



**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 2020

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EXECUTIVE SUMMARY

The NIOH examined the cardiorespiratory organs of 557 deceased individuals in 2020. This represents a 26% decrease in the cases received in 2019, mainly due to logistical issues attributable to the COVID pandemic. Of these, 54.6% were black, 45.1% were white and 0.4% were coloured. Of the cases submitted, 62.5% (n=348) were ex-miners, 33.6% (n=187) current miners and 4.0% (n=22) cases could not be classified.

The overall disease rates (per 1000 autopsies) for 2020 are shown in Figure 1.

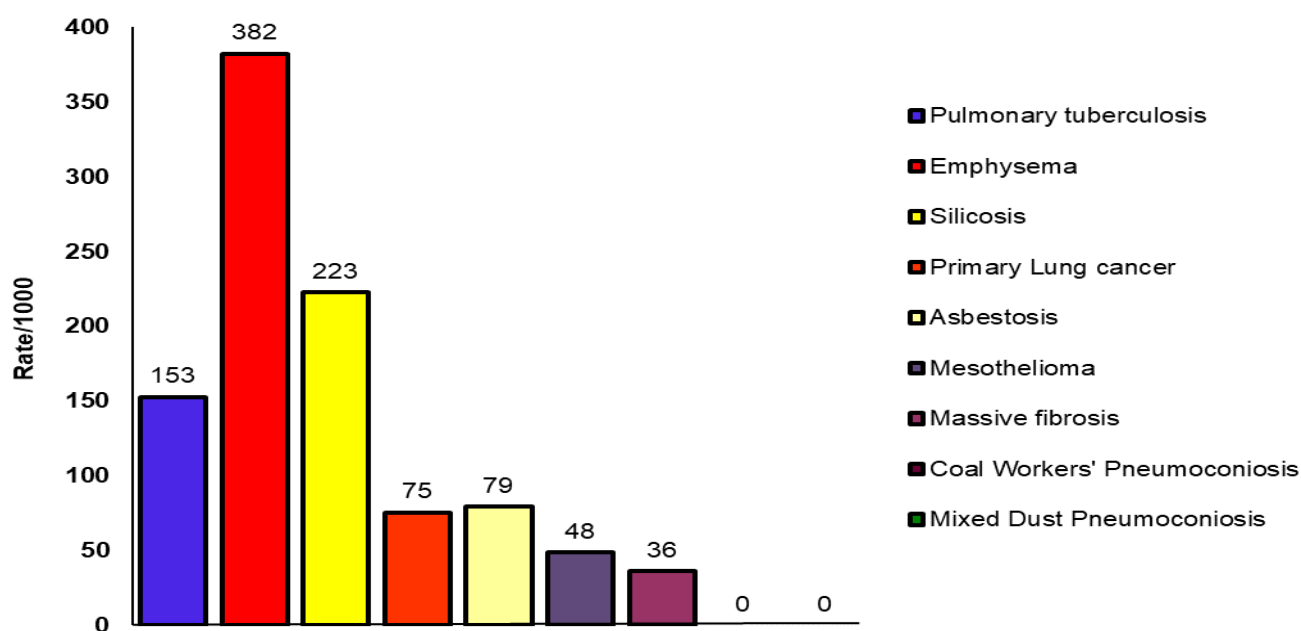


FIG. 1 OVERALL DISEASE RATES FOR 2020

The overall rate of pulmonary tuberculosis (PTB) decreased, from 192/1000 in 2019 to 153/1000 in 2020. The rate in black gold miners decreased from 290/1000 in 2019 to 228/1000 in 2020. In black platinum miners, the PTB rate increased from 142/1000 in 2019 to 206/1000 in 2020.

The overall rate of silicosis decreased from 246/1000 in 2019 to 223/1000 in 2020. The rate in gold miners decreased to 322/1000 in 2020 compared to 338/1000 in 2019. In black gold miners, the rate decreased from 368/1000 in 2019 to 316/1000 in 2020 (FIG 4-1 on page 11), whilst the rate in white gold miners increased from 309/1000 in 2019 to 328/1000 in 2020.

The organs of 29 women were submitted for examination with a history of working in the gold mining industry (13.8%), in the asbestos industry (55.2%) and in "other" mining (17.2%). The remainder had environmental asbestos exposure (13.8%). Fifteen (51.7%) had diseases related to asbestos exposure.

Some cases were received with incomplete exposure information. Active follow-up of cases received has improved the completeness of the information obtained. However, in 2020 information could not be obtained for the following: mine type (commodity) 7(1.3%), duration of service 25 (4.5%) and last mine worked 7 (1.3%).

Since 2010, the province or foreign country from which the organs were sent has been recorded on the PATHAUT database. Table 1-1 shows the distribution of cases by province and population group. Most cases originated from the North West (27.8%), Gauteng (27.5%) and Free State (16.9%) provinces. One (0.2%) case was received from Lesotho.

TABLE 1-1 DISTRIBUTION OF AUTOPSY CASES BY PROVINCE AND POPULATION GROUP (2020)

Province	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Eastern Cape	4	1.3	3	1.2	0	-	7	1.3
Free State	53	17.4	41	16.3	0	-	94	16.9
Gauteng	51	16.8	101	40.2	1	50.0	153	27.5
Kwazulu-Natal	0	-	6	2.4	0	-	6	1.1
Limpopo	5	1.6	5	2.0	0	-	10	1.8
Mpumalanga	12	4.0	20	8.0	0	-	32	5.7
North West	91	29.9	63	25.1	1	50.0	155	27.8
Northern Cape	87	28.6	6	2.4	0	-	93	16.7
Western Cape	0	-	6	2.4	0	-	6	1.1
Lesotho	1	0.3	0	-	0	-	1	0.2
Total	304		251		2		557	

Although the Pathology Division has scaled down its outreach activities in recent years, it continues to engage with stakeholders. These include occupational health units on the mines, undertakers and occupational and environmental health university students, in 2020 there were no physical outreach activities, follow-ups on missing case information was done through telephonic communication (Appendix 2).

One journal article using autopsy data were published (Appendix 2).

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GLOSSARY

Asbestosis	Lung fibrosis caused by asbestos fibres
Coal workers' pneumoconiosis	Lung fibrosis caused by exposure to coal dust
Emphysema	Lung disease caused by the destruction of the alveolar walls
Massive fibrosis	Lung fibrosis caused by exposure to dust and measuring more than 1 cm in diameter
Mesothelioma	A malignant tumour of the pleural cavity of the lungs
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
Surveillance	The ongoing and systematic collection, analysis, interpretation and dissemination of information related to adverse health outcomes for action
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

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 agrees. 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. These data are the only 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 M170879).

