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 2019

Lucia Mhlongo

Kerry Wilson

Ntebogeng Kgokong

Deepna Govind Lakhoo

Naseema Vorajee

Jessica Linden

Casey McCusker

Delerise Fassom

Anita Gildenhuys

Jill Murray

Ntombizodwa Ndlovu

PO Box 4788
Johannesburg
2000

e-mail: anitag@nioh.ac.za

NIOH Pathology Report 1/2021

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EXECUTIVE SUMMARY

The NIOH examined the cardiorespiratory organs of 759 deceased individuals in 2019. Of these, 58.6% were black, 40.4% were white, 0.7% were coloured and 0.3% were submitted without information of their population group. Of the cases submitted, 63.4% (n=481) were ex-miners, 34.7% (n=263) current miners and 1.9% (n=15) cases could not be classified.

The overall disease rates (per 1000 autopsies) for 2019 are shown in Figure 1.
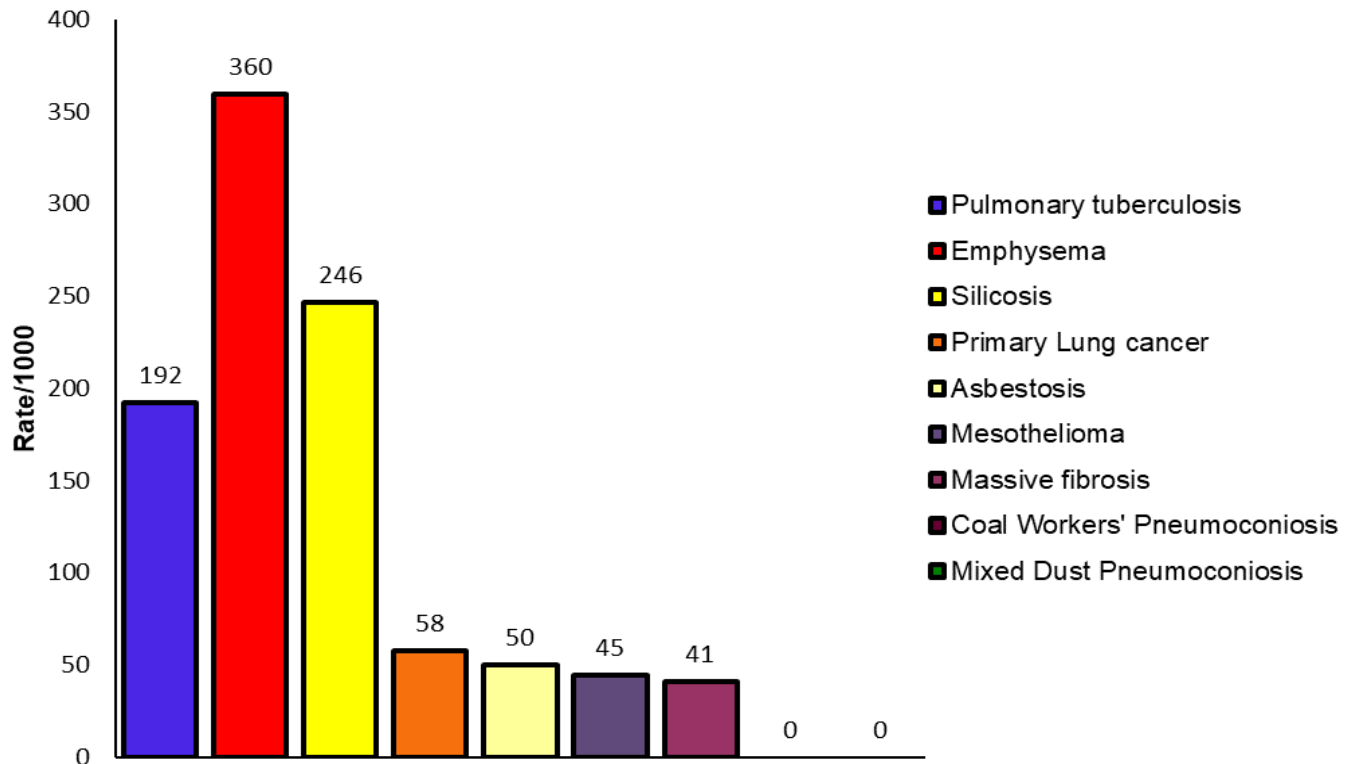
FIG. 1   OVERALL DISEASE RATES FOR 2019

The overall rate of pulmonary tuberculosis (PTB) increased, from 138/1000 in 2018 to 192/1000 in 2019. The rate in black gold miners increased from 216/1000 in 2018 to 290/1000 in 2019. This is the first increase seen since 2007 (Fig 3-2 page 9). In black platinum miners, the PTB rate decreased from 143/1000 in 2018 to 142/1000 in 2019.

The overall rate of silicosis increased from 215/1000 in 2018 to 246/1000 in 2019. The rate in gold miners increased to 338/1000 in 2019 compared to 312/1000 in 2019. In black gold miners, the rate increased from 328/1000 in 2018 to 368/1000 in 2019, having fluctuated between 378/1000 in 2008 and 368/1000 in 2019 (FIG 4-1 on page 11). The rate in white gold miners increased from 296/1000 in 2018 to 309/1000 in 2019.

The organs of 26 women were submitted for examination with a history of working in the gold mining in (42.3%) and in the asbestos industry (46.3%).

Some cases were received with incomplete exposure information. Active follow-up of cases received has improved the completeness of the information obtained. However, in 2019 information could not be obtained for the following: mine type (commodity) 12 (1.5%), duration of service 27 (3.6%) and last mine worked 12 (1.5%).

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 (31.8%), Gauteng (25.7%) and Free State (19.1%) provinces. Twenty-six (3.4%) cases were received from Lesotho, one case was received from Namibia and one from Botswana.

TABLE 1-1   DISTRIBUTION OF AUTOPSY CASES BY PROVINCE AND POPULATION GROUP (2019)

Province	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Eastern Cape	6	1.4	0	-	0	-	0	-	6	0.8
Free State	103	23.1	42	13.7	0	-	0	-	145	19.1
Gauteng	55	12.4	140	45.6	0	-	0	-	195	25.7
Kwazulu-Natal	0	-	8	2.6	0	-	0	-	8	1.1
Limpopo	1	0.2	2	0.7	0	-	0	-	3	0.4
Mpumalanga	11	2.5	25	8.1	0	-	0	-	36	4.7
North West	156	35.1	82	26.7	1	20.0	2	100	241	31.8
Northern Cape	86	19.3	4	1.3	4	80.0	0	-	94	12.4
Western Cape	0	-	3	1.0	0	-	0	-	3	0.4
Botswana	1	0.2	0	-	0	-	0	-	1	0.1
Lesotho	26	5.8	0	-	0	-	0	-	26	3.4
Namibia	0	-	1	0.3	0	-	0	-	1	0.1
Total	445		307		5		2		759	

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 (Appendix 2).

Two journal articles using autopsy data were published (Appendix 2). One PhD study utilising the PATHAUT data was completed (registered with the University of the Witwatersrand).

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GLOSSARY

Asbestosis   Lung fibrosis caused by asbestos fibres

Coal workers'   Lung fibrosis caused by exposure to coal dust
pneumoconiosis

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   Lung fibrosis caused by simultaneous exposure to multiple dust types
pneumoconiosis

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   Non-occupational asbestos exposure. Cases with such exposure are
asbestos exposure   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 2019. 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 (1975-2019)

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	r421	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
Total	75 383	66	36 838	32	1 646	1	5		361		114 236

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 95 130 in 2019 (Minerals Council South Africa https://www.mineralscouncil.org.za/sa-mining/gold).

