Death trends for 2010 - 2022 for members of a large private medical scheme in South Africa

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Background. In the absence of more recent national data on underlying causes of death in South Africa (SA), we examined mortality trends from 2010 to 2022 among members of a large private medical scheme. This analysis sheds light on the health profile of this specific demographic.
Objective. To investigate trends in Discovery Health Medical Scheme (DHMS) members' death rates and underlying cause of death patterns between 2010 and 2022.
Methods. All-cause deaths were compared across years accounting for demographic changes, by analysing age- and sex-standardised rates using 2019 age and sex population weightings. We used underlying cause-of-death data from death notifications.
Results. The 2019 age- and sex-standardised death rate was lower than the 2010 rate by 10%, with a steady decline experienced between 2010 and 2019. We have seen reduced age- and sex-standardised death rates from HIV/AIDS during this period, and despite the high prevalence, reduced age- and sex-standardised death rates from non-communicable diseases. Malignant neoplasms and cardiovascular disease have been and remained the two leading causes of death for Discovery Health Medical Scheme (DHMS) clients between 2012 and 2022. Age- and sex-standardised death rates, however, reached historic high levels during the first 2 years of the COVID-19 pandemic in SA. In 2020, overall age- and sex-standardised death rates for DHMS members increased to 542 deaths per 100 000 life years, which was higher than pre-pandemic levels. Age- and sex-standardised death rates went on to reach their highest level in the history of the scheme in 2021, at 767 deaths per 100 000 life years. Age- and sex-standardised death rates, however, had returned to near 2019 (pre-pandemic) levels by 2022, at 477 deaths per 100 000 life years. Males experienced a higher increase in age-standardised death rates during 2020 and remained at an increased risk of death in 2022 compared with pre-pandemic levels. When COVID-19 -related deaths are excluded, the age-standardised rates for both females and males in 2022 was lower than observed in the pre-pandemic years. While the low mortality experience could be related to competing causes and mortality displacement, further analysis over a longer period is needed to confirm this.
Conclusion. DHMS experienced the highest level of age- and sex-standardised death rates during 2020 and 2021, the initial 2 years of the COVID-19 pandemic. Most of this increase was explained by COVID-19 deaths.
Keywords: COVID-19, COVID-19 deaths, mortality trends, underlying cause of death, death rate.

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Reliable mortality statistics are the cornerstone of national health information systems, and are necessary for population health assessment, health policy and service planning, and programme evaluation. They are essential for studying the occurrence and distribution of health-related events, their determinants and management of related health problems.[1]

Globally, a growing majority of deaths are attributable to chronic non-communicable diseases.[2]

The quadruple burden of health challenges facing South Africa (SA) relates to diseases such as HIV and tuberculosis, maternal and child morbidity and mortality, non-communicable diseases (mainly related to lifestyle) and violence, injuries and trauma.[1]

In the present study, we describe mortality trends during a 12-year period for the Discovery Health Medical Scheme (DHMS) population, covering 2.8 million private medical insurance beneficiaries.

Methods

A total of 162 796 deaths between 2010 and 2022 among DHMS members were analysed by sex and 5-year age groups. These deaths represent just over 34 million-person years of observation.

Deaths are audited against the Department of Home Affairs' records for confirmation, and as a result only include deaths for SA citizens with valid national identity documents (ID), and permanent residents whose birth records had already been captured onto the National Population Register prior to death. An underlying cause of death using the 10th version of the International Classification of Diseases (ICD-10)[3] is assigned by Discovery Health. For deaths occurring outside of hospitals, data from the official death notification forms (BI-1663 and DHA-1663) are used to assign the underlying cause of death. For in-hospital deaths, these forms are not always shared with Discovery Health, and hence hospital ICD-10 coding is used for the assignment of an underlying cause of death. ICD-10 codes are assigned by hospital case managers based on hospital file case notes. In addition, Discovery Health has a team of qualified coding members who review, audit and assign an underlying cause of death using ICD-10 coded information from the different sources. Underlying cause of death was categorised into five groups: four groups used by the Global Burden of Disease[4] – namely communicable diseases, maternal causes, perinatal conditions and nutritional deficiencies and non-communicable diseases, including cardiovascular diseases and cancers, injuries and HIV/AIDS and tuberculosis; and a fifth group representing COVID-19 -related deaths. A death was coded with an

underlying cause of death as COVID-19 using the WHO guidelines,[5] which classify deaths as related to COVID-19 if a person who died had an active SARS-CoV-2 infection at the time of death, identified from positive pathology polymerase chain reaction (PCR) test results, or admissions coded as related to COVID-19 by clinicians. Deaths coded to 'symptoms, signs and ill-defined conditions' (ICD-10 codes R00-R94 and R96-R99) were distributed proportionately to all causes within communicable diseases and non-communicable diseases. Injury deaths where the intent is not determined (ICD-10 codes Y10-Y34 and Y87.2) were distributed proportionately to all causes below the group level for injuries.