The data presented in this report summarise 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 v7.1. This report describes autopsy cases examined during the year 2020. 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. To maintain consistency with previous reports, the term 'men' and all data refers to 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 (1975-2020)

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	1 059	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	0.1	5	0.6	801
2018	446	58	321	41	6	0.7			2	0.3	775
2019	445	59	307	40	5	0.7			2	0.3	759
2020	304	54.6	251	45.1	2	0.3					557
Total	75 687	66	37 089	32	1 648	1	5		361		114 793

It is important to note that a referral bias exists: there is a low autopsy rate for black men who have left employment at the mines, whereas the majority of retired white miners are autopsied. 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 94 399 in 2020 (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 men 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 men who die close to Johannesburg.

Table 2-2 shows the distribution of autopsies by population group for 2020. The vast majority (97.5%) of autopsy examinations were performed on the cardio-respiratory organs only.

TABLE 2-2 NUMBER AND PROPORTION OF AUTOPSIES BY TYPE AND POPULATION GROUP (2020)

Autopsy type	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Cardio-respiratory organs only	302	99.3	239	95.2	2	100	543	97.5
Full autopsy	2	0.7	12	4.8	0	-	14	2.5
Total	304		251		2		557	

The age distribution of cases for 2020 is shown in Table 2-3 and presented graphically in Figure 2-1. The mean age at autopsy of black men was 54.9 years in 2020, similar to that in 2019 (54.5 years). The mean age of white men at autopsy was 69.9 years in 2020, similar to 68.2 years in 2019.

TABLE 2-3 NUMBER AND PROPORTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2020)

Age group (years)	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
20-29	3	1.0	0	0.0	0	-	3	0.5
30-39	37	12.2	0	0.0	0	-	37	6.6
40-49	65	21.4	5	1.0	1	50.0	71	12.7
50-59	103	33.9	31	12.4	0	-	134	24.1
60-69	51	16.8	87	34.7	1	50.0	139	25.0
70-79	29	9.5	83	33.1	0	-	112	20.1
80+	16	5.3	45	17.9	0	-	61	11.0
Total	304		251		2		557	

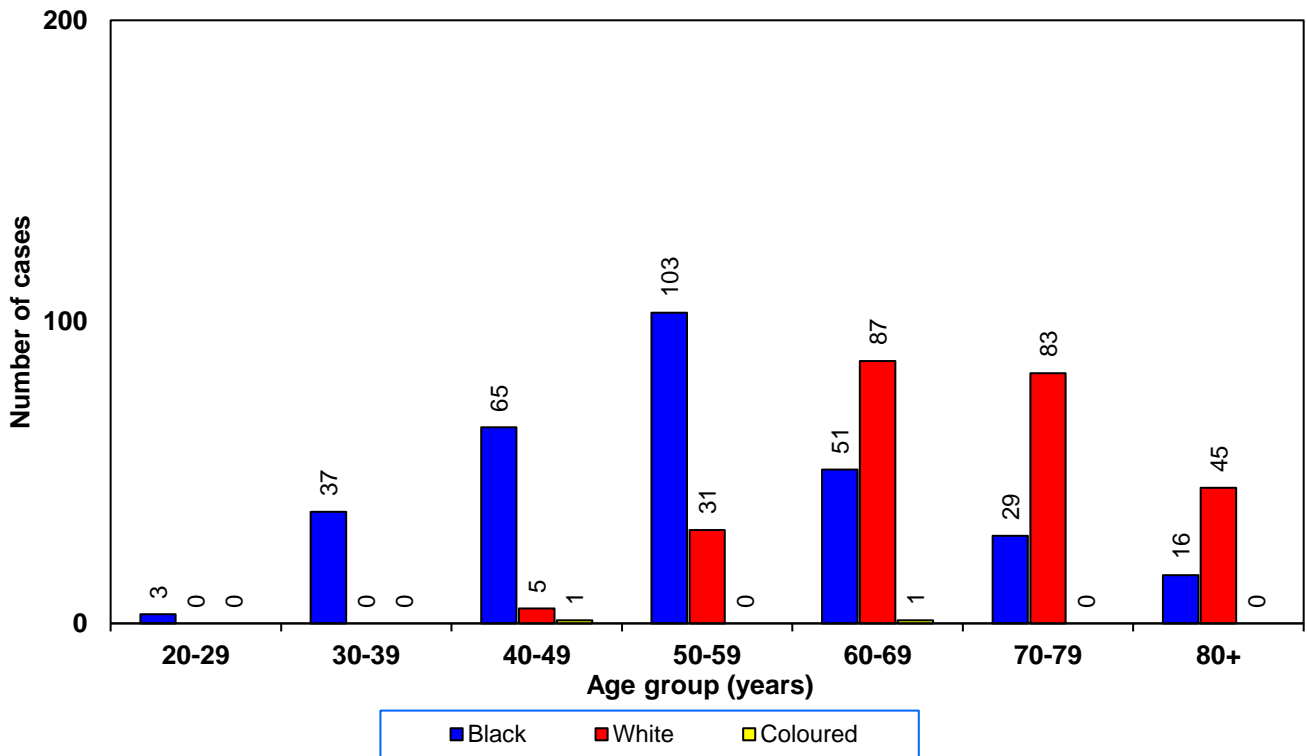


FIG 2-1 DISTRIBUTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2020)

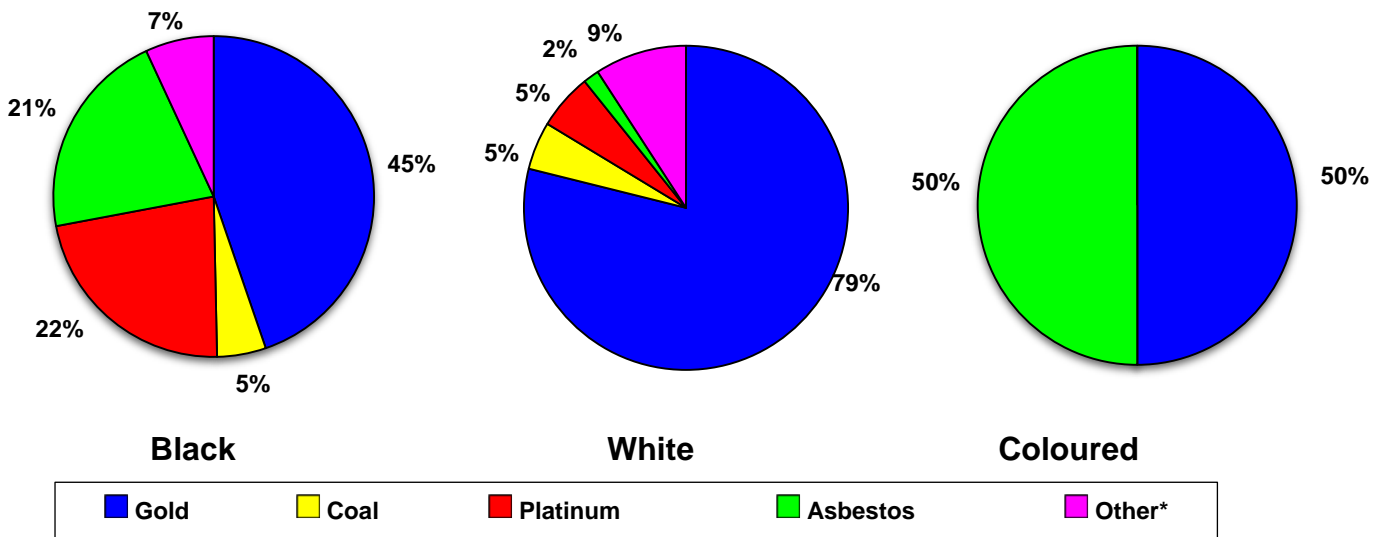
There are men who worked in a number of different mining commodities during their lifetimes and had “mixed” exposures. This was not taken into account in the analysis of exposure type (commodity). Cases were placed in categories according to the commodity in which they had worked for the longest duration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