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 2019. The vast majority (96.7%) of autopsy examinations were performed on the cardio-respiratory organs only.

TABLE 2-2   NUMBER AND PROPORTION OF AUTOPSIES BY TYPE AND POPULATION GROUP (2019)

Autopsy type	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Cardio-respiratory organs only	445	100	282	91.9	5	100	2	100	734	96.7
Full autopsy	0	-	25	8.1	0	-	0		25	3.3
Total	445		307		5		2		759	

The age distribution of cases for 2019 is shown in Table 2-3 and presented graphically in Figure 2-1. The mean age at autopsy of black men was 54.5 years in 2019, similar to that in 2018 (53.8 years). The mean age of white men at autopsy was 68.2 years in 2019, similar to 68.4 years in 2018.

TABLE 2-3   NUMBER AND PROPORTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2019)

Age group (years)	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
20-29	4	0.9	0	-	0	-	0	-	4	0.5
30-39	65	14.6	3	1.0	0	-	0	-	68	9.0
40-49	82	18.4	11	3.6	0	-	0	-	93	12.3
50-59	153	34.4	44	14.3	1	20.0	0	-	198	26.1
60-69	77	17.3	116	37.8	3	60.0	0	-	196	25.8
70-79	45	10.1	78	25.4	1	20.0	0	-	124	16.3
80+	18	4.0	54	17.6	0	-	0	-	72	9.5
Unknown	1	0.2	1	0.3	0	-	2	100	4	0.5
Total	445		307		5		2		759	
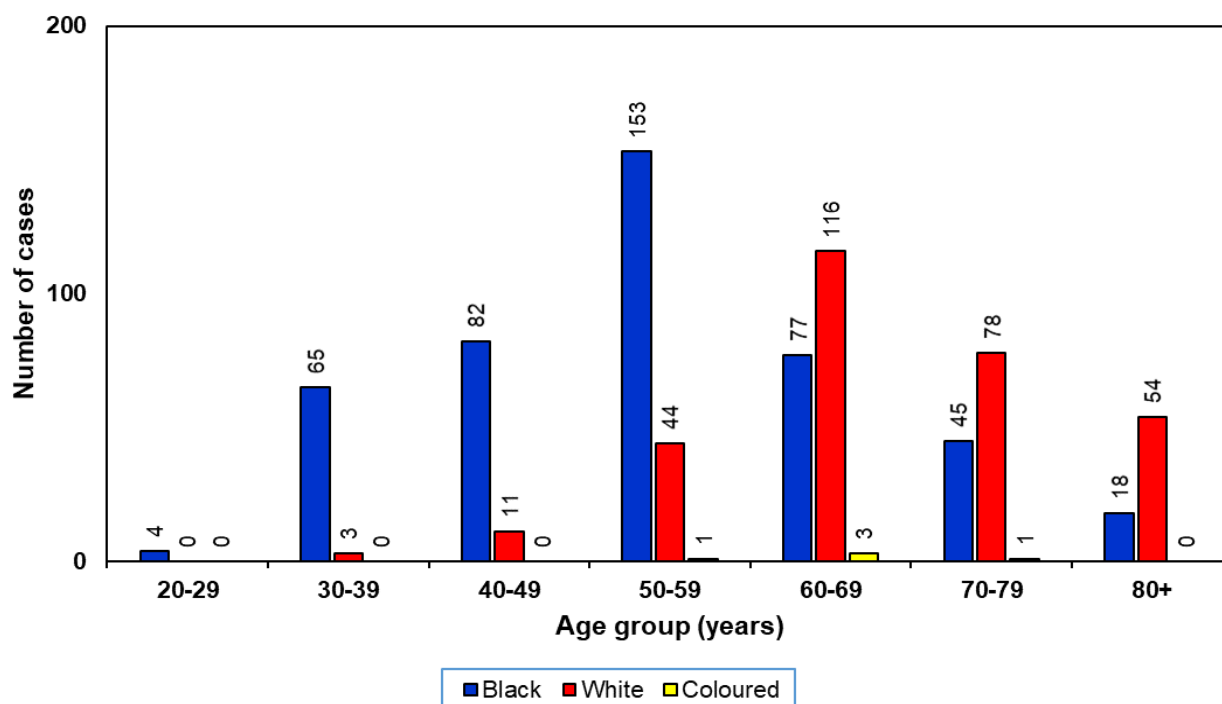
FIG 2-1 DISTRIBUTION OF AUTOPSIES BY AGE AND POPULATION GROUP (2019)

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 2019. The majority of autopsies (61.1%) were on men from the gold mining industry, which was higher than in 2018 (57.4%). 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 16.7% in 2019.

TABLE 2-4   NUMBER AND PROPORTION OF AUTOPSIES BY COMMODITY AND POPULATION GROUP (2019)

Commodity	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Gold	231	51.9	233	75.9	0	-	0	-	464	61.1
Platinum	113	25.4	14	4.6	0	-	0	-	127	16.7
Coal	11	2.5	23	7.5	0	-	0	-	34	4.5
Asbestos	52	11.7	4	1.3	3	60.0	0	-	59	7.8
Diamond	3	0.7	5	1.6	0	0	0	-	8	1.1
Iscor	3	0.7	4	1.3	0	-	0	-	7	0.9
Copper	4	0.9	3	1.0	0	-	0	-	7	0.9
Manganese	13	2.9	2	0.7	0	-	0	-	15	2.0
Industry	2	0.4	5	1.6	0	-	0	-	7	0.9
Other*	7	1.6	10	3.2	2	40.0	0	-	19	2.5
Unknown	6	1.3	4	1.3	0	-	2	100	12	1.6
Total	**445**		**307**		**5**		**2**		**759**	

*iron, quarry, steel, chrome, lead, S.A. railways, uranium, Eskom, lime, cement, environmental asbestos

Black   **White**   **Coloured**

| ■ Gold | □ Coal | ■ Platinum | ■ Asbestos | ■ Other* |
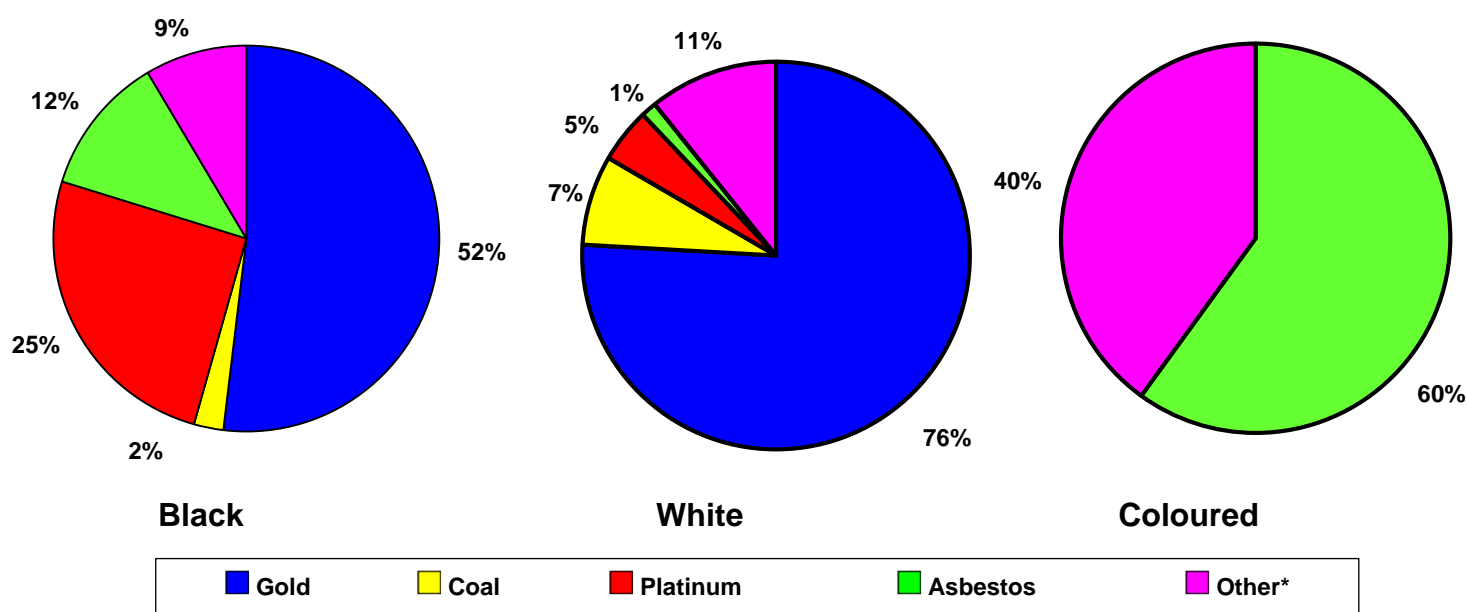
*Includes cement, chrome, copper, diamond, environmental asbestos, Eskom, industry, iron, lead, lime, manganese, S.A. Railways, steel, as well as cases where service histories could not be obtained

