A two-year retrospective analysis of the epidemiology of sudden death at a Medico-Legal Mortuary in Tshwane, South Africa, from 1 January 2010 to 31 December 2011

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Background. Sudden death refers to the unexpected and abrupt loss of life, often due to cardiac causes, occurring within a short time after symptom onset. In Africa, sudden death often leads to upheaval and suspicions within families and communities. Conducting thorough research on the causes and prevention of sudden death is crucial to alleviating these concerns and improving public understanding and trust.
Objective. To establish the demographics, circumstances and causes of sudden death in the geographic area served by the mortuary used to collect data. In this retrospective study, records of sudden death cases from 1 January 2010 to 31 December 2011 were meticulously reviewed. Demographic variables: age, sex, ethnicity, time of death, date of death, location of death, events preceding death and cause of death were extracted onto a standardised data collection form using a Microsoft Excel spreadsheet. The data were then analysed using descriptive statistics, including frequency, percentage, mean standard deviation and median, and presented in graphs and tables.
Results. Preliminary findings indicated that 66% of sudden death cases were male, with the 40 - 49 years age group being the most affected. Most deaths took place between 06:00 and 11:59 in the morning. Acute symptoms commonly preceded these fatalities, which predominately occurred in private residences. The primary causes of sudden death varied, with respiratory incidents being predominant, followed by cardiovascular causes. Additionally, 95% of the cases resulted from acquired diseases, while 3% were associated with genetic factors.
Discussion. The epidemiology of sudden death provides insight into its prevalence, patterns and associated risk factors, offering an opportunity to design and implement standard operating procedures for improved quality of professional service, preventative health measures and public health strategies in countries like SA, where comprehensive epidemiological statistics are lacking.
Conclusion. The epidemiology of sudden deaths in the region is intricately linked to various clinical and socio-demographic factors. Understanding these parameters provides critical insights for public health planning and intervention strategies. Further research to explore appropriate public health prevention and intervention measures is recommended.
Keywords. Sudden death, sudden cardiac death, autopsy, medico-legal.

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The World Health Organization (WHO) defines sudden death (SD) as a death occurring within 24 hours after the onset of symptoms, [1] while the medico-legal term refers to deaths that are not preceded by significant symptoms.[2] The leading cause of SD is typically cardiovascular diseases, often referred to as sudden cardiac death (SCD), although other organs can also be implicated. Approximately five million cases of SCD occur worldwide each year, posing a major public health concern as SCD is responsible for 40 - 50% of the years of potential life lost due to heart disease. The burden of premature mortality from SCD surpasses that of all other causes of death combined among women and is second only to the combined burden of cancers and accidents among men.[3]

When SD cases do not have a primary cardiac cause, they are often categorised as non-cardiac SD. Therefore, SD is categorised based on the specific anatomical system involved and can be SCD or non-cardiac SD.[2] Major causes of non-cardiac SD include fatal pulmonary embolism (respiratory system); strokes, epileptic seizures, brain injuries, as well as drug influences and catecholamine toxicity (neurological system). Minor causes of non-cardiac SD include severe bleeding into the peritoneal cavity or gastrointestinal tract (gastrointestinal system) and adrenal insufficiency (endocrine system).[2] Most cases of SD occur outside of hospitals and unobserved by witnesses.[4]

It has been established that many cases of SD occur within the adult population, with an increasing incidence directly proportional to advancing age. However, in a study conducted in 2019, among individuals 35 years and younger, the age group of 0 - 5 years had the highest incidence rate of SD, owing to infants suffering from Sudden Infant Death Syndrome (SIDS) falling into this age group.[5] That study also found men had a three- to four-fold higher risk of SD than women. Moreover, individuals of African descent displayed higher incidence rates than those of European or Hispanic descent, while the Asian population displayed the lowest incidence rate of SCD.

Exploring the causes of SD reported in international studies would provide valuable insight into the incidence, risk factors and circumstances surrounding SD. The incidence of SD varies according to geographic location and socioeconomic status. In an Australian study conducted in 2015, the overall incidence rate of SD was 99.4 per 100 000 cases. This is slightly higher than studies performed in North America, where they found 53 per 100 000 cases in Oregon (USA) and 91.7 per 100 000 cases in Canada. In contrast, Asian countries have a much lower SD incidence rate. A prospective study conducted in Japan reported an incidence rate of 14.9 per 100 000 cases, while Singapore estimated an incidence rate of 20.9 per 100 000 cases.[6] Data on SD in the African continent is limited, but the estimated incidence rate of SCD in sub-Saharan Africa is 33.6 per 100 000 cases.[5]

In a study examining the circumstances surrounding 200 cases of SD at the Forensic Institutes of Lyon and Saint-Etienne in France, from January 1980 to January 1999, 75.