Table 2-4 and Figure 2-2 show the distributions of autopsies by commodity and population group for 2020. The majority of autopsies (60.1%) were on men from the gold mining industry, which is similar to 2019 (61.1%). The proportion of autopsies from the platinum mining industry increased over the years, from 8.3% in 1999 to 23.1% in 2017, and subsequently decreased and is now 14.7% in 2020.

TABLE 2-4 NUMBER AND PROPORTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2020)

Commodity	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Gold	136	44.7	198	78.9	1	50.0	335	60.1
Platinum	68	22.4	14	5.6	0	-	82	14.7
Coal	15	4.9	12	4.8	0	-	27	4.9
Asbestos	64	21.1	4	1.6	1	50.0	69	12.4
Copper	2	0.7	2	0.7	0	-	4	0.7
Manganese	7	2.3	3	1.2	0	-	10	1.8
Industry	1	0.3	3	1.2	0	-	4	0.7
Other*	8	2.6	11	4.4	0	-	19	3.4
Unknown	3	1.0	4	1.6	0	-	7	1.3
Total	304		251		2		557	

*Chrome, diamond, environmental asbestos, Eskom, iron, lead, lime, silica, works



*Includes

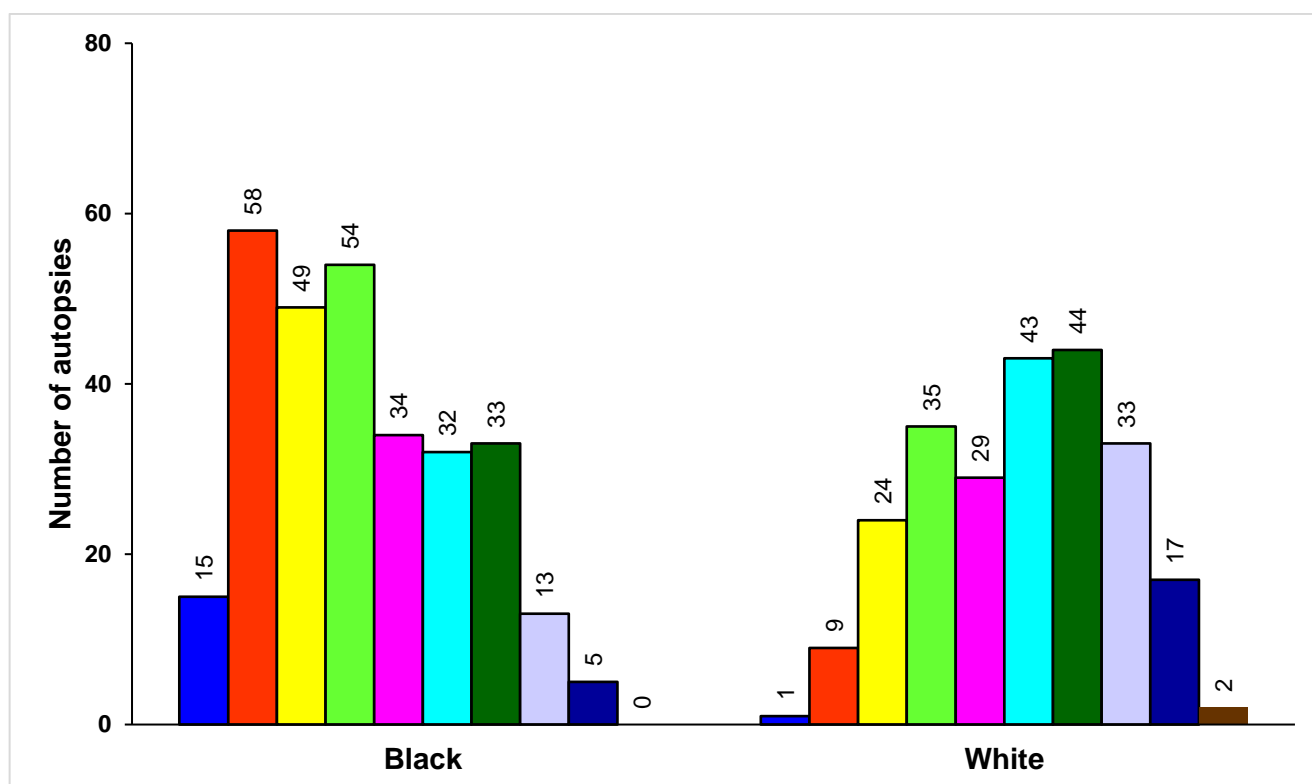
*Chrome, copper, diamond, environmental asbestos, Eskom, industry, iron, lead, lime, silica, works and manganese as well as cases where service histories could not be obtained

FIG 2-2 DISTRIBUTION OF AUTOPSIES BY COMMODITY AND POPULATION (2020)

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 2020, the duration of service was obtained for all but 4.5% (n=25) of cases.