FIG 2-2   DISTRIBUTION OF AUTOPSIES BY COMMODITY AND POPULATION (2019)

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 2019, the duration of service was obtained for all but 3.6% (n=27) of cases.

TABLE 2-5   NUMBER AND PROPORTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2019)

Years of service	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
<1	11	2.5	1	0.3	1	20.0	0	-	13	1.7
1-5	54	12.1	14	4.6	3	60.0	0	-	71	9.4
6-10	91	20.4	23	7.5	0	-	0	-	114	15.0
11-15	92	20.7	37	12.1	1	20.0	0	-	130	17.1
16-20	53	11.9	58	18.9	0	-	0	-	111	14.6
21-25	50	11.2	50	16.3	0	-	0	-	100	13.2
26-30	48	10.8	38	12.4	0	-	0	-	86	11.3
31-35	26	5.8	42	13.7	0	-	0	-	68	9.0
36-40	6	1.3	22	7.2	0	-	0	-	28	3.7
41+	1	0.2	10	3.3	0	-	0	-	11	1.4
Unknown	13	2.9	12	3.9	0	-	2	100	27	3.6
Total	**445**		**307**		**5**		**2**		**759**	

Years of service:

■ <1   ■ 1 - 5   ■ 6 – 10   ■ 11 – 15   ■ 16 – 20   ■ 21 – 25   ■ 26 – 30   ■ 31 – 35   ■ 36 – 40   ■ 41+
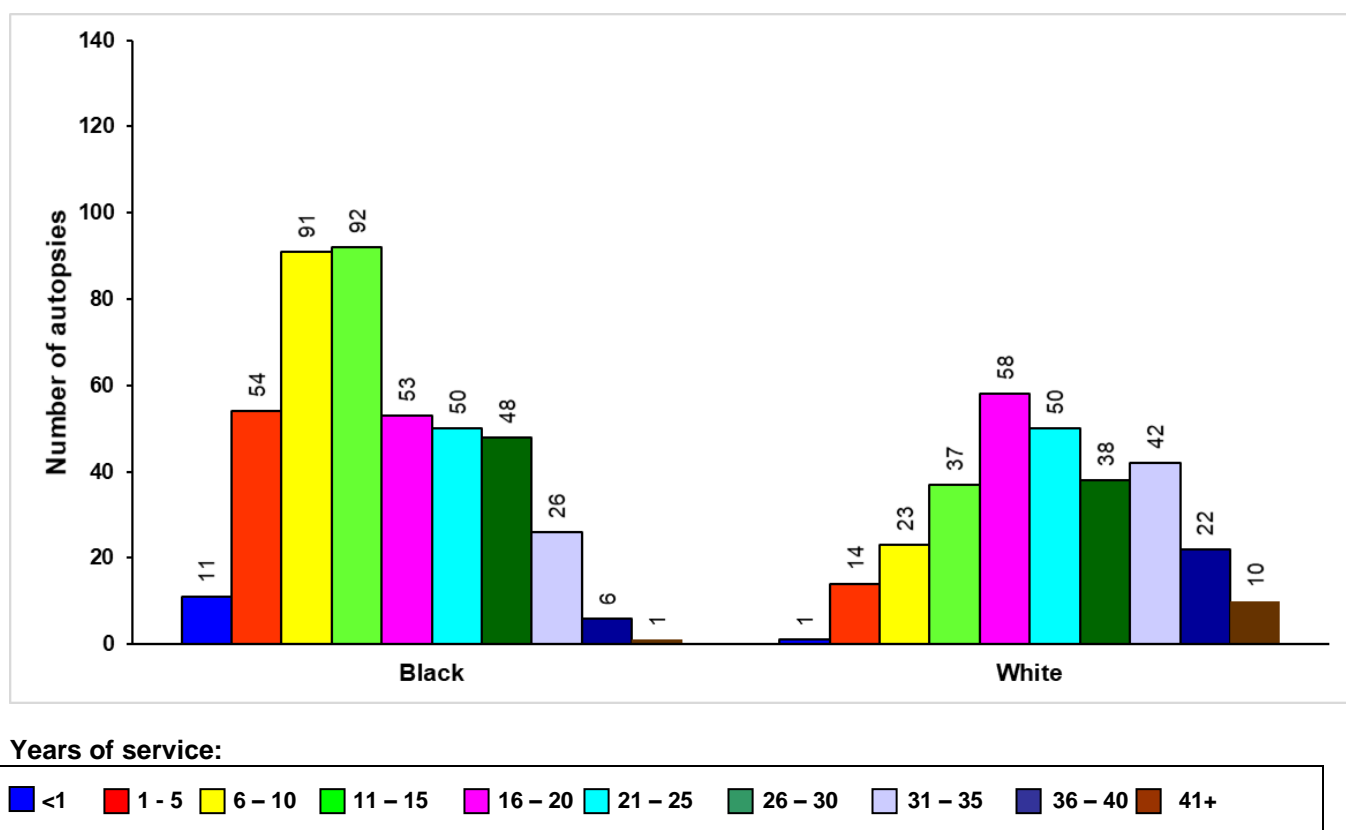
FIG 2-3   DISTRIBUTION OF AUTOPSIES BY YEARS OF SERVICE AND POPULATION GROUP (2019)

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 (2019)

Commodity	Black			White		
	N	Mean (Years)	SD*	N	Mean (Years)	SD*
Gold	231	53	11	233	68	12
Platinum	113	48	9	3	66	9
Coal	11	51	10	23	71	8
Asbestos	52	70	9	4	76	3
Iscor	3	73	8	4	67	2
Copper	4	69	12	3	77	11
Manganese	13	67	13	2	59	30
Industry	2	37	3	5	66	11
Other	10	72	13	15	72	6
Unknown	5	61	22	3	77	15
Total	444	53	14	295	68	11

* Standard deviation

TABLE 2-7   MEAN DURATION OF SERVICE BY COMMODITY AND POPULATION GROUP (2019)

