gold miners is shown in tables, 4-2 and 4-3. The overall rate of silicosis in all gold miners in 2023 (244/1000) is lower than that of 2022 (306/1000). The age distribution of silicosis differed between the black and white miners (Table 4-2). In black miners, the majority of those diagnosed with silicosis were between the 50 to 69 years age category, whilst the majority of white miners diagnosed with the same disease were older than 60 years (Table 4-2). A trend of increasing rates of silicosis by years of service was seen (Table 4-3).

TABLE 4-2 NUMBER OF CASES AND PREVALENCE OF SILICOSIS IN THE GOLD MINING INDUSTRY, BY AGE AND POPULATION GROUP (2023)

Age group (years)	Black		White		Total	
	N	Rate	N	Rate	N	Rate
30-39	0	-	0	-	0	-
40-49	4	-	0	-	4	-
50-59	21	467	0	-	21	375
60-69	13	565	6	128	19	271
70-79	3	-	8	211	11	229
80+	0	-	11	324	11	314
Total	41	297	25	188	66	244

Note: rates have not been calculated where there are fewer than 6 cases

TABLE 4-3 NUMBER OF CASES AND PREVALENCE OF SILICOSIS IN THE GOLD MINING INDUSTRY BY YEARS OF SERVICE AND POPULATION GROUP (2023)

Years of service	Black		White		Total	
	N	Rate	N	Rate	N	Rate
<1	0	-	0	-	0	-
1-5	0	-	2	-	2	-
6-10	4	-	2	-	6	222
11-15	3	-	1	-	4	-
16-20	6	167	4	-	10	179
21-25	4	-	5	-	9	237
26-30	11	524	5	-	16	410
31-35	11	846	4	-	15	484
36-40	1	-	2	-	3	-
41+	1	-	0	-	1	-
Total	41	297	25	188	66	244

Note: rates have not been calculated where there are fewer than 6 cases; cases with low years of service may have incomplete work histories

SECTION 5 – OTHER PNEUMOCONIOSES

MASSIVE FIBROSIS

There were 7 (1.6%) cases of massive fibrosis: six in black and one in white miners. All seven were from the gold mining industry.

Note: There was a change in the definition of massive fibrosis from lung fibrosis measuring 2 cm and more to lung fibrosis measuring 1 cm and more in 2019. The reason for the change was to align the pathology diagnosis with the International Labour Organization (ILO) radiological measurements.

COAL WORKERS' PNEUMOCONIOSIS

There was one case of coal workers' pneumoconiosis in cases examined in 2023.

MIXED DUST PNEUMOCONIOSIS

There was one cases of mixed dust pneumoconiosis in cases examined in 2023. The single case is from the gold mining industry.

ASBESTOSIS AND PLEURAL PLAQUES

There were 46 cases of asbestosis. Of these, 37.0% (n=17) had slight, 30.4% (n=14) had moderate and 32.6% (n=15) had marked fibrosis. Thirty-nine (84.8%) had worked in the asbestos mining industry and none reported environmental asbestos exposure.

There were 27 cases with asbestos plaques and of these 19 had asbestosis. However, in many autopsies the parietal pleura (the site where plaque formation usually occurs) is seldom submitted with the lungs thus the number of plaques may be higher.

The distribution of asbestosis by age and population group is shown in Table 5-1.

TABLE 5-1 NUMBER OF CASES AND PREVALENCE OF ASBESTOSIS BY AGE AND POPULATION GROUP (2023)

Age group	Black		White		Total	
(years)	N	Rate	N	Rate	N	Rate
50-59	1	-	0	-	1	-
60-69	14	203	1	-	15	116
70-79	13	302	1	-	14	147
80+	11	647	5	-	16	229
Total	39	147	7	38	46	102

Note: rates have not been calculated where there are fewer than 6 cases

SECTION 6 – EMPHYSEMA

There were 222 cases of emphysema (49.3% of all autopsies a decrease from 80% in 2022). The extent of emphysema was mild in 71.6% (n=159), moderate in 26.1% (n=58) and marked in 2.3% (n=5) cases. The overall rate of emphysema decreased from 793/1000 in 2022 to 493/1000 in 2023. The distribution of emphysema by age and population group is presented in Table 6-1. Emphysema rates increased with age group in the miners, with highest rates seen in black miners aged 60 to 69 and 70 to 79 in white miners.