TABLE 2-5 NUMBER AND PROPORTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2020)

Years of service	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
<1	15	4.9	1	0.4	0	-	16	2.9
1-5	58	19.1	9	3.6	1	50.0	68	12.2
6-10	49	16.1	24	9.6	0	-	73	13.1
11-15	54	17.8	35	13.9	1	50.0	90	16.2
16-20	34	11.2	29	11.6	0	-	63	11.3
21-25	32	10.5	43	17.1	0	-	75	13.5
26-30	33	10.9	44	17.5	0	-	77	13.8
31-35	13	4.3	33	13.1	0	-	46	8.3
36-40	5	1.6	17	6.8	0	-	22	3.9
41+	0	-	2	0.8	0	-	2	0.4
Unknown	11	3.6	14	5.6	0	-	25	4.5
Total	304		251		2		557	



Years of service:

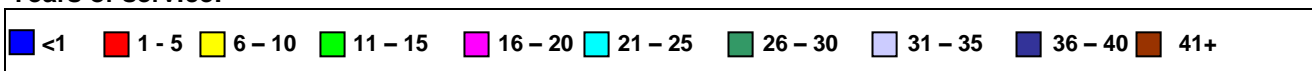


FIG 2-3 DISTRIBUTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2020)

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 (2020)

Commodity	Black			White		
	N	Mean (Years)	SD*	N	Mean (Years)	SD*
Gold	136	50	12	198	70	10
Platinum	68	48	8	14	65	7
Coal	15	52	14	12	70	10
Asbestos	64	69	10	4	77	10
Copper	2	63	5	2	63	14
Manganese	7	58	19	3	62	12
Industry	1	36	-	3	80	1
Other	8	74	12	11	79	10
Unknown	3	68	7	4	68	12
Total	304	55	14	251	68	11

* Standard deviation

TABLE 2-7 MEAN DURATION OF SERVICE BY COMMODITY AND POPULATION GROUP (2020)

Commodity	Black			White		
	N	Mean (Years)	SD*	N	Mean (Years)	SD*
Gold	135	19	9	194	23	10
Platinum	63	17	8	13	18	7
Coal	14	16	12	12	18	11
Asbestos	64	4	5	4	20	9
Copper	2	8	5	2	8	2
Manganese	1	2	-	3	21	5
Industry	7	13	10	7	23	8
Other	7	23	11	7	21	12
Total	293	15	10	237	23	10

*Standard deviation

SECTION 3 – ACTIVE TUBERCULOSIS

The distribution of active tuberculosis (TB) by anatomical site is presented in Figure 3-1 (n=105). Active pulmonary TB (PTB) was diagnosed in 15.3% (n=85) of all autopsies in 2020, compared to 27.4% (n=472) in 2007. Most of the men with PTB were black (n=55; 64.7%) and 30 (35.3%) were white.

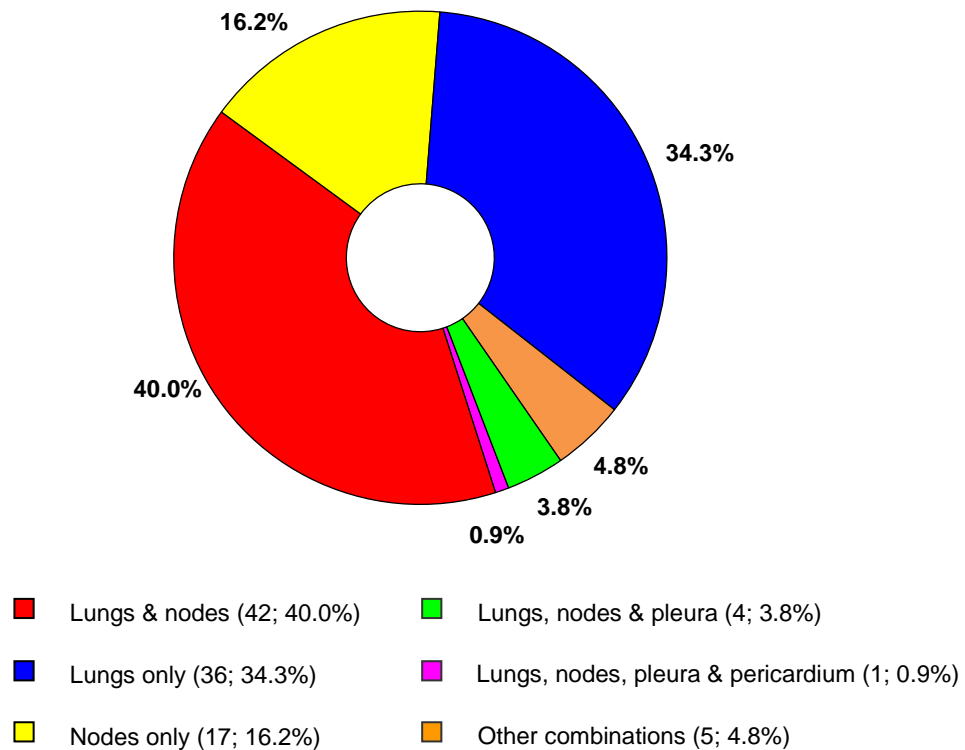


FIG 3-1 DISTRIBUTION OF ACTIVE TB BY SITE (2020)

Disease rates in subsequent tables and figures are expressed per 1000 miners.

In 2020, the overall PTB rate was 153/1000. In black miners, PTB rates increased since the early 1990s and peaked at 368/1000 in 2007, declined annually to 168/1000 in 2018, increased to 234/1000 in 2019 but now declined again to 181/1000 in 2020 (Fig 3-2). The rate in white miners was much lower than that in black miners, 120/1000 (2020), and declined compared to the rate in 2019 (127/1000).