Commodity	Black			White		
	N	Mean (Years)	SD*	N	Mean (Years)	SD*
Gold	204	17	10	238	23	10
Platinum	119	15	8	23	18	9
Coal	8	16	10	23	20	11
Asbestos	84	6	7	3	9	4
Iscor	0	-	-	3	20	3
Copper	0	-	-	1	20	-
Manganese	10	10	6	3	31	4
Industry	1	5	-	0	-	-
Other	16	23	11	12	21	12
Total	442	15	10	306	22	10

*Standard deviation

SECTION 3 – ACTIVE TUBERCULOSIS

The distribution of active tuberculosis (TB) by anatomical site is presented in Figure 3-1 (n=170). Active pulmonary TB (PTB) was diagnosed in 19.2% (n=146) of all autopsies in 2019, compared to 27.4% (n=472) in 2007. Most of the men with PTB were black (n=104; 71.2%), 39 (26.7%) were white, two (1.3%) were coloured and for one (0.7%) the race was not known.
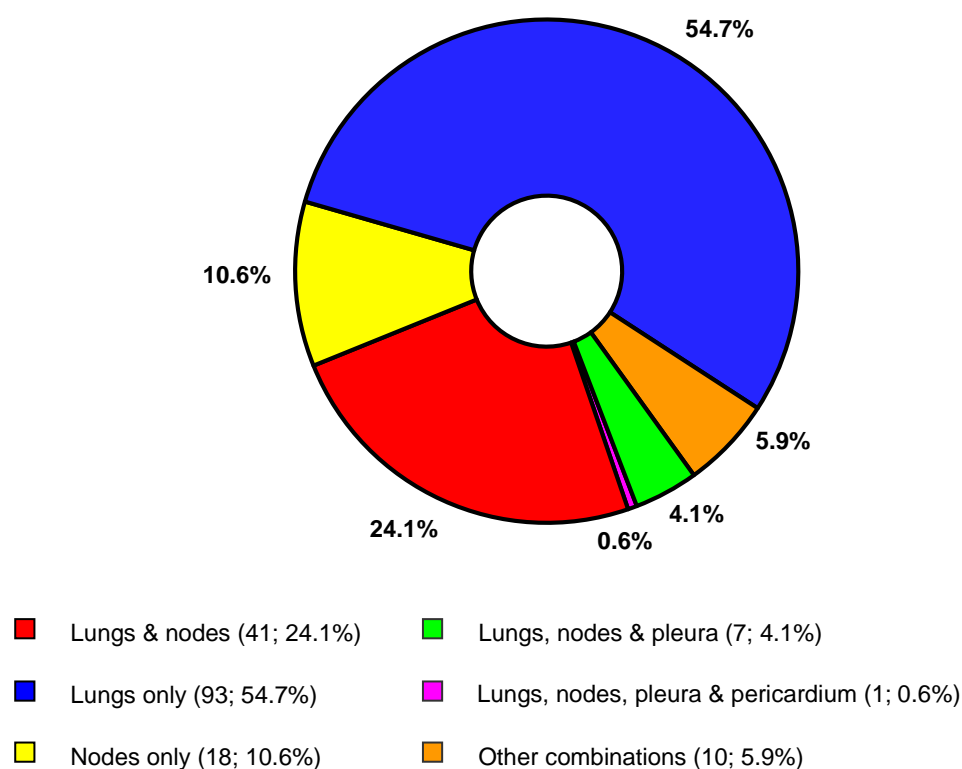
FIG 3-1   DISTRIBUTION OF ACTIVE TB BY SITE (2019)

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

In 2019, the overall PTB rate was 192/1000. In black miners, PTB rates increased since the early 1990s and peaked at 368/1000 in 2007, declined annually to 168/1000 in 2018 but now increased to 234/1000 in 2019 (Fig 3-2). The rate in white miners was much lower than that in black miners, 127/1000 (2019) and increased compared to the rate in 2018 (93/1000).
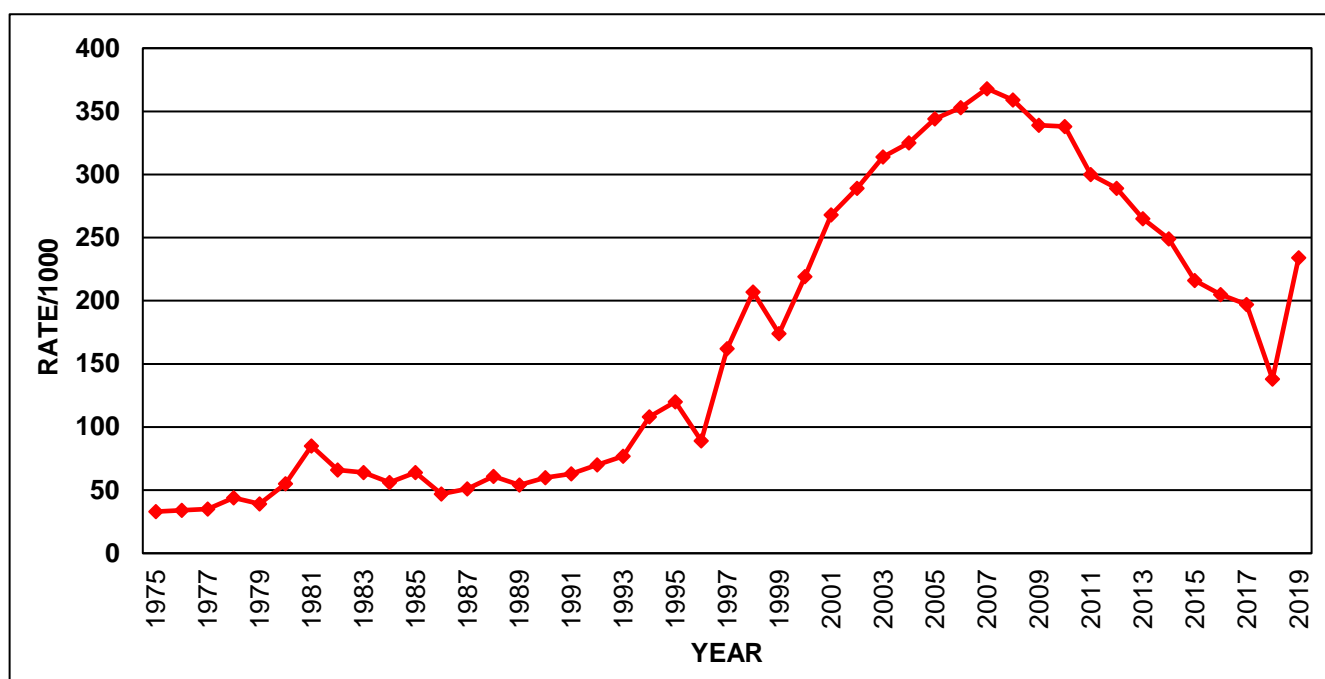
FIG 3-2 ACTIVE PTB RATES IN BLACK MINERS AT AUTOPSY (1975-2019)

The distribution of active PTB cases by commodity is shown in Table 3-1. Most cases of active PTB (68.5%) were from the gold (61.1% of all autopsy cases came from that commodity) and platinum (12.3%) mining industries.