TABLE 6-1 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY AGE AND POPULATION GROUP (2023)

Age group	Black		White		Total	
(years)	N	Rate	N	Rate	N	Rate
20-29	0	-	0	-	0	-
30-39	2	-	0	-	2	-
40-49	16	267	2	-	18	273
50-59	22	361	7	538	29	392
60-69	42	609	34	567	76	589
70-79	23	535	37	712	60	632
80+	10	588	27	509	37	529
Total	115	432	107	582	222	493

Note: rates have not been calculated where there are fewer than 6 cases

Most miners with emphysema were from the gold mining industry (n=131, 59.0%) (Table 6-2).

TABLE 6-2 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black		White		Total	
	N	Rate	N	Rate	N	Rate
Gold	54	391	77	579	131	483
Platinum	14	378	5	-	19	404
Coal	0	-	8	571	8	444
Asbestos	37	552	5	-	42	545
Manganese	5	-	0	-	5	-
Other	3	-	3	-	6	667
Unknown	2	-	9	818	11	733
Total	115	432	107	582	222	493

Note: rates have not been calculated where there are fewer than 6 cases

TABLE 6-3 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY YEARS OF SERVICE AND POPULATION GROUP (2023)

Years of service	Black		White		Total	
	N	Rate	N	Rate	N	Rate
<1	10	455	2	-	12	480
1-5	20	408	8	500	28	431
6-10	11	393	12	800	23	535
11-15	13	361	13	650	26	464
16-20	21	447	13	520	34	472
21-25	12	522	19	576	31	554
26-30	9	360	11	550	20	444
31-35	8	615	12	600	20	606
36-40	3	-	3	300	6	400
41+	2	-	1	-	3	-
Unknown	6	375	13	722	19	559
Total	115	432	107	582	222	493

Note: rates have not been calculated where there are fewer than 6 cases

SECTION 7 – MESOTHELIOMA

There were 36 cases of mesothelioma in 2023.

TABLE 7-1 NUMBER AND PERCENTAGE OF MESOTHELIOMA CASES BY AGE AND POPULATION GROUP (2023)

Age group	Black		White		Total	
(years)	N	%	N	%	N	%
30-39	0	-	0	-	0	-
40-49	0	-	0	-	0	-
50-59	3	10.0	0	-	3	8.3
60-69	14	46.7	1	16.7	15	41.7
70-79	9	30.0	1	16.7	10	27.8
80+	4	13.3	4	66.7	8	22.2
Total	30	100	6	100	36	100

The distribution of mesothelioma by commodity and population group is presented in Table 7-2. Twenty-four (66.7%) of the cases had worked in asbestos mines at some stage in their careers. Nineteen of the cases had their longest service in asbestos (most exposure) and five had mixed exposures that included asbestos. One mesothelioma case had a history of environmental asbestos exposure.

TABLE 7-2 NUMBER AND PERCENTAGE OF MESOTHELIOMA CASES BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black		White		Total	
	N	%	N	%	N	%
Asbestos	17	56.7	2	33.3	19	52.8
Platinum	4	13.3	0	-	4	11.1
Manganese	5	16.7	0	-	5	13.9
Gold	1	3.3	3	50.0	4	11.1
Copper	0	-	1	16.7	1	2.8
Unknown	2	6.7	0	-	2	5.6
Other*	1	3.3	0	-	1	2.8
Total	30	100	6	100	36	100

*Includes an environmentally exposed individual (non-miner)

SECTION 8 – PRIMARY LUNG CANCER

Thirty cases of primary lung cancer were found at autopsy, 56.7% (n=17) of which were in black miners, and 43.3% (n=13) were in white miners. Most of the cases were adenocarcinoma (n=11; 36.7%), followed by those with squamous cell carcinoma (n=10; 33.3%), a few had small cell carcinoma (n=7; 23.3%) and large cell carcinoma (n=2; 6.7%).

The distribution of primary lung cancer by age and population group is presented in Table 8-1. The highest rate was seen in miners aged 70-79 (105).

TABLE 8-1 NUMBER AND PROPORTION OF PRIMARY LUNG CANCER CASES BY AGE AND POPULATION GROUP (2023)

Age group (years)	Black		White		Total	
	N	Rate	N	Rate	N	Rate
40-49	1	-	0	-	1	-
50-59	4	-	2	-	6	81
60-69	6	87	6	100	12	93
70-79	6	140	4	-	10	105
80+	0	-	1	-	1	-
Total	17	64	13	71	30	67

Note: rates have not been calculated where there are fewer than 6 cases

The distribution of primary lung cancer by commodity and population group is presented in Table 8-2. The majority of cases came from the gold mining industry (Table 8-2).