We analysed trends of total all-cause deaths for 2010 - 2022 for DHMS members overall, and by sex. These rates were standardised to the 2019 DHMS age and sex population distributions. In addition, the rates were also standardised to the 2019 SA mid-year population estimates produced by Statistics SA[6] to allow comparison with the national population rates.

Results

Age- and sex-standardised overall deaths from all causes decreased between 2010 and 2019 by 10%, from 515 deaths per 100 000 life years to 462 deaths per 100 000 life years (Fig. 1). A significant increase in the age- and sex-standardised death rate was observed from 2020, and the DHMS age- and sex-standardised death rate reached its highest level in 2021 over the 13-year observation period to 767 deaths per 100 000 life years. Age- and sex-standardised death rates declined again in 2022 relative to the peak in 2021, and were slightly above pre-pandemic levels at 477 deaths per 100 000 life years in 2022.

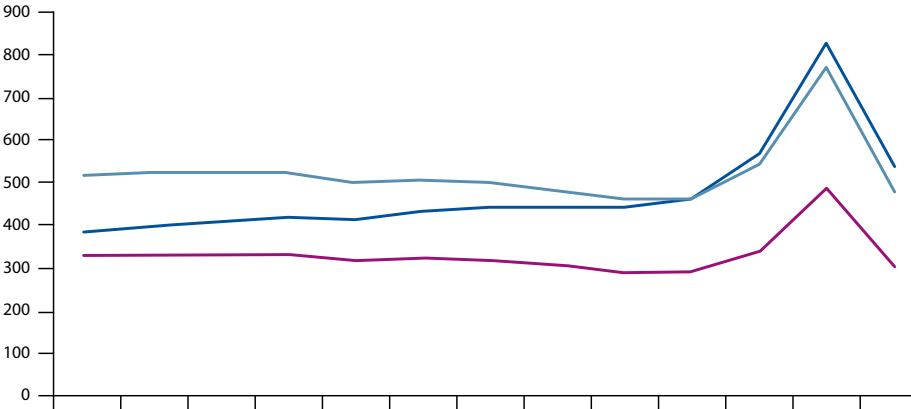
Among males, a 14% decrease in the age- and sex-standardised death rate was observed, from 594 per 100 000 life years in 2010 to 513 per 100 000 life years in 2019. Standardised deaths rates among women fell over the same period by 6%, from 442 per 100 000 life years to 414 per 100 000 life years (Fig. 2). A significant increase in the age-standardised death rates was seen for both males and females in 2020 and 2021. The death rate was highest in 2021 over the 13-year observation period for both males and females, at 904 and 641 deaths per 100 000 life years, respectively. Age- and sex-standardised death rates for both sexes declined in 2022 and were slightly above pre-pandemic levels at 535 deaths per 100 000 life years for males in 2022 and 423 deaths per 100 000 life years for females in 2022. Males, however, saw a much higher increase in their age-standardised death rates during the initial 2 years of the COVID-19 pandemic, namely 2020 and 2021. In 2022, males remained at 4.4% higher age-standardised death rates compared with 2019 (pre-pandemic levels), whereas females had 2.0% higher age-standardised death rates compared with pre-pandemic levels.

When standardising the all-cause death rate to the 2019 SA population distribution, the DHMS all-cause death rate reduces for both males and females. This is due to a higher average age in DHMS relative to the full SA population in 2019: 36.0 years v. 29.9 years for males, and 37.9 years v. 30.3 years for females, respectively. The average age difference between DHMS males and females was 1.9 years, whereas the difference between overall SA males and females was 0.4 years in 2019.