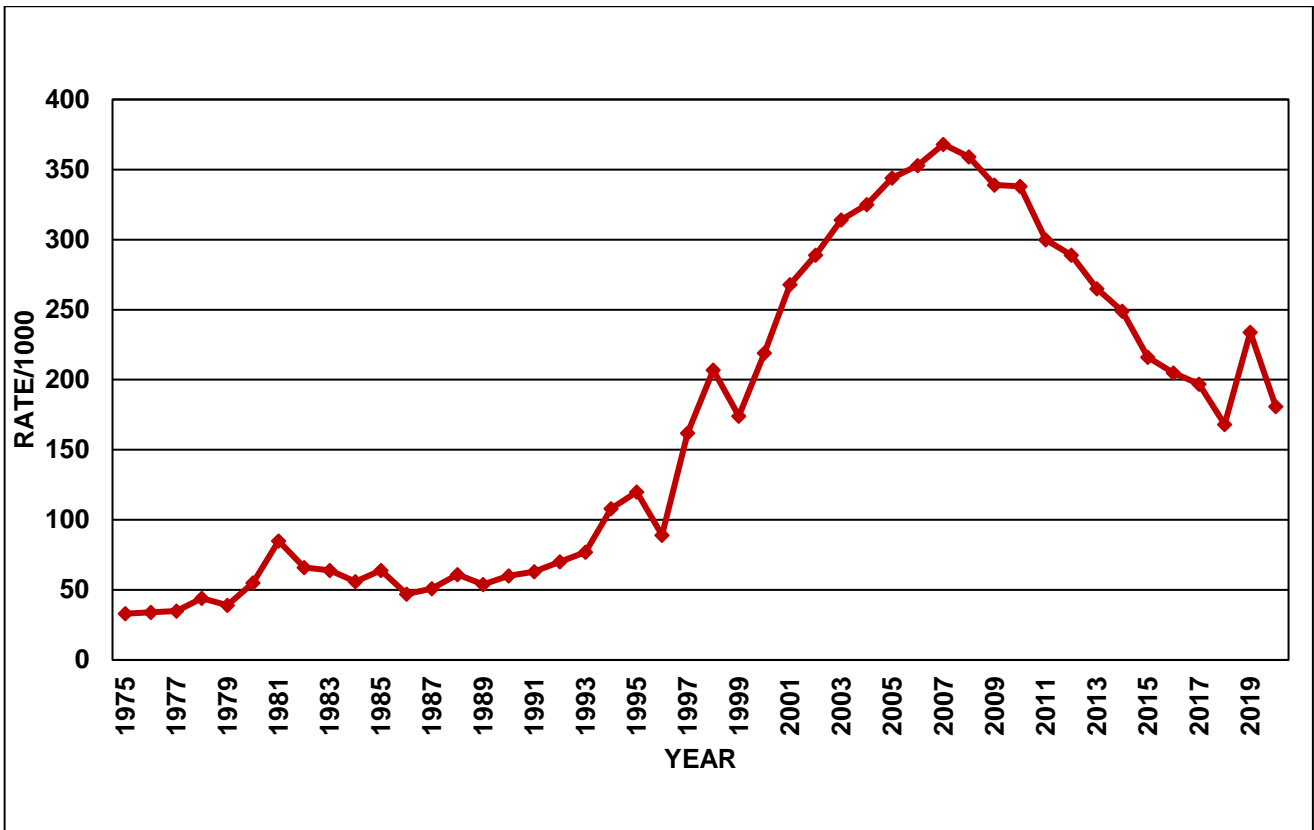


FIG 3-2 ACTIVE PTB RATES IN BLACK MINERS AT AUTOPSY (1975-2020)

The distribution of active PTB cases by commodity is shown in Table 3-1. Most cases of active PTB (67.1%) were from the gold (60.1% of all autopsy cases came from that commodity) and platinum (14.7%) mining industries.

TABLE 3-1 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY COMMODITY AND POPULATION GROUP (2020)

Commodity	Black		White		Total	
	N	Rate	N	Rate	N	Rate
Gold	31	228	26	131	57	216
Platinum	14	206	0	-	14	142
Coal	2	-	2	-	4	-
Asbestos	4	-	1	-	5	-
Manganese	1	-	0	-	1	-
Industry	0	-	1	-	1	-
Other	3	-	0	-	3	-
Total	55	181	30	120	85	153

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=30; 35.3%) were in the age group 50-59 years, followed by those in the 60-69 years age group (n=21; 24.7%).

TABLE 3-2 NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY AGE AND POPULATION GROUP (2020)

Age group (years)	Black		White		Total	
	N	Rate	N	Rate	N	Rate
20-29	0	-	0	-	0	-
30-39	6	162	0	-	6	162
40-49	10	154	0	-	10	141
50-59	26	252	4	-	30	224
60-69	10	196	11	126	21	151
70-79	2	-	11	133	13	116
80+	1	-	4	-	5	-
Unknown	0	-	0	-	1	-
Total	55	181	30	120	85	153

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

SECTION 4 – SILICOSIS

Silicotic nodules were found in the lungs of 124 cases (22.3% of all autopsies), 87.1% of which came from the gold mining industry. Of all cases with silicosis, occasional silicotic nodules were found in 49 (39.5%), a few in 26 (21.0%), a moderate number in 29 (23.4%) and a large number in 20 (16.1 %) 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 (2020)

Commodity	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
Gold	43	316	65	328	0	-	108	322
Platinum	4	-	2	-	0	-	6	73
Coal	1	-	2	-	0	-	3	-
Asbestos	0	-	1	-	1	-	2	-
Copper	0	-	1	-	0	-	2	-
Manganese	2	-	0	-	0	-	1	-
Other	1	-	1	-	0	-	2	-
Total	51	168	72	287	1		124	223

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 silicosis rates in black gold miners increased from 39/1000 in 1975, peaked at 403/1000 in 2016, and is now 316/1000. The rate in white gold miners has also increased since 1997 from 176/1000 to 328/1000 in 2020, which is also an increase from the rate in 2019 (309/1000).

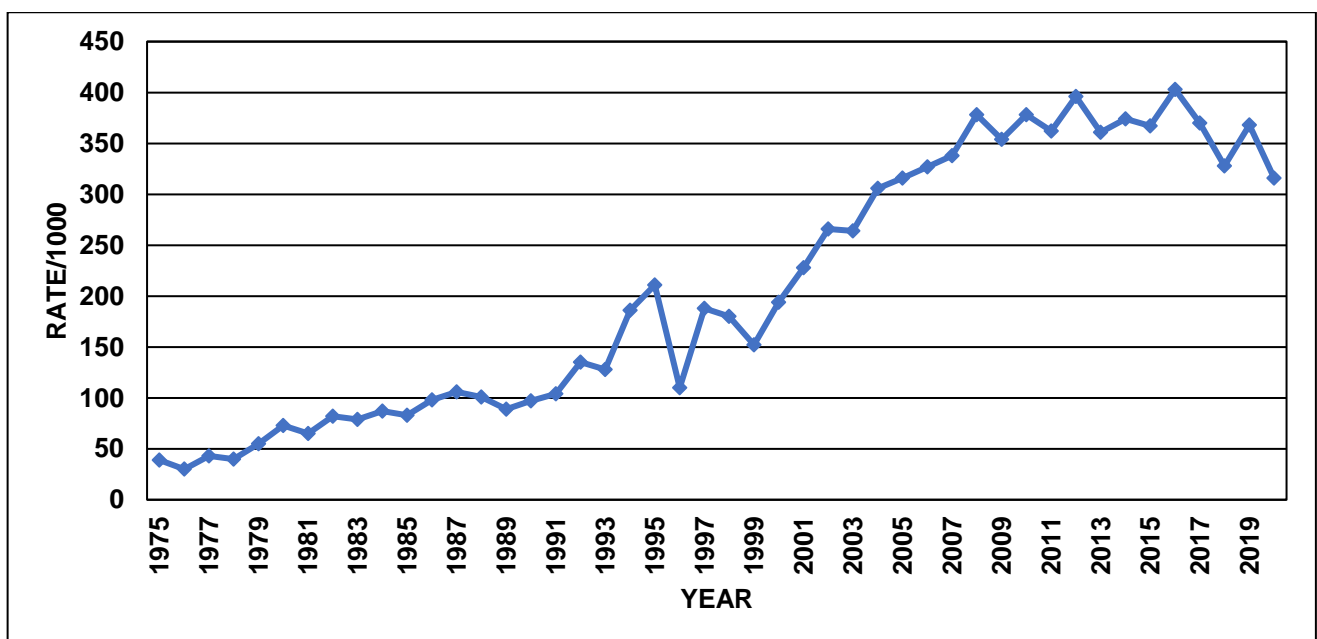


FIG 4-1 SILICOSIS IN BLACK GOLD MINERS AT AUTOPSY (1975-2020)