TABLE 3-1   NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY COMMODITY AND POPULATION GROUP (2019)

Commodity	Black		White		Coloured		Unknown		Total	
	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Gold	67	290	33	142	0	-	0	-	100	216
Platinum	16	142	2	-	0	-	0	-	18	142
Coal	3	-	2	-	0	-	0	-	5	-
Asbestos	8	154	0	-	0	-	0	-	8	136
Manganese	1	-	0	-	0	-	0	-	1	-
Copper	1	-	0	-	0	-	0	-	1	-
Iscor	1	-	0	-	0	-	0	-	1	-
Industry	1	-	1	-	0	-	0	-	2	-
Other	4	-	0	-	2	-	0	-	6	222
Unknown	2	-	1	-	0	-	1	-	4	-
Total	104	234	39	127	2		1		146	192

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

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The age distribution of cases with active PTB is shown in Table 3-2. Most of the PTB cases (n=50; 34.2%) were in the age group 60-69 years, followed by those in the 50-59 year age group (n=44; 30.1%).

TABLE 3-2   NUMBER OF CASES AND PREVALENCE OF ACTIVE PTB BY AGE AND POPULATION GROUP (2019)

Age group (years)	Black N	Black Rate	White N	White Rate	Coloured N	Coloured Rate	Unknown N	Unknown %	Total N	Total Rate
20-29	1	-	0	-	0	-	0	-	1	-
30-39	10	154	2	-	0	-	0	-	10	147
40-49	21	256	9	204	0	-	0	-	23	247
50-59	34	222	20	172	1	-	0	-	44	222
60-69	29	377	6	77	1	-	0	-	50	255
70-79	3	-	2	-	0	-	0	-	9	73
80+	6	333	0	-	0	-	0	-	8	111
Unknown	0	-	0	-	0	-	1	-	1	-
Total	104	234	39	127	2		1		146	192

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

SECTION 4 – SILICOSIS

Silicotic nodules were found in the lungs of 187 cases (24.6% of all autopsies), 84.0% of which came from the gold mining industry. Of all cases with silicosis, occasional silicotic nodules were found in 78 (41.7%), a few in 35 (18.7%), a moderate number in 46 (24.6%) and a large number in 28 (15.0 %) 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 (2019)

Commodity	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
Gold	85	368	72	309	0	-	157	338
Platinum	8	71	4	-	0	-	12	94
Coal	0	-	3	-	0	-	3	-
Asbestos	5	-	1	-	0	-	6	102
Copper	2	-	0	-	0	-	2	-
Manganese	2	-	0	-	0	-	2	-
Other	0	-	0	-	2	-	2	-
Unknown	1	-	2	-	0	-	3	-
Total	103	231	82	267	2		187	246

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. Silicosis rates in black gold miners have shown a steady increase over the years with a rate of 39/1000 in 1975 to 368/1000 in 2019. This, however, is an increase from 328/1000 in 2018 having fluctuated between 378/1000 in 2008 and 368/1000 in 2019. The rate in white gold miners has also increased since 1997 from 176/1000 to 309/1000 in 2019, which is also an increase from the rate in 2018 (296/1000).
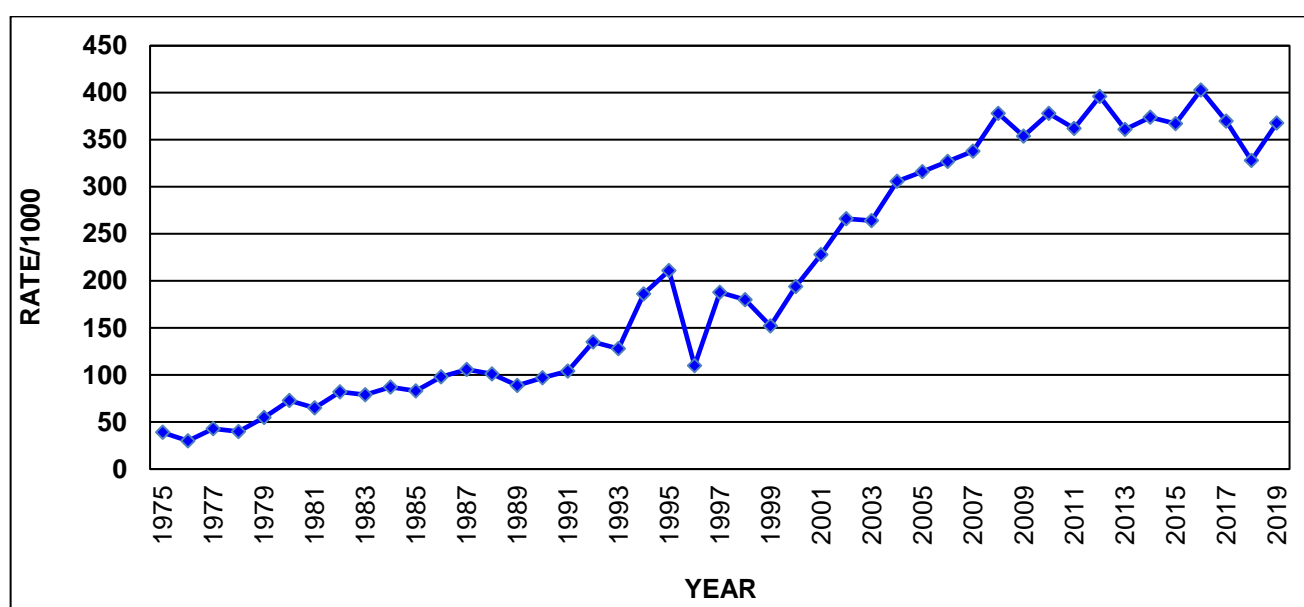
FIG 4-1 SILICOSIS IN BLACK GOLD MINERS AT AUTOPSY (1975-2019)

Silicosis in gold miners is shown in the following tables, 4-2 and 4-3. The rate of silicosis in gold miners in 2019 (338/1000) is higher than that of 2018 (312/1000). The age distribution of silicosis differed between the black and white men (Table 4-2). In black men, silicosis was diagnosed in one man in the 30-39 year age category (Table 4-2).

TABLE 4-2   NUMBER OF CASES AND PREVALENCE OF SILICOSIS IN THE GOLD MINING INDUSTRY, BY AGE AND POPULATION GROUP (2019)

Age group (years)	Black		White		Total	
	N	Rate	N	Rate	N	Rate
30-39	1	-	0	-	1	-
40-49	6	130	2	-	8	140
50-59	44	468	5	-	49	374
60-69	22	595	32	356	54	425
70-79	11	647	14	275	25	368
80+	1	-	19	452	20	465
Total	85	368	72	309	157	338

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 (2019)

Years of service	Black		White		Total	
	N	Rate	N	Rate	N	Rate
1-5	0	-	1	-	1	-
6-10	6	162	6	461	12	240
11-15	9	209	6	230	15	217
16-20	11	379	11	234	22	289
21-25	22	564	13	325	35	443
26-30	22	579	9	310	31	463
31-35	11	579	14	389	25	455
36-40	3	-	8	889	11	440
41+	0	-	4	-	4	-
Unknown	1	-	0	-	1	-
Total	85	368	72	309	157	338

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

SECTION 5 – OTHER PNEUMOCONIOSES

MASSIVE FIBROSIS

There were 31 (4.1%) cases of massive fibrosis: 22 in black, eight in white and one in coloured miners. Twenty-seven were from the gold mining industry, two from the copper mining industry, one from the platinum mining industry and for one case mining commodity was not stated.

Note: the number of massive fibrosis cases was much higher than in previous reports. This is due to 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 2019.

MIXED DUST PNEUMOCONIOSIS

There were no cases of mixed dust pneumoconiosis in cases examined in 2019.

ASBESTOSIS AND PLEURAL PLAQUES

There were 38 cases of asbestosis. Of these, 47.4% (n=18) had slight, 23.7% (n=9) had moderate and 28.9% (n=11) had marked fibrosis. Thirty-seven (97.4%) had worked in the asbestos mining industry at some time in their lives.