Deaths by underlying cause

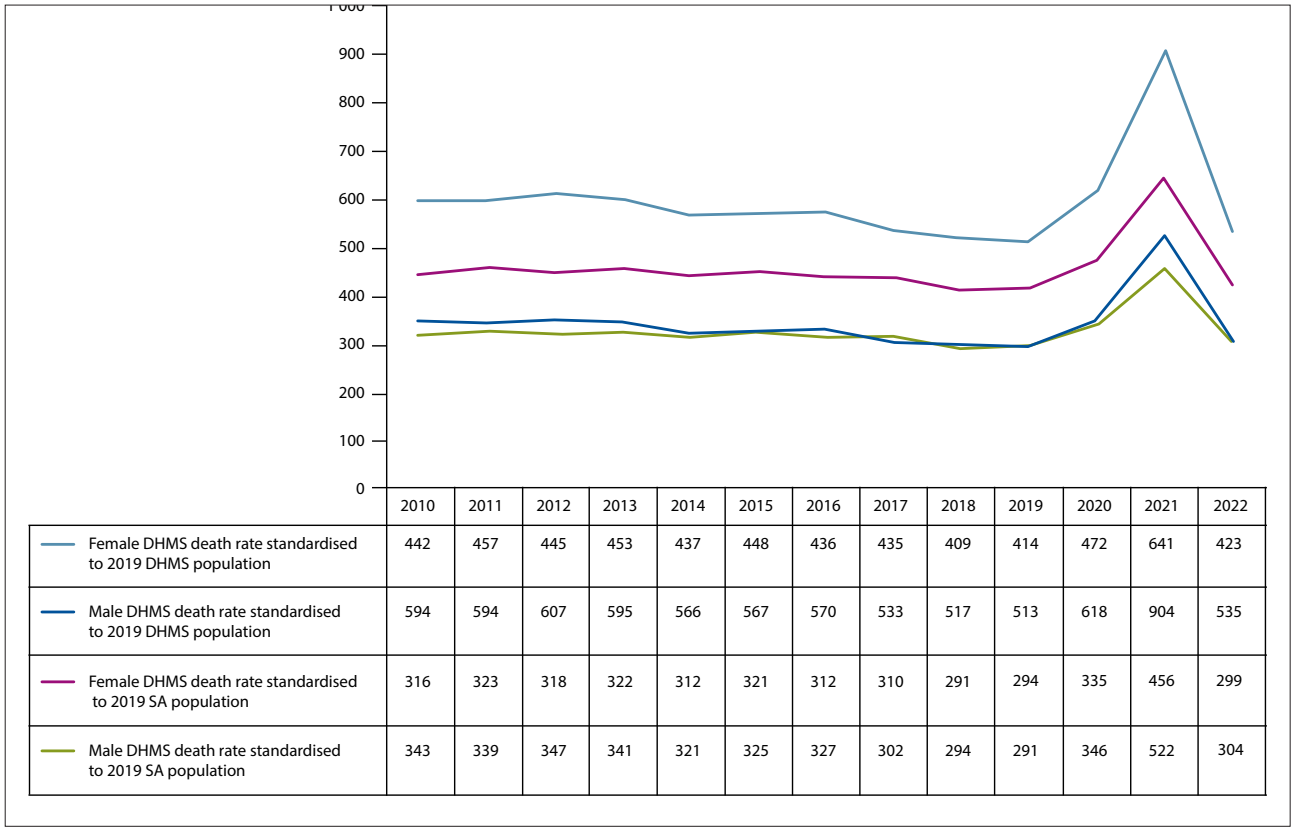
In 2012, 17.5% of DHMS deaths were coded with either 'symptoms, signs and ill-defined conditions' or 'injury where the intent is not determined'. Ten years later in 2022, 10.4% of deaths fall into these categories. After redistributing these deaths, non-communicable diseases were the cause of 78.5% of deaths in 2022, followed by injuries causing 9.8% of deaths. COVID-19 was the cause of 5.7% of deaths in 2022 (Table 1). When comparing the causes of death in 2018 with the analysis of causes of death produced by Statistics SA (the most recent year for which they have released cause of death data),[1] we see that DHMS have a lower proportion of communicable disease deaths at 10.2% (communicable disease plus HIV deaths) relative to 28.8% for SA overall, and a higher proportion of non-communicable disease deaths of 80.7% relative to 59.3% for SA overall. These distributions varied by age group, with injuries more common in the younger ages and COVID-19 more common in the older ages (Fig. 3).

Deaths due to injuries, as a proportion of all deaths, decreased in 2020 and 2021, and increased in 2022, but not to pre-pandemic levels. These trends align with trends already published from other studies.[11-13] This trend was mostly evident in younger age groups (ages 1 - 24



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Crude death rate	384	397	407	418	414	433	443	442	441	462	568	826	535
Age- and sex-adjusted DHMS death rate standardised to 2019 DHMS population	515	523	523	521	499	505	500	482	461	462	542	767	477
Age- and sex-adjusted DHMS death rate standardised to 2019 SA population	329	331	332	332	316	323	319	306	292	292	341	488	302

Fig. 1. Crude v. age- and sex-standardised (to the 2019 Discovery Health Medical Scheme (DHMS) and South African populations) death rate per 100 000 life years for DHMS members.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Female DHMS death rate standardised to 2019 DHMS population	442	457	445	453	437	448	436	435	409	414	472	641	423
Male DHMS death rate standardised to 2019 DHMS population	594	594	607	595	566	567	570	533	517	513	618	904	535
Female DHMS death rate standardised to 2019 SA population	316	323	318	322	312	321	312	310	291	294	335	456	299
Male DHMS death rate standardised to 2019 SA population	343	339	347	341	321	325	327	302	294	291	346	522	304

Fig. 2. Age-standardised (to the 2019 Discovery Health Medical Scheme (DHMS) and South African populations) death rate per 100 000 life years split between males and females for DHMS members.