Silicosis in gold miners is shown in tables, 4-2 and 4-3. The rate of silicosis in gold miners in 2020 (322/1000) is lower than that of 2019 (338/1000). The age distribution of silicosis differed between the black and white men (Table 4-2). In black men, silicosis was diagnosed in seven men aged younger than 50 years (Table 4-2). No silicosis cases were detected in those that had served for 5 years or less (Table 4-3).

TABLE 4-2 NUMBER OF CASES AND PREVALENCE OF SILICOSIS IN THE GOLD MINING INDUSTRY, BY AGE AND POPULATION GROUP (2020)

Age group (years)	Black		White		Total	
	N	Rate	N	Rate	N	Rate
30-39	1	-	0	-	1	-
40-49	6	182	0	-	6	158
50-59	22	407	6	18	28	359
60-69	9	600	16	232	25	298
70-79	4	-	27	397	31	425
80+	1	-	16	485	17	486
Total	43	316	65	328	108	322

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 (2020)

Years of service	Black		White		Total	
	N	Rate	N	Rate	N	Rate
<1	0	-	0	-	0	-
1-5	0	-	0	-	0	-
6-10	2	-	5	-	7	184
11-15	8	235	8	320	16	267
16-20	5	-	6	273	11	306
21-25	8	308	10	278	18	290
26-30	11	579	19	487	30	517
31-35	8	727	9	321	17	436
36-40	0	-	7	412	7	368
41+	0	-	1	-	1	-
Unknown	1	-	0	-	1	-
Total	43	316	65	328	108	322

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

SECTION 5 – OTHER PNEUMOCONIOSES

MASSIVE FIBROSIS

There were 20 (3.6%) cases of massive fibrosis: twelve in black and eight in white miners. Eighteen were from the gold mining industry, one from the asbestos mining industry and one from the platinum 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 is to align the pathology diagnosis with the International Labour Organisation (ILO) radiological measurements.

COAL WORKERS' PNEUMOCONIOSIS

There were no cases of coal workers' pneumoconiosis in cases examined in 2020.

MIXED DUST PNEUMOCONIOSIS

There were no cases of mixed dust pneumoconiosis in cases examined in 2020.

ASBESTOSIS AND PLEURAL PLAQUES

There were 44 cases of asbestosis. Of these, 36.4% (n=16) had slight, 43.2% (n=19) had moderate and 20.5% (n=9) had marked fibrosis. Thirty-six (81.8%) had worked in the asbestos mining industry and 3 (7%) had environmental asbestos exposure at some time in their lives.

There were 13 cases with asbestos plaques and of these 4 had asbestosis. However, the parietal pleura (the site where plaque formation usually occurs) is seldom submitted with the lungs.

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 (2020)

Age group (years)	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
30-39	1	-	0	-	0	-	1	-
50-59	3	-	0	-	0	-	3	-
60-69	13	255	2	-	1	-	16	115
70-79	14	483	2	-	0	-	16	143
80+	6	375	2	-	0	-	8	131
Total	37	122	6	24	1		44	79

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

SECTION 6 – EMPHYSEMA

There were 213 cases of emphysema, the extent of which was mild in 82.2% (n=175), moderate in 15.5% (n=35) and marked in 1.4% (n=3) cases. The overall rate of emphysema increased from 360/1000 in 2019 to 382/1000 in 2020. The distribution of emphysema by age and population group is presented in Table 6-1.

TABLE 6-1 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY AGE AND POPULATION GROUP (2020)

Age group (years)	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
20-29	1		0	-	0	-	1	-
30-39	4		0	-	0	-	4	-
40-49	13	200	1	-	0	-	14	197
50-59	25	243	10	323	1	-	35	261
60-69	23	451	44	506	0	-	68	489
70-79	17	586	43	518	0	-	60	536
80+	8	500	23	511	0	-	31	508
Total	91	299	121	482	1		213	382

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

Most of the men with emphysema were from the gold mining industry (n=126, 59.2%) (Table 6-2).

TABLE 6-2 NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY COMMODITY AND POPULATION GROUP (2020)

Commodity	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
Gold	32	235	94	475	0	-	126	376
Platinum	18	265	9	643	0	-	27	329
Coal	4	-	5	-	0	-	9	333
Asbestos	30	469	2	-	1	-	33	478
Copper	1	-	1	-	0	-	2	-
Manganese	3	-	1	-	0	-	4	-
Industry	0	-	1	-	0	-	1	-
Other	3	-	6	545	0	-	9	450
Unknown	0	-	2	-	0	-	2	-
Total	91	299	121	482	1		213	382

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 (2020)

Years of service	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
<1	6	400	0	-	0	-	6	375
1-5	24	414	1	-	1	-	26	382
6-10	17	347	11	458	0	-	28	384
11-15	13	241	18	514	0	-	31	344
16-20	4	-	10	345	0	-	14	222
21-25	9	281	26	605	0	-	35	467
26-30	10	303	23	523	0	-	33	429
31-35	4	-	19	576	0	-	23	500
36-40	2	-	5	-	0	-	7	318
41+	0	-	1	-	0	-	1	-
Unknown	2	182	7	500	0	-	9	360
Total	91	299	121	482	1		213	382

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

SECTION 7 – MESOTHELIOMA

There were 27 cases of mesothelioma in 2020.

TABLE 7-1 NUMBER AND PERCENTAGE OF MESOTHELIOMA CASES BY AGE AND POPULATION GROUP (2020)

Age group (years)	Black		White		Total	
	N	%	N	%	N	%
50-59	6	27.3	0	-	6	22.2
60-69	10	45.5	2	40.0	12	44.5
70-79	4	18.2	2	40.0	6	22.2
80+	2	9.1	1	20.0	3	11.1
Total	22		5		27	

The distribution of mesothelioma by commodity and population group is presented in Table 7-2. Nineteen (70.4%) of the cases had worked in asbestos mines at some stage in their careers. Sixteen of the cases had the longest service in asbestos (most exposure) and seven had mixed exposures that included asbestos.