There were 25 cases with asbestos plaques and of these 11 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 (2019)

Age group (years)	Black		White		Total	
	N	Rate	N	Rate	N	Rate
50-59	6	39	0	-	6	30
60-69	8	104	0	-	8	41
70-79	15	333	0	-	15	121
80+	7	389	2	-	9	409
Total	36	81	2	-	38	50

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

SECTION 6 – EMPHYSEMA

There were 273 cases of emphysema, the extent of which was mild in 79.5% (n=217), moderate in 17.5% (n=48) and marked in 2.9% (n=8) cases. The overall rate of emphysema increased from 294/1000 in 2018 to 360/1000 in 2019. 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 (2019)

Age group (years)	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
30-39	3	-	2	-	0	-	5	-
40-49	7	85	0	-	0	-	7	75
50-59	38	248	19	432	1	-	58	293
60-69	36	468	64	552	0	-	100	510
70-79	20	444	43	551	0	-	63	508
80+	6	333	34	630	0	-	40	556
Total	110	247	162	528	1		273	360

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=183, 67.0%) (Table 6-2).

TABLE 6-2   NUMBER OF CASES AND PREVALENCE OF EMPHYSEMA BY COMMODITY AND POPULATION GROUP (2019)

Commodity	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
Gold	61	264	122	524	0	-	183	394
Platinum	19	168	11	786	0	-	30	236
Coal	3	-	9	391	0	-	12	353
Asbestos	15	288	2	-	0	-	17	288
Iscor	0	-	2	-	0	-	2	-
Copper	2	-	2	-	0	-	4	-
Manganese	3	-	2	-	0	-	5	-
Industry	0	-	2	-	0	-	2	-
Other	5	-	9	600	1	-	15	556
Unknown	2	-	1	-	0	-	3	-
Total	110	247	162	528	1		273	360

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 (2019)

Years of service	Black		White		Coloured		Total	
	N	Rate	N	Rate	N	Rate	N	Rate
<1	3	-	1	-	0	-	4	-
1-5	12	222	7	500	1	-	20	282
6-10	17	187	12	522	0	-	29	254
11-15	14	152	18	486	0	-	32	246
16-20	15	283	30	517	0	-	45	405
21-25	17	340	32	640	0	-	49	490
26-30	14	292	20	526	0	-	34	395
31-35	11	423	21	500	0	-	32	471
36-40	2	-	11	500	0	-	13	464
41+	1	-	6	-	0	-	7	636
Unknown	4	-	4	-	0	-	8	296
Total	110	247	162	528	1		273	360

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

SECTION 7 – MESOTHELIOMA

There were 34 cases of mesothelioma in 2019.

TABLE 7-1 NUMBER AND PERCENTAGE OF MESOTHELIOMA CASES BY AGE AND POPULATION GROUP (2019)

Age group (years)	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
50-59	10	43.5	0	-	0	-	10	29.4
60-69	8	34.8	3	30.0	1	100	12	35.3
70-79	3	13.0	5	50.0	0	-	8	23.5
80+	2	8.7	2	20.0	0	-	4	11.8
Total	23		10		1		34	

The distribution of mesothelioma by commodity and population group is presented in Table 7-2. Twenty-two (64.7%) of the cases had worked in asbestos mines at some stage in their careers. Fifteen 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 (2019)

Commodity	Black		White		Coloured		Total	
	N	%	N	%	N	%	N	%
Gold	1	4.3	4	40.0	0	-	5	14.7
Platinum	6	26.1	0	-	0	-	6	17.7
Coal	0	-	1	10.0	0	-	1	2.9
Asbestos	13	56.5	1	10.0	1	100.0	15	44.1
Manganese	1	4.3	0	-	0	-	1	5.9
Copper	1	4.3	0	-	0	-	1	2.9
Industry	0	-	2	20.0	0	-	2	2.9
Other	1	4.3	2	20.0	0	-	3	8.9
Total	23		10		1		34	

SECTION 8 – PRIMARY LUNG CANCER

Forty-four cases of primary lung cancer were found at autopsy, 44.5% (n=20) of which were in black miners and 54.5% (n=24) were white miners. Most of the cases were adenocarcinoma (n=31; 70.4%), followed by those with squamous cell carcinoma (n=9, 20.5%), small cell carcinoma (n=3; 6.8%) and large cell carcinoma (n=1; 2.3%).

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

TABLE 8-1   NUMBER AND PROPORTIONOF PRIMARY LUNG CANCER CASES BY AGE AND POPULATION GROUP (2019)

Age group (years)	Black		White		Total	
	N	Rate	N	Rate	N	Rate
40-49	3	-	0	-	3	-
50-59	6	39	1	-	7	35
60-69	7	91	5	-	12	61
70-79	3	-	11	141	14	113
80+	1	-	7	130	8	11
Total	20	45	24	78	44	

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 (2019)

Commodity	Black		White		Total	
	N	Rate	N	Rate	N	Rate
Gold	5	-	14	60	19	41
Platinum	9	80	0	-	9	71
Coal	0	-	4	-	4	-
Asbestos	5	-	1	-	6	102
Copper	0	-	1	-	1	-
Industry	0	-	1	-	1	-
Iscor	1	-	1	-	2	-
Other	0	-	1	-	1	-
Unknown	0	-	1	-	1	-
Total	20	45	24	78	44	58

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 (15.7%). The proportion of unnatural deaths (9.5%) was similar to that in 2018 (8.1%). The clinical cause of death was not stated for 20.3% of the cases.

TABLE 9-1 CLINICAL CAUSE OF DEATH BY POPULATION GROUP (2019)

System	Black		White		Coloured		Unknown		Total	
	N	%	N	%	N	%	N	%	N	%
Respiratory	63	14.2	55	17.9	1	20.0	0	-	119	15.7
Cardio-vascular	6	1.3	17	5.5	0	-	0	-	23	3.0
Central Nervous System	6	1.3	5	1.6	0	-	0	-	11	1.4
Gastro-intestinal	8	1.8	3	1.0	0	-	0	-	11	1.4
Genito-urinary	6	1.3	5	1.6	0	-	0	-	11	1.4
Haematological	1	0.2	1	0.3	0	-	0	-	2	0.3
Unnatural	61	13.7	11	3.6	0	-	0	-	72	9.5
Miscellaneous	206	46.3	146	47.6	4	80.0	0	-	356	46.9
Not stated	88	19.8	64	20.8	0	-	2	100.0	154	20.3
Total	445		307		5		2		759	