Table 1. Proportion of deaths per year across the five broad cause groups (underlying cause of death coded data not available for 2016 and 2017)

Year	Communicable diseases, perinatal conditions, maternal causes and nutritional deficiencies, %	HIV/AIDS and tuberculosis, %	COVID-19, %	Non-communicable disease, %	Injuries,%
2012	5.6	4.2	0.0	79.1	11.1
2013	5.1	4.7	0.0	78.7	11.4
2014	5.0	4.1	0.0	80.2	10.6
2015	4.3	3.9	0.0	79.4	12.4
2018	7.9	2.3	0.0	80.7	9.1
2019	7.1	2.3	0.0	81.6	9.0
2020	4.7	1.6	16.8	70.3	6.7
2021	3.3	1.2	37.7	52.2	5.5
2022	4.4	1.6	5.7	78.5	9.8
SA deaths in 2018	28.8			59.3	11.9

years old) which saw on average a reduction of 43% in the proportion of injury-related deaths in 2020 compared with 2012. The proportion of injury-related deaths in 2022 for this age group remains 3% lower compared with 2012 (Fig. 3).

Deaths increased by 51.7% from 2012 to 2022 (from 9 823 deaths in 2012 to 14 906 deaths in 2022). The biggest increase in volumes of deaths were non-communicable diseases (50.6% increase from 2012 to 2022) followed by injuries (33.6% increase from 2012 to 2022) (Fig. 4).

Among DHMS members, non-communicable diseases had the highest age- and sex-standardised death rate and a 14% decrease from 429.3 per 100 000 life years to 370.7 per 100 000 life years was observed from 2010 to 2022. HIV/AIDS and tuberculosis had the lowest age- and sex-standardised death rate, and a 41% decrease from 19.6 per 100 000 life years to 11.5 per 100 000 life years was observed from 2010 to 2022. Communicable diseases, perinatal conditions, maternal causes and nutritional deficiencies also saw a decrease of 23% in the same period (Fig. 5).

Standardising to the 2019 SA population, we see a lower age- and sex-standardised death rate for DHMS across communicable diseases, perinatal conditions, maternal causes and nutritional deficiencies (27.8 v. 38.2 deaths per 100 000 life years), HIV/AIDS and tuberculosis (10.9 v. 13 deaths per 100 000 life years), non-communicable disease (234.7 v. 372 deaths per 100 000 life years) and injuries (31.9 v. 40.8 deaths per 100 000 life years) due to the younger age distribution of the SA population. The 2018 DHMS death rates age- and sex-standardised to the SA population are substantially lower than national estimates across communicable diseases, perinatal conditions, maternal causes and nutritional deficiencies (27.8 v. 126.9 deaths per 100 000 life years), HIV/