TABLE 7-2 NUMBER AND PERCENTAGE OF MESOTHELIOMA CASES BY COMMODITY AND POPULATION GROUP (2020)

Commodity	Black		White		Total	
	N	%	N	%	N	%
Gold	1	4.5	1	20.0	2	7.4
Copper	1	4.5	0	-	1	3.7
Asbestos	16	72.7	0	-	16	59.3
Industry	0	-	1	20.0	1	3.7
Other	3	13.6	3	60.0	6	22.2
Unknown	1	4.5	0	-	1	3.7
Total	22		5		27	

SECTION 8 – PRIMARY LUNG CANCER

Forty-two cases of primary lung cancer were found at autopsy, 40.5% (n=17) of which were in black miners and 59.5% (n=25) were white miners. Most of the cases were adenocarcinoma (n=20; 47.6%), followed by those with squamous cell carcinoma (n=14, 33.3%), small cell carcinoma (n=5; 11.9%), and large cell carcinoma (n=3; 7.2%).

The distribution of primary lung cancer by age and population group is presented in Table 8-1.

TABLE 8-1 NUMBER AND PROPORTION OF PRIMARY LUNG CANCER CASES BY AGE AND POPULATION GROUP (2020)

Age group (years)	Black		White		Total	
	N	Rate	N	Rate	N	Rate
30-39	1	-	0	-	1	-
40-49	2	-	1	-	3	-
50-59	5	-	2	-	7	52
60-69	3	-	11	126	14	101
70-79	5	-	9	108	14	125
80+	1	-	2	-	3	-
Total	17	56	25	100	42	75

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. Although the highest rate was seen in the asbestos mining industry (Table 8-2).

TABLE 8-2 NUMBER AND PROPORTION OF PRIMARY LUNG CANCER CASES BY COMMODITY AND POPULATION GROUP (2020)

Commodity	Black		White		Total	
	N	Rate	N	Rate	N	Rate
Gold	6	44	22	111	28	84
Platinum	4	-	0	-	4	-
Coal	0	-	2	-	2	-
Asbestos	7	109	1	-	8	116
Total	17	56	25	100	42	75

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

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. Diseases of the respiratory system were the most frequent (15.1%). The proportion of unnatural deaths (8.8%) was similar to that in 2019 (9.5%). Seven cases were stated as COVID-19 related deaths, these cases are classified under diseases of the respiratory system. The clinical cause of death was not stated for 8.1% of the cases.

TABLE 9-1 CLINICAL CAUSE OF DEATH BY POPULATION GROUP (2020)

System	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Respiratory	27	8.9	56	22.3	1	50.0	84	15.1
Cardio-vascular	6	2.0	15	6.0	0	-	21	3.8
Central Nervous System	1	0.3	8	3.2	0	-	9	1.6
Gastro-intestinal	2	0.7	7	2.8	0	-	9	1.6
Genito-urinary	2	0.7	2	0.8	0	-	4	0.7
Haematological	0	-	2	0.8	0	-	2	0.4
Unnatural	39	12.8	10	4.0	0	-	49	8.8
Miscellaneous	197	64.8	136	54.2	1	50.0	334	60.0
Not stated	30	9.9	15	6.0	0	-	45	8.1
Total	304		251		2		557	

*Data for the metabolic system included in the hematological system, miscellaneous includes those deaths coded as natural causes

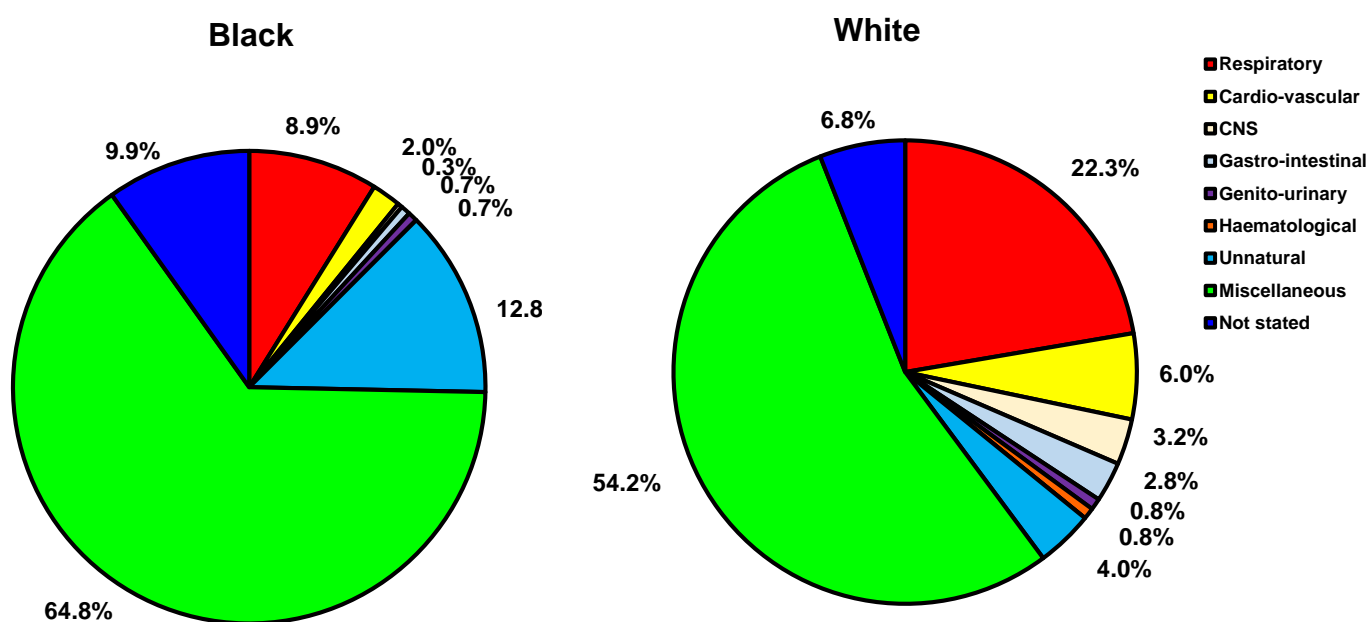


FIG 9-1 CLINICAL CAUSES OF DEATH (2020)

SECTION 10 – AUTOPSY FINDINGS IN WOMEN

Of the 557 cases examined in 2020, 29 (5.2%) were women compared to 26 (3.4%) in 2019, 40 (5.2%) in 2018 and 42 (5.2%) in 2017. There were 25 (86.2%) black, and four white (13.8%) women. On average, the women were older than the men (69.1 years and 61.3 years, respectively).