*Data for the metabolic system included in the hematological system
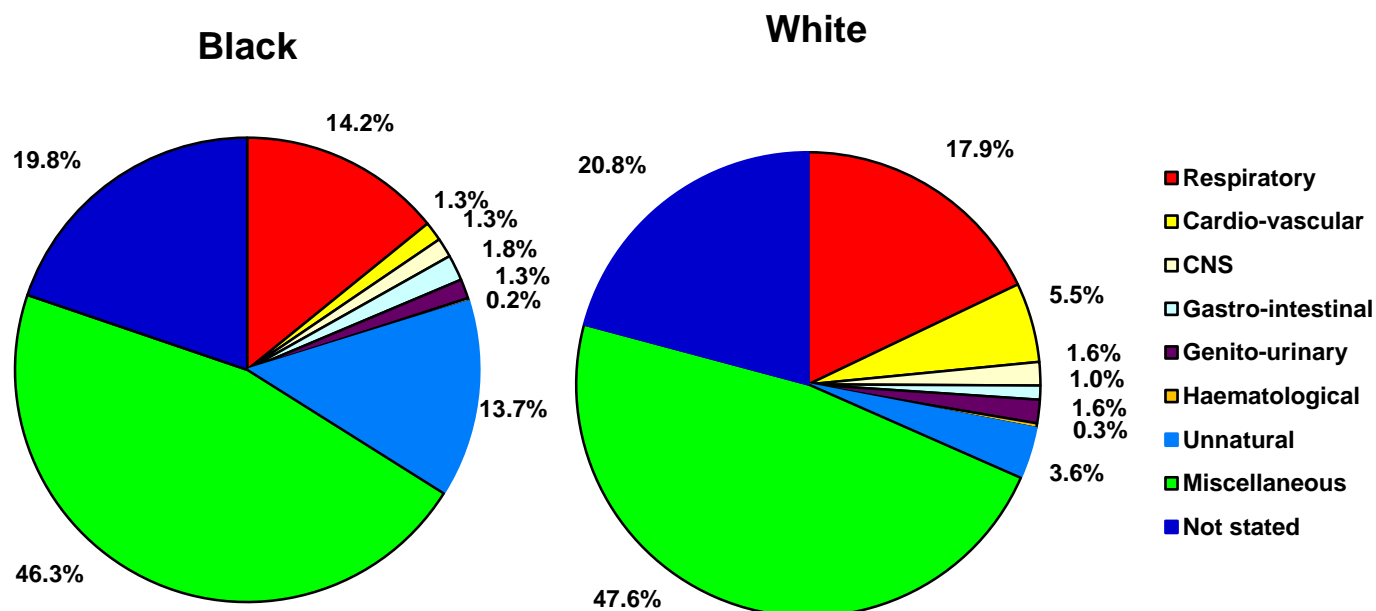
FIG 9-1 CLINICAL CAUSES OF DEATH (2019)

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SECTION 10 – AUTOPSY FINDINGS IN WOMEN

Of the 759 cases examined in 2019, 26 (3.4%) were women compared to 40 (5.2%) in 2018, 42 (5.2%) in 2017 and 38 (4.5%) in 2015. There were 24 (92.3%) black, and two white (7.7%). On average, the women were younger than the men (57.8 years and 60.2 years, respectively).

**TABLE 10-1 NUMBER AND PROPORTION OF AUTOPSIES IN WOMEN
BY AGE AND POPULATION GROUP (2019)**

Age group (years)	Black		White		Total	
	N	%	N	%	N	%
30-39	5	20.8	0	-	5	19.2
40-49	4	16.7	0	-	4	15.4
50-59	4	16.7	0	-	4	15.4
60-69	5	20.8	1	50.0	6	23.1
70-79	3	12.5	1	50.0	4	15.4
80+	3	12.5	0	-	3	11.5
Total	24		2		26	

Table 10-2 summarises the distribution of autopsies in women by commodity and population group. Half of the women (n=12, 46%) had been exposed to asbestos on the mines.

**TABLE 10-2 NUMBER AND PROPORTION OF AUTOPSIES IN WOMEN
BY COMMODITY AND POPULATION GROUP (2019)**

Commodity	Black		White		Total	
	N	%	N	%	N	%
Gold	11	45.8	0	-	11	42.3
Asbestos	11	45.8	1	50	12	46.3
Manganese	1	4.2	0	-	1	3.8
Other	1	4.2	1	50	2	7.7
Total	24		2		26	

Five women had asbestos-related diseases: three had asbestosis and two had mesothelioma (Table 10-3).

TABLE 10-3 NUMBER AND PROPORTION OF DISEASES IN WOMEN (2019)

Disease	N	%
PTB	5	19,2
Silicosis	0	0,0
Emphysema	1	3,8
Asbestosis	3	11,5
Mesothelioma	2	7,7
Primary lung cancer	0	0.0
No lung disease	15	57.7
Total	26	100

APPENDIX 1: DISTRIBUTION OF AUTOPSIES ACCORDING TO THE LAST MINE WHERE THE DECEASED WORKED (2019)

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Asbestos	Asbestos Mine	1	1			2
	Cape Blue	1				1
	Daniel Skuil Asb Mine	1				1
	Everite		1			1
	Gefco	35		1		36
	Koegas	1				1
	Pomfret Asb Mine	5		2		7
	Wandrag Asbestos Mine	2				2
Total from asbestos		**46**	**2**	**3**	**0**	**51**
Cementation	Cementation	1	2			3
	Ulco Cementation	1				1
Total from cementation		**2**	**2**	**0**	**0**	**4**
Chrome	Dilokong chrome mine		1			1
Total from chrome		**0**	**1**	**0**	**0**	**1**
Coal	Amcoal Colliery		1			1
	Arnot Colliery	1	1			2
	Blinkpan Colliery		1			1
	Coalbrook Colliery		1			1
	Coal Mine	1	3			4
	Durban Navigation Colliery		1			1
	Duvha Opencast		1			1
	Goedehoop Colliery	2	1			3
	Greenside Colliery	1	1			2
	Grootgeluk		1			1
	Hlobane Colliery		1			1
	Kriel Colliery		1			1
	Kroonfontein Coal	1	1			2
	Matla Coal	3	1			4
	Natal Anthracite coll		1			1
	New Clydesdale Colliery		1			1
	New Vaal Colliery		1			1
	Optimum Colliery		1			1
	Rietspruit Colliery		1			1
	Sasol Coal Mine	2	3			5

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Coal Continued	Springbok colliery		1			1
	Tweefontein		1			1
	Vryheid Coronation		1			1
Total from coal		**11**	**27**	**0**	**0**	**38**
Copper	Copper Mine			1		1
	O`Kiep Copper		2	1		3
	Prieska	2				2
Total from copper		**2**	**2**	**2**	**0**	**6**
Diamond	Cullinan Diamond mine		1			1
	Diamond Mine	1	3			4
	Finch Diamond Mine	2				2
	Premier Diamond Mine		1			1
Total from diamond		**3**	**5**	**0**	**0**	**8**
Gold	African Rainbow Minerals & Expl	2				2
	Angilon GM		1			1
	Anglo Gold Ashanti	22	16			38
	Bambanani GM	4	1			5
	Barberton GM		1			1
	Beatrix Gold	42	3			45
	Blyvoorquizicht		10			10
	Buffelsfontein Gold	2	7			9
	Crown Mines		1			1
	Deelkraal	1	3			4
	Doornfontein		1			1
	Doringkop GM		1			1
	Driefontein Cons GM	21	12			33
	Durban Roodepoort Deep	1	3			4
	East Driefontein		3			3
	East Rand Prop		6			6
	Elandsrand		3			3
	Evander GM	1	2			3
	Freddies Gold		2			2
	Free State Geduld		7			7
	Gencor	7				7
	Goldfields	2	4			6
	Gold mine	1				1

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Gold (contd)	Grinaker GM		1			1
	Grootvlei prop		3			3
	Harmony	49	27			76
	Hartebeesfontein	2	8			10
	J.I.C. Gold Mine	1	5			6
	Joel	2				2
	Klipval GM		1			1
	Kloof	11	8			19
	Kopanong Gold Mine	2				2
	Libanon		1			1
	Loraine	1	1			2
	Marievale		1			1
	Masimong Gold Mine	3				3
	Moab Khotsong GM		1			1
	Oryx		1			1
	President Brand		3			3
	President Steyn	6	3			9
	Randfontein		6			6
	Rand Uranium Gold Mine	1	1			2
	Saaiplaas GM		1			1
	Savuka GM	1				1
	Sheba		1			1
	Simmer and Jack GM	10	2			12
	South Deep GM		5			5
	St Helena		1			1
	Stilfontein		5			5
	Tautona GM	2				2
	Tshepone GM	5	2			7
	Unisel GM	2				2
	Vaal Reefs	7	16			23
	West Driefontein		1			1
	West Rand Consolidation		1			1
	Western Areas		5			5
	Western Deep Levels	7	12			19
	Western Holdings	2				2
	Winkelhaak	1				1
	Wit Nigel GM		1			1
Total from gold		**221**	**211**	**0**	**0**	**432**