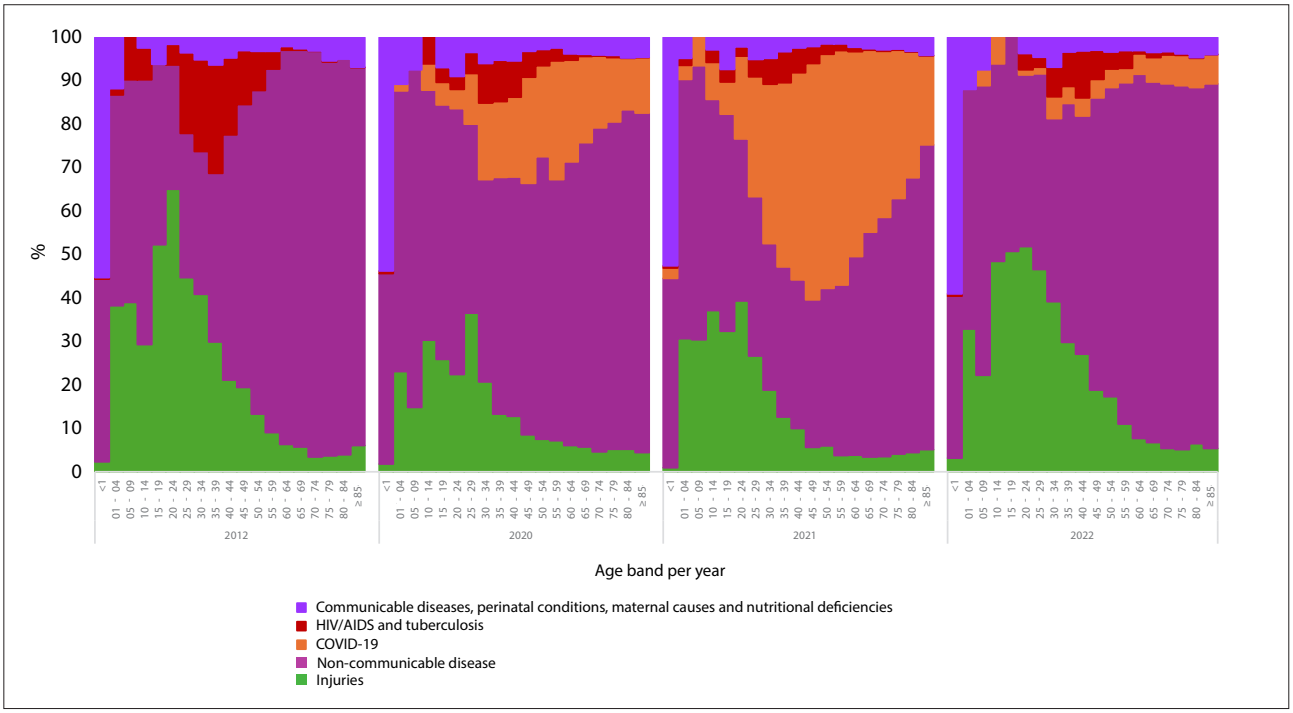


Fig. 3. Proportion of deaths by five broad cause groups by age band for Discovery Health Medical Scheme in 2012, 2020, 2021 and 2022.