**TABLE 10-1 NUMBER AND PROPORTION OF AUTOPSIES IN WOMEN
BY AGE AND POPULATION GROUP (2020)**

Age group (years)	Black		White		Total	
	N	%	N	%	N	%
30-39	3	12.0	0	-	3	10.3
40-49	2	8.0	0	-	2	6.9
50-59	2	8.0	0	-	2	6.9
60-69	5	5.0	1	25.0	6	20.7
70-79	6	24.0	1	25.0	7	24.1
80+	7	28.0	2	50.0	9	31.0
Total	25		4		29	

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 (2020)**

Commodity	Black		White		Total	
	N	%	N	%	N	%
Gold	4	16.0	0	-	4	13.8
Coal	2	8.0	0	-	2	6.9
Asbestos	16	64.0	0	-	16	55.2
Other	2	8.0	4	100	6	20.7
Unknown	1	4.0	0	-	1	3.4
Total	25		4		29	

Fifteen women had asbestos-related diseases: seven had asbestosis and eight had mesothelioma (Table 10-3).

TABLE 10-3 NUMBER AND PROPORTION OF DISEASES IN WOMEN (2020)

Disease	N	%
PTB	3	10.3
Silicosis	0	0,0
Emphysema	7	24.1
Asbestosis	7	24.1
Mesothelioma	8	27.6
Primary lung cancer	2	6.9
No lung disease	2	7.0
Total	29	100

APPENDIX 1: DISTRIBUTION OF AUTOPSIES ACCORDING TO THE LAST MINE WHERE THE DECEASED WORKED (2020)

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Asbestos	Cape Blue	7				7
	Daniel Skuil Asb Mine	2				2
	Gefco	51	2			53
	Koegas			1		1
	Pomfret Asb Mine	1				1
	Penge Asbestos		1			1
Total from asbestos		61	3	1	0	65
Chrome	Samancor Western chrome	1	1			2
Total from chrome		1	3	0	0	4
Coal	Amcoal Colliery	1				1
	Arnot Colliery	1				1
	Black Wattle Colliery		1			1
	Coal Mine	4	2			6
	Durban Navigation Colliery		1			1
	Ermelo Coal		1			1
	Khutala Colliery		1			1
	Kriel Colliery	1	0			1
	Matla Coal	5				5
	Sasol Coal Mine	2	2			4
	Sigma Colliery	1				1
	Spingfield Colliery		1			1
	Vryheid Coronation		1			1
Total from coal		15	10	0	0	25
Copper	Copper Mine		1			1
	O`Kiep Copper		1			1
	Phalaborwa	1				1
Total from copper		1	2			3
Diamond	Boart Drilling Diamond		1			1
	De Beers Consolidated		3			3
	Rex Diamond Mine		1			1
Total from diamond			5			5
Gold	African Rainbow Minerals & Expl	1				1
	Anglogold Ashanti GM	8	9			17
	Bambanani GM	1				1

	Last mine worked	Black	White	Coloured	Unknown	Total
Gold (contd)	Barberton GM		1			1
	Beatrix Gold	27	5			32
	Blyvoorquizicht		5			5
	Bracken Mines		1			1
	Buffelsfontein Gold	1	8			9
	Cementation		2			2
	Consolidated Murchison		1			1
	Deelkraal		6			6
	Doornfontein		2			2
	Driefontein Cons GM	18	6	1		25
	Durban Roodepoort Deep		3			3
	East Driefontein	1	2			3
	East Rand Prop		4			4
	Elandsrand		1			1
	Evander GM		1			1
	Ezulwini Gold Mine		1			1
	Freddies Gold	1	2			3
	Free State Geduld		12			12
	Free State Saaiplaas		4			4
	Gencor	5				5
	Goldfields		2			2
	Gold mine		1			1
	Grootvlei Prop		3			3
	Harmony	25	14			39
	Hartebeesfontein		4			4
	Joel	1				1
	Kinross		1			1
	Kloof	18	7			25
	Kopanang Gold mine	2				2
	Libanon	1	2			3
	Main Reef GM	1				1
	Marievale		1			1
	Masimong Gold Mine	1				1
	President Brand		5			5
	President Steyn		6			6
	Primrose GM		1			1
	Randfontein		2			2

	Last mine worked	Black	White	Coloured	Unknown	Total
Gold (contd)	Roodekop		1			1
	Saaiplaas GM		1			1
	Sallies		1			1
	Sheba		1			1
	Simmer & Jack GM	5	3			8
	South Deep GM	2	5			7
	St Helena	1	1			2
	Stilfontein	1	4			5
	Tshepone GM	1				1
	Vaal Reefs	3	13			16
	Village Main Reef	1				1
	Welkom GM		2			2
	West Driefontein		6			6
	West Rand Consolidation		2			2
	West Witwatersrand		1			1
	Western Deep Levels	10	7			17
	Western Holdings		3			3
	Winkelhaak		4			4
Total from gold		136	178	1	0	315
Lead	Blackmountain	1				1
Lime	Lime Acres	2				2
Manganese	Associated Manganese	1	1			2
	Black Rock Asb Mine	2				2
	Manganese mine	2	1			3
Total from lead, lime and manganese		9	2	0	0	11
Platinum	Bafokeng	1	2			3
	Deilmann Haniel SA (Northam)		1			1
	Eastern Platinum Mine	12	1			13
	Impala Platinum	18	9			27
	Karee Platinum	21				21
	Kroondal Mine, Rustenburg		1			1
	Kuruman	2	1			3
	Lonmin Platinum		2			2
	Modikwa	2				2
	Northam Platinum		1			1
	Rustenburg Platinum	2	6			8

	Last mine worked	Black	White	Coloured	Unknown	Total
Platinum (contd)	Unknown Platinum	1	4			5
	Waterval Plat Mine		2			2
	Western Platinum	17	1			18
	Zondereinde Platinum Mine		2			2
Total from platinum		76	33	0	0	109
Shaft sinkers	Shaft sinkers		2			2
Silicon	Silicon Smelters		1			1
Total for shaft sinkers & cementation		0	3	0	0	3
Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Non-miner	Environmental	1	3			4
	Eskom		2			2
	Industry	2	3			5
Total for non-miners		3	8	0	0	11
Unknown	Unknown	3	4			7
Total for Unknown		3	4		0	7
TOTAL		304	251	2	0	557

APPENDIX 2: PUBLICATIONS AND ACTIVITIES EMANATING FROM PATHAUT DATA OR AUTOPSY SERVICE (2020)

Journal articles

Mabila SL, Almberg KS, Friedman L, Cohen RA, Ndlovu N, Vorajee N, Murray J. Effects of commodity on the risk of emphysema in South African miners. *International Archives of Occupational and Environmental Health* 93, 315–323 (Issue date 2020). <https://doi.org/10.1007/s00420-019-01483-8>

Outreach Programme Activities

There were no meetings or outreach activities in 2020 due to COVID-19 restrictions.