TABLE 8-2 NUMBER AND PROPORTION OF PRIMARY LUNG CANCER CASES BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black		White		Total	
	N	Rate	N	Rate	N	Rate
Gold	4	-	10	75	14	52
Coal	0	-	1	-	1	-
Asbestos	6	90	1	-	7	91
Platinum	4	-	0	-	4	-
Manganese	1	-	0	-	1	-
Other	2	-	0	-	2	-
Unknown	0	-	1	-	1	-
Total	17	64	13	71	30	67

Note: rates have not been calculated where there are fewer than 6 case

SECTION 9 – CLINICAL CAUSES OF DEATH

Table 9-1 and Figure 9-1 show the clinical cause of death as stated in the accompanying documents submitted with the cardio-respiratory organs, by population group. The majority of cases were only recorded as “natural causes” as the clinical cause of death. Among those with specified causes, diseases of the respiratory system were the most frequent (10.9%) similar to the 11.0% seen in 2022. The proportion of unnatural deaths (11.6%) was similar to that in 2022 (11.0%). The clinical cause of death was not stated for 1.1% of the cases, a slight improvement in comparison to the previous year, 2022 (1.7%).

TABLE 9-1 CLINICAL CAUSE OF DEATH BY POPULATION GROUP (2023)

Commodity	Black		White		Total	
	N	%	N	%	N	%
Respiratory	15	5.6	34	18.5	49	10.9
Cardio-vascular	1	0.4	13	7.1	14	3.1
Central nervous system	0	-	5	2.7	5	1.1
Gastro-intestinal	0	-	0	-	0	-
Genito-urinary	1	0.4	2	1.1	3	0.7
Unnatural	38	14.3	14	7.6	52	11.6
Natural	206	77.4	105	57.1	311	69.1
Miscellaneous*	1	0.4	9	4.9	10	2.2
Not stated	3	1.1	2	1.1	5	1.1
Missing	1	0.4	0	-	1	0.2
Total	266	100	184	100	450	100

* The metabolic system is included in miscellaneous along with those providing immediate cause of death only.

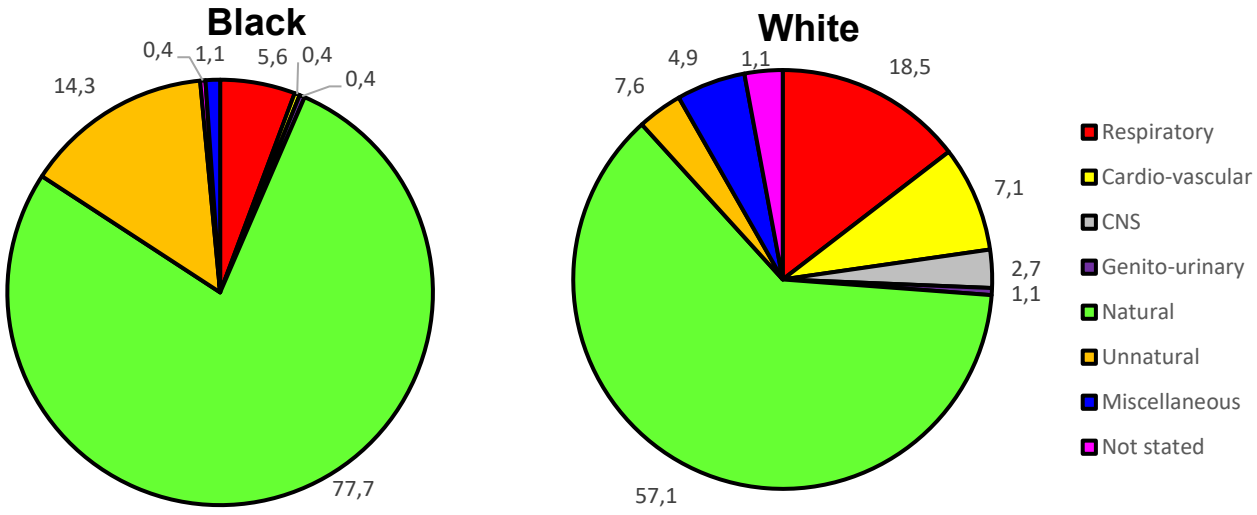


FIG 9-1 CLINICAL CAUSES OF DEATH (2023)

SECTION 10 – AUTOPSY FINDINGS IN WOMEN

Of the 450 cases examined in 2023, 33 (7.3%) were women compared to 30 (7.3%) in 2022, and 33 (5.2%) in 2021. All cardiorespiratory organs from females in 2023 were from black females. The mean age of the women was similar to that of the men (61.1 years and 64.4 years, respectively); a similar finding from the previous year's (2022) observation (women = 64.1 years and men = 65.5years).