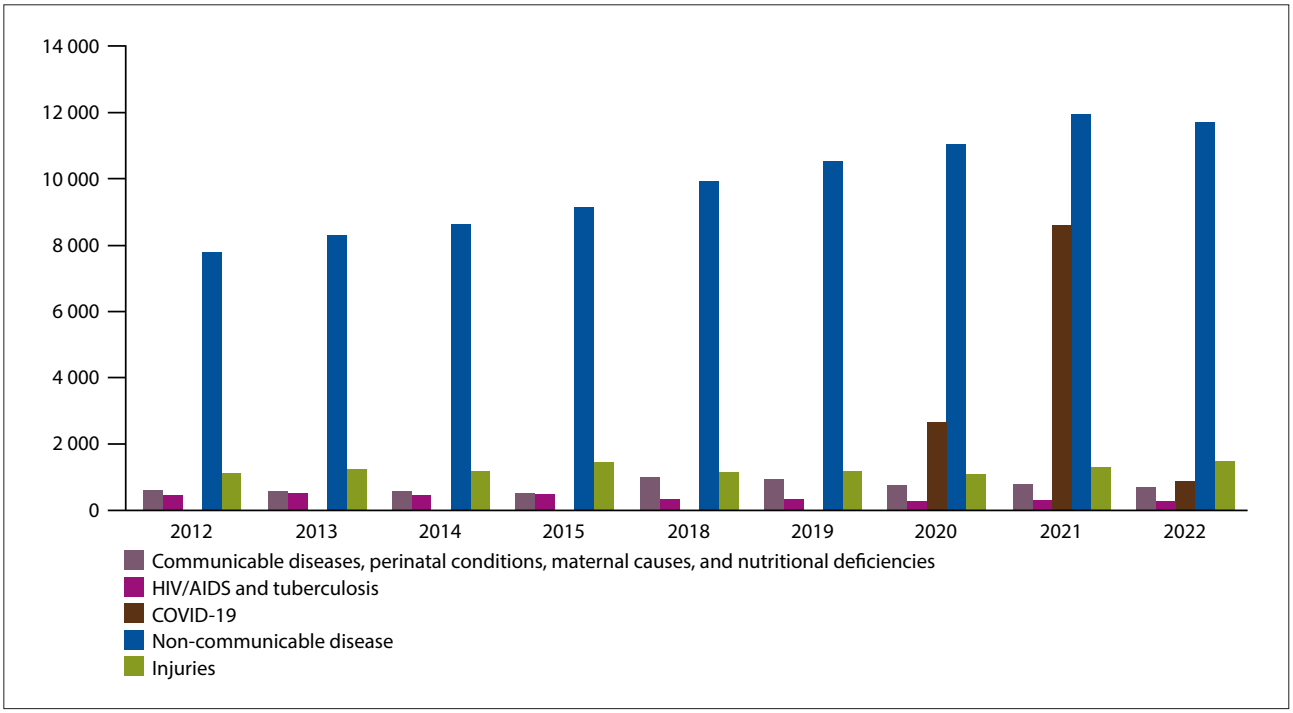


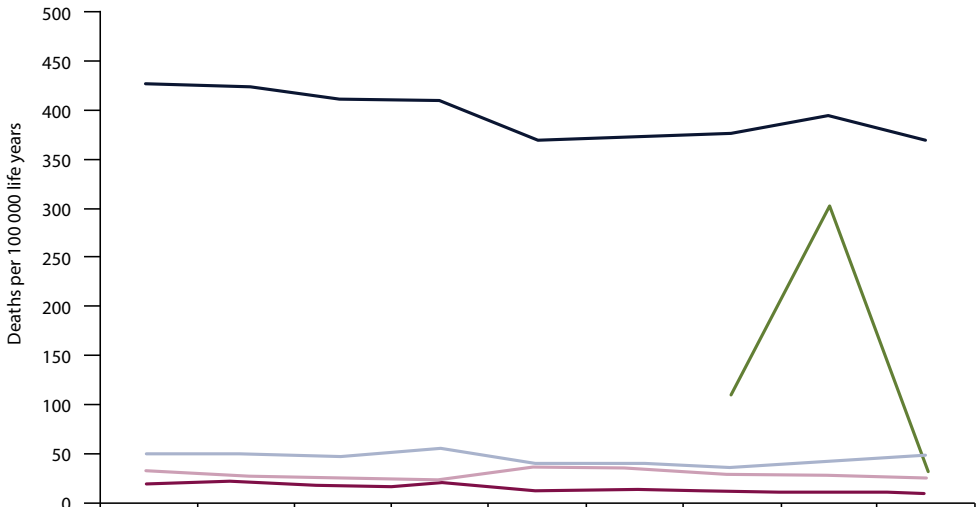
Fig. 4. Deaths, n, *by five broad cause groups for Discovery Health Medical Scheme over time (underlying cause of death coded data not available for 2016 and 2017).*

AIDS and tuberculosis (10.9 v. 306.4 deaths per 100 000 life years), non-communicable disease (234.7 v. 417.9 deaths per 100 000 life years) and injuries (31.9 v. 96.6 deaths per 100 000 life years)[7] (Table 2).

Some COVID-19 coded deaths would have occurred in the absence of the COVID-19 pandemic, but were coded as COVID-19 related. Given that 2022 rates with and without COVID-19 -related deaths are very closely aligned, we can conclude that COVID-19 related deaths were responsible for most (but certainly not all) of the excess deaths seen in the 2020 and 2021 periods. As a result, when we removed all deaths coded by healthcare workers as having been related to COVID-19 from the analysis, only a slightly elevated risk of death was noted in 2021 (Fig. 6). The elevated 2021 experience might be due to COVID-19 deaths not classified as such.

A similar pattern was seen across males and females (Fig. 7) when COVID-19-related deaths are excluded, and in addition, the age-standardised death rates for both males and females were lower than pre-pandemic levels in 2019.

The top two causes of death (Table 3) have not changed from 2012 to 2022 for DHMS members, although rates and rankings have changed. Diabetes moved from eighth (1.8%) in 2012 to fourth (7.6%) in 2022. COVID-19 was the fifth-highest cause of death among DHMS members in 2022 and the highest cause of death (37.7%) during 2021.



	2012	2013	2014	2015	2018	2019	2020	2021	2022
Communicable diseases, perinatal conditions, maternal causes and nutritional deficiencies	32.7	28.0	25.0	23.2	38.2	34.9	28.8	28.8	25.1
HIV/AIDS and tuberculosis	19.6	23.0	18.0	20.3	13.0	13.9	11.4	12.6	11.5
COVID-19							112.1	300.9	34.7
Non-communicable diseases	429.3	425.1	411.9	410.6	372.0	375.7	378.7	396.1	370.7
Injuries	48.9	51.3	47.0	57.0	40.8	41.6	36.9	43.7	49.1

Fig. 5. Age- and sex-standardised death rate by five broad cause groups for Discovery Health Medical Scheme over time (underlying cause of death coded data not available for 2016 and 2017).

Table 2. Age- and sex-standardised death rate for Discovery Health Medical Scheme (DHMS) members for 2018 standardised to 2019 DHMS and SA population by four broad cause groups compared with overall South Africa (SA) rates during the same year

Population	Population standardised to	Year	Communicable diseases, perinatal conditions, maternal causes and nutritional deficiencies	HIV/AIDS and tuberculosis	Non-communicable disease	Injuries
DHMS	2019 DHMS	2018	38.2	13.0	372.0	40.8
DHMS	2019 SA	2018	27.8	10.9	234.7	31.9
SA	2019 SA	2018	126.9	306.4	417.9	96.6

Although rates and rankings across males and females are slightly different in each year and across years, the top five causes of death are fairly similar across males and females (Table 4).

Discussion

Overall, underlying causes of deaths have remained relatively consistent over the past 13 years. Malignant neoplasms and cardiovascular disease have been and remained the two leading causes of death for DHMS clients between 2012 and 2022, except during 2021 when COVID-19 became the leading cause of death. Diabetes moved from being the eighth-highest cause of death in 2012 to fourth in 2022.

Encouragingly, HIV/AIDS and tuberculosis deaths have decreased over time, from 19.6 deaths per 100 000 life years in 2010 to 11.5 deaths per 100 000 life years in 2022.