	Last mine worked	Black	White	Coloured	Unknown	Total
Iron	Sishen Iron Mine	4				4
Lime	Lime Acres	2				2
Manganese	Associated Manganese	4				4
	Black Rock Asb Mine	2	1			3
	Hotazel Manganese Mine	3	1			4
	S A Manganese	2				2
Total from iron, lime and manganese		**17**	**2**	**0**	**0**	**19**
Platinum	Anglo American Platinum	1	1			2
	Atok Platinum	1				1
	Bafokeng	1				1
	Eastern Platinum	19				19
	Impala Platinum	39	10			49
	Karee Platinum	35	2			37
	Kroondal Mine		1			1
	Lebowa		1			1
	Lonmin Platinum		4			4
	Modikwa	1	1			2
	Northam Platinum	1	3			4
	Paardekraal Anglo Plats		1			1
	Rustenburg Platinum	5	4			9
	Swartklip Platinum		2			2
	Two Rivers Platinum Mine		1			1
	Union Platinum	1				1
	Unknown Platinum	3	1			4
	Western Platinum	23				23
Total from platinum		**130**	**32**	**0**	**0**	**162**
Shaft sinkers	Shaft sinkers	2	2			4
Steel	Highveld Steel and Vanadium		1			1
Steel & Iron	Iscor	1	4			5
Uranium	Dominion Reefs Uranium		1			1
Quarry	Quarry Mine		1			1
Total for shaft sinkers, steel, steel & iron, quarry, uranium		**3**	**9**	**0**	**0**	**12**

Commodity	Last mine worked	Black	White	Coloured	Unknown	Total
Non-miner	Environmental	1	2			3
	Chamber of Mines		1			1
	DCB Dorbyl		1			1
	Eskom		1			1
	Industry	2	3			5
	Transnet		2			2
Total for non-miners		**3**	**10**	**0**	**0**	**13**
Unknown	Unknown	6	4		2	12
Total for Unknown		**6**	**4**		**2**	**12**
TOTAL		**445**	**307**	**5**	**2**	**759**

APPENDIX 2: PUBLICATIONS AND ACTIVITIES EMANATING FROM PATHAUT DATA OR AUTOPSY SERVICE (2019)

Journal articles

Ndlovu N, Richards G, Vorajee N, Murray J. 2019. Silicosis and pulmonary tuberculosis in deceased female South African miners. Occupational Medicine doi: 10.1093/occmed/kqz067

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

Reports

Govender V. Report on MBOD/NIOH collaborative workshop on ODMWA post-mortem examinations. Occupational Health Southern Africa, July/August 2019 vol 25(4) pp 1-4.

Conference and workshop presentations

N Ndlovu, Murray J. The PATHAUT Database: trends and analysis. Wits ODMWA Workshop, 5 May 2019, Johannesburg, South Africa (Oral presentation)

N Ndlovu, The usefulness of administrative data for occupational disease surveillance. OSH Africa 2019, 18 – 20 September 2019, Johannesburg, South Africa (Oral presentation)

N Ndlovu, Value of occupational health and safety data collection, Mine Medical Professionals Association 25 October 2019, Johannesburg, South Africa (Oral presentation)

N Ndlovu, Murray J. Silicosis in female South African miners. School of Public Health Research Day, University of the Witwatersrand, 21 August 2019, Johannesburg, South Africa (Oral presentation: Awarded best oral presentation in Occupational and Environmental Health category)

Murray J, N Ndlovu, N Vorajee, G Richards. Silicosis in female and male south African gold miners. European Respiratory Society International Congress, Madrid Spain 2019. 26 September – 2nd October

N Ndlovu, Murray J. Pulmonary tuberculosis trends in South African miners: 1975 - 2014. School of Public Health Research Day, University of the Witwatersrand, 21 August 2019, Johannesburg, South Africa (Poster presentation)

Degrees

Ndlovu Ntombizodwa, PhD (awarded September 2019), School of Public Health, University of the Witwatersrand. Evaluation of autopsy data for occupational lung disease surveillance.

Outreach Programme Activities

ACTIVITY	DATE	VENUE	PERSON
The Pathology Division attended a meeting with the Medical Bureau of Occupational Diseases (MBOD). The purpose of the meeting was to discuss the integrated database – the Pathaut / MBOD and the update on the electronic system, and the post-mortem services.	14 March 2019	MBOD Braamfontein	Dr N Vorajee Ms N Buthelezi
The Pathology Division attended the MBOD meeting; Presentation: "Occupational Lung Diseases, Artificial Intelligence, Exposure Data, Biometrics and Service Optimization Workshop"	15 April 2019	Sunnyside Park Hotel Parktown	Mr D Afrika
The Pathology Division hosted an information session with delegation from Sibanye Still Waters. Presentations were given on the role of the Pathology Division in the fulfilment of its statutory obligation for the examination of the cardiorespiratory organs for compensable lung disease and the exact procedure that is followed and the importance of the autopsy service was highlighted and ways in which the mine could assist the service were discussed.	17 April 2019	NIOH	Dr N Vorajee Mr D Afrika
NIOH/MBOD Collaborative Workshop on Post-mortem Examinations. Presentations	17 May 2019	NIOH Tony Davies Lecture theatre	Dr N Vorajee Ms J Mthombeni Prof J Murray
Presentation, Topic: Autopsy for ODMWA compensation	23 August 2019	Northern Cape Mine Managers Association wellness stream – Health and Hygiene	Dr D Fassom Ms J Mthombeni
The NIOH hosted 12 Diploma in Occupational Medicine and Health Students from the University of Pretoria, School of Health Systems and Public Health (SHSPH), Presentation: The services that the Pathology Division offers.	23 July 2019	NIOH Tony Davies Lecture theatre	Mr. D. Afrika
Presentation at the European Respiratory Society International Congress	26 September – 2 October 2019	Madrid Spain	Prof J Murray

ACTIVITY	DATE	VENUE	PERSON
NIOH Pathology division hosted occupational medicine registrars: Overview of the macroscopic and microscopic findings of the major occupational lung diseases.	9 October 2019	NIOH Pathology division	Dr D Lakhoo Dr J Linden
The NIOH hosted a group of students from the Tshwane University of Technology who were studying for a Bachelor Degree in Environmental Health, presentation to the students on "Occupational Disease in Mine Work Act (ODMWA), compensation and disease diagnosis". The purpose was to learn about the Occupational Environment Health and Safety (OEHS) services provided by National Institute for Occupational Health (NIOH).	11 October 2019	Tony Davies Lecture Theatre	Dr D Fassom
The NIOH hosted an information sharing session for Occupational Nurses from Sasol. The various departments within the institution presented on various topics under occupational health in mining as well as the compensation system and process.	8 November 2019	Tony Davies Lecture Theatre	Dr D Fassom Ms N Kgokong
The NIOH pathology division was invited to the meeting by the Department of Health, Presentation: "Update on Medical Bureau of Occupational Diseases (MBOD) / Compensation Commissioner for Occupational Diseases (CCOD); medical assessments and compensation for occupational lung diseases".	19 November 2019	Sunnyside Park Hotel	Dr D Fassom