TABLE 10-1 NUMBER AND PROPORTION OF AUTOPSIES IN WOMEN BY AGE AND POPULATION GROUP (2023)

Age group (years)	Black		Total	
	N	%	N	%
30-39	2	6.1	2	6.1
40-49	7	21.2	7	21.2
50-59	6	18.2	6	18.2
60-69	5	15.1	5	15.1
70-79	10	30.3	10	30.3
80+	3	9.1	3	9.1
Total	33	100	33	100

Table 10-2 summarises the distribution of autopsies in women by commodity and population group.

TABLE 10-2 NUMBER AND PROPORTION OF AUTOPSIES IN WOMEN BY COMMODITY AND POPULATION GROUP (2023)

Commodity	Black		Total	
	N	%	N	%
Gold	12	36.4	12	36.4
Asbestos	14	42.4	14	42.4
Platinum	2	6.1	2	6.1
Environmental Asbestos	2	6.1	2	6.1
Manganese	1	3.0	1	3.0
Unknown	2	6.1	2	6.1
Total	33	100	33	100

Six women had emphysema, and twelve had asbestos-related diseases: (four had asbestosis, and eight had mesothelioma). Two women had PTB and one had lung cancer (Table 10-3).

TABLE 10-3 NUMBER AND PROPORTION OF DISEASES IN WOMEN (2023)

Disease	N	%
PTB	2	6.1
Silicosis	0	-
Emphysema	6	18.2
Asbestosis	4	12.1
Mesothelioma	8	24.2
Primary Lung Cancer	1	3.0
No lung disease	12	36.4
Total	33	100

APPENDIX 1: DISTRIBUTION OF AUTOPSIES ACCORDING TO THE LAST MINE WHERE THE DECEASED WORKED (2023)

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Asbestos	Cape Blue		2			2
	Gefco	59	5			64
	Pomfret Asb Mine	1	1			2
Total from asbestos		**60**	**8**	**0**	**0**	**68**
Steel and Iron	Iron Ore Mine	1				1
Total from iron and steel		**1**	**0**	**0**	**0**	**1**
Coal	Coal Mine	2				2
	Delmas Colliery		1			1
	New Vaal Colliery		2			2
	Cornelia Colliery		1			1
	Khutala Colliery		3			3
	Arnot Colliery		1			1
	New Denmark	1	1			2
	Sasol Coal Mine	1				1
	Hlobane Colliery		1			1
	Duiker Colliery		1			1
	Springfield Colliery		1			1
	Samrec Annesley Mine		1			1
Total from coal		**4**	**13**	**0**	**0**	**17**
Copper	Phalaborwa		1			1
Total from copper		**0**	**1**	**0**	**0**	**1**
Diamond	Cullinan Diamond Mine		1			1
	Diamond Mine		2			2
Total from diamond		**0**	**3**	**0**	**0**	**3**

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Gold	Anglo American GM	1	2			3
	Anglogold Ashanti GM	11	4			15
	Barberton GM		1			1
	Beatrix Gold	22	3			25
	Blyvoorquizicht		1			1
	Buffelsfontein Gold		3			3
	Driefontein Cons GM	19	3			22
	Durban Roodepoort Deep		3			3
	East Driefontein		4			4
	East Rand Prop		3			3
	Evander GM	1	1			2
	Ezulwini Gold Mine		1			1
	Free State Geduld		8			8
	Free State Saaiplaas		2			2
	Gold Mine	5	7			12
	Gencor	3	1			4
	Glenhavy GM		1			1
	Grootvlei Prop		3			3
	Harmony	24	21			45
	Hartebeesfontein	1	4			5
	Joel		2			2
	Kloof	28	2			30
	Leslie		2			2
	Libanon		1			1
	Loraine		2			2
	Masimong Gold Mine	2				2
	Modderfontein		1			1
	President Brand		1			1
	President Steyn		3			3
	Randfontein	3	3			6
	Rand Uranium Gold Mine		1			1
	Saaiplaas GM	1				1
	Simmer & Jack GM	3	1			4
	South Deep GM		2			2
	Stilfontein		2			2
	Target Gold Mine	1	1			2
	Tshepone GM	3	1			4
	Unisel GM		1			1