Our study also shows a gradual decline in the death rates attributable to non-communicable diseases from 2012 to 2022.

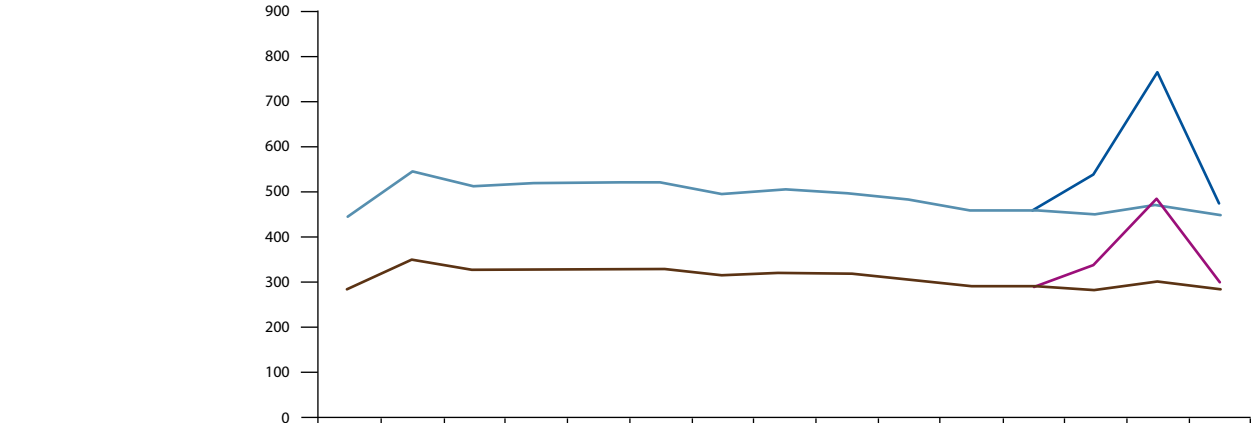
The lower death rates for DHMS v. the SA population are due to the known socioeconomic differences across the medical scheme's population and the non-medical scheme's population.[8-10]

DHMS experienced higher death rates during 2020 and 2021, the COVID-19 pandemic's initial 2 years. Most of this increase was explained by COVID-19 deaths. DHMS data show COVID-19 -related deaths led to the scheme experiencing its highest death rates in 2021.

Males experienced a higher increase in death rates in 2020 and 2021 and remained at an increased risk of death even in 2022 compared with pre-pandemic levels. When excluding COVID-19 related deaths, both females and males in 2022 experienced death rates lower than pre-pandemic levels. More time is needed to assess and confirm this lower experience in 2022.

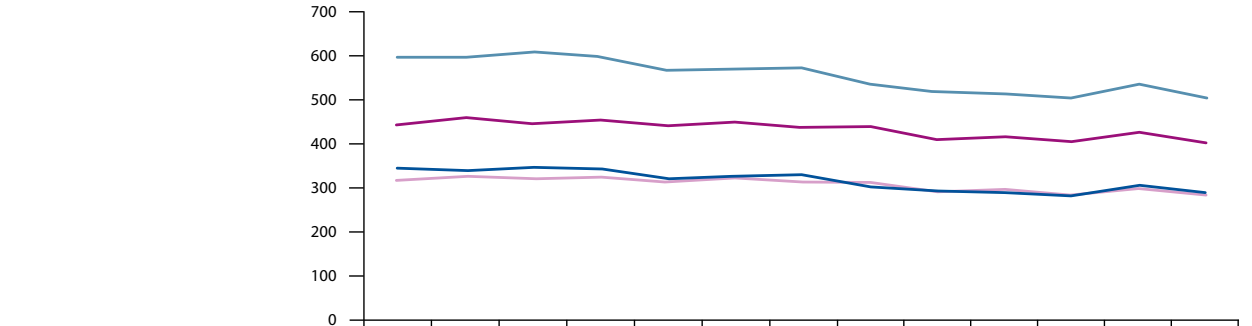
The reduction in deaths due to injuries in 2020 and 2021 is consistent with other publications attributing the decrease in deaths due to injuries due to COVID-19 lockdowns.[11-13]

The data are derived from members of a private medical insurance plan, and owing to socioeconomic disparities, the findings from this analysis may not be fully representative of the wider SA population. However, the extremely long delays that plague the release of national data on causes of death in SA mean that this analysis is the first to be able to examine the burden of mortality by broad causes of death during the COVID-19 pandemic.



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Age- and sex-adjusted DHMS death rate standardised to 2019 DHMS population	450	547	515	523	523	521	499	505	500	482	461	462	542	767	477
Age- and sex-adjusted DHMS death rate (excluding COVID-19) standardised to 2019 DHMS population	450	547	515	523	523	521	499	505	500	482	461	462	450	476	450
Age- and sex-adjusted DHMS death rate standardised to 2019 SA population	286	352	329	331	332	332	316	323	319	306	292	292	341	488	302
Age- and sex-adjusted DHMS death rate (excluding COVID-19) standardised to 2019 SA population	286	352	329	331	332	332	316	323	319	306	292	292	284	302	286

Fig. 6. Age- and sex-standardised death rate per 100 000 life years for Discovery Health Medical Scheme (DHMS) members including and excluding COVID-19 related deaths, standardised to the 2019 DHMS and South African populations. (DHMS = Discovery Health Medical Scheme.)



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Female DHMS death rate standardised to 2019 DHMS population	442	457	445	453	437	448	436	435	409	414	403	424	401
Male DHMS death rate standardised to 2019 DHMS population	594	594	607	595	566	567	570	533	517	513	502	533	503
Female DHMS death rate standardised to 2019 SA population	316	323	318	322	312	321	312	310	291	294	285	298	284
Male DHMS death rate standardised to 2019 SA population	343	339	347	341	321	325	327	302	294	291	281	305	288

Fig. 7. Age-standardised (to the 2019 Discovery Health Medical Scheme and South African populations) death rate per 100 000 life years for DHMS members including and excluding COVID-19 related deaths split by sex. (DHMS = Discovery Health Medical Scheme.)

Competing causes and the sudden mortality displacement would likely result in suppressed mortality rates for a few years from 2022 onwards. This could briefly mask any increase in mortality associated with long COVID. This analysis would need to be repeated once more time has elapsed, and consider a cumulative incidence function type survival analysis to address the competing risks.

Data availability. Data used for this analysis will be shared upon request within 2 years of publication, provided the requester has secured the necessary ethics approval and is subject to final approval by the DHMS Research Governance Committee. All shared data will be anonymised to safeguard patient confidentiality and to comply with ethical guidelines.

Table 3. Top 10 causes of deaths in Discovery Health Medical Scheme members in 2012, 2019, 2021 and 2022, excluding deaths coded to symptoms, signs and ill-defined conditions or injury deaths where the intent is not determined

Underlying cause of death	Rank 2012	2012 deaths, *n* (%)	Rank 2019	2019 deaths, *n* (%)	Rank 2021	2021 deaths, *n* (%)	Rank 2022	2022 deaths, *n* (%)
Cardiovascular diseases	1	2 600 (26.5)	2	2 562 (19.9)	3	2 902 (12.7)	2	3 055 (20.5)
Malignant neoplasms	2	2 451 (25)	1	3 334 (25.9)	2	3 572 (15.7)	1	3 691 (24.8)
Unintentional injuries	3	680 (6.9)	6	614 (4.8)	6	689 (3)	7	686 (4.6)
HIV	4	380 (3.9)						
Digestive diseases	5	373 (3.8)	9	349 (2.7)	9	353 (1.5)	9	412 (2.8)
Respiratory diseases	6	330 (3.4)	5	643 (5)	7	511 (2.2)	5	741 (5)
Respiratory infectious	7	214 (2.2)						
Diabetes mellitus	8	175 (1.8)	3	905 (7)	4	1 237 (5.4)	3	1 129 (7.6)
Neurological conditions	9	158 (1.6)	8	455 (3.5)	8	467 (2)	8	523 (3.5)
Neonatal conditions	10	127 (1.3)						
Endocrine blood immune disorders			4	849 (6.6)	5	1 106 (4.9)	6	716 (4.8)
Infectious and parasitic diseases			7	529 (4.1)	10	337 (1.5)	10	343 (2.3)
Genitourinary diseases			10	271 (2.1)				
COVID-19					1	8 605 (37.7)	4	857 (5.7)
Top 10 causes		7 488 (76.2)		19 779 (86.7)		12 153 (81.5)		12 153 (81.5)
Total		9 821 (100)		12 860 (100)		22 802 (100)		14 911 (100)

Table 4. Top five causes of deaths in Discovery Health Medical Scheme members split by sex in 2012 and 2022, excluding deaths coded to symptoms, signs and ill-defined conditions or injury deaths where the intent is not determined

Underlying cause of death	2012 rank female	2012 female, deaths (%)	2012 rank, male	2012 male, deaths (%)	2022 rank, female	2022 female deaths (%)	2022 rank, male	2022 male deaths (%)
Cardiovascular disease	1	33.7	2	30.8	2	23.7	2	22.1
Malignant neoplasm	2	27.9	1	32.1	1	26.8	1	28.3
Unintentional injury	3	6.6	3	9.8			5	5.3
HIV	5	4.7	4	4.7				
Digestive disease	4	5.6	5	3.8				
Diabetes mellitus					3	7.4	3	9.4
COVID-19					5	5.7	4	7.1
Respiratory disease					4	6.0		

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