Gold (contd)	Vaal Reefs	4	11			15
	Village Main Reef		1			1
	West Driefontein		1			1
	West Rand Consolidation		1			1
	Western Deep Levels	1	5			6
Total from gold		**133**	**121**	**0**	**0**	**254**
Copper	Phalaborwa	1				1
Manganese	Associated Manganese	1				1
	Black Rock Asb Mine	2				2
	Hotazel Manganese Mine	5				5
	Manganese Mine	2				2
	S A Manganese	1				1
	SAMAT GM	1				1
Total from copper and manganese		**12**	**0**	**0**	**0**	**12**
Platinum	Ango American Platinum	1				1
	Eastern Platinum Mine		1			1
	Impala Platinum	35	5			40
	Karee Platinum		1			1
	Kroondal Mine, Rustenburg	1				1
	Lonmin Platinum		1			1
	Northam Platinum		2			2
	Rustenburg Platinum		3			3
	Swartklip Platinum		1			1
	Western Platinum		3			3
	Wildebeestfontein	1				1
	Unknown Platinum	3	6			9
Total from platinum		**41**	**23**	**0**	**0**	**64**
Shaft sinkers	Shaft sinkers	1				1
Total for shaft sinkers		**1**	**0**	**0**	**0**	**1**

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Non-miner	Environmental	4				4
	Industry		1			1
Total for non- miners		**4**	**1**	**0**	**0**	**5**
Unknown	Cementation		1			1
	Idwala Lime		1			1
	Kuruman	5				5
	Unknown	5	12			17
Total for Unknown		**10**	**14**	**0**	**0**	**24**
TOTAL		**266**	**184**	**0**	**0**	**450**

APPENDIX 2: PUBLICATIONS AND ACTIVITIES EMANATING FROM PATHAUT DATA OR AUTOPSY SERVICE (2023)

Degrees

Manenzhe, Radzilani, MSc, (ongoing) School of Pathology, Anatomical Pathology, University of Witwatersrand, The value of minimally invasive tissue sampling in the diagnosis of occupational lung disease in deceased South African Miners.

Mthombeni, Julian, PhD, (ongoing) School of Public Health, University of Witwatersrand, Quantification and mapping of manganese deposition and associated histopathological correlates in the lungs of deceased South African miners.

Outreach Programme Activities

ACTIVITY	DATE	VENUE	PERSON
Arcelor Mittal hosted their annual health and safety day at their Vanderbijlpark plant, Gauteng province. The NIOH in partnership with Gijima Occupational Hygiene created awareness on issues involving occupational hazards and diseases.	26 April 2023	Arcelor Mittal Vanderbijlpark plant, Gauteng	Dr. Delerise Fassom Mr. Radzilani Manenzhe Mrs. Tsabeng Mogaki
40 members from the University of Utah and South Africa, mostly 3rd and 4th year university students, were in attendance. The visit provided a perspective on how public health challenges affect the workforce and societal wellbeing.	07 July 2023	NIOH Tony Davies Auditorium	Dr. Delerise Fassom
The NIOH hosted delegates from the Mine Ventilation Society - Free State Branch (Welkom). An overview of the Pathology Section, services offered, occupational lung disease, autopsy service and compensation was presented.	07 July 2023	NIOH Tony Davies Auditorium	Dr. Delerise Fassom
The NIOH hosted students from the USA. An overview of the origin of Pathology Section, ser-	07 July 2023	NIOH Tony Davies	Dr. Delerise Fassom

vices offered, occupational lung disease, autopsy service and compensation was presented. Twelve members were in attendance from Tshepong, Phakista and Beatrix mines. Those in attendance were occupational hygienist, managers, supervisors and environmental officers.			
A group of 2nd year students enrolled in the Diploma of Occupational Medicine and Health from the University of Pretoria School of Health Systems and Public Health, visited the NIOH Pathology department for a walk-about and overview of the services rendered.	18 July 2023	NIOH Pathology Department	Dr. Delerise Fassom
The NIOH hosted a delegation of eight, led by Dr Vania Chongo Faruk, the head of the National Occupational Health Programme Mozambique Ministry of Health, and IOM Team. An overview of the origins, main focus areas and autopsy service conducted by the pathology division was presented.	28 August 2023	NIOH Pathology Department	Dr. Delerise Fassom
Arcelor Mittal Health and Wellness Day Exhibition	08 September 2023	Arcelor Mittal Vanderbijlpark plant, Gauteng	Dr. Delerise Fassom Mr. Radzilani Manenzhe Mrs.Tsabeng Mogaki
The Pathology Department hosted Professor Cooper, a soft tissue and head and neck pathology subspecialist, who works at the University of Pennsylvania, He was accompanied by two of his registrars, along with a registrar from Botswana.	04 October 2023	NIOH Pathology Department	Dr. Deepna Lakhoo Dr. Jana Graham Dr. Delerise Fassom
The Pathology department hosted Dr. Inge Kleinhans and Dr. Yaruma Ndombi, who are both Public Health registrars, showing them occupation lung pathology macroscopically and microscopically.	17 October 2023	NIOH Pathology Department	Dr. Delerise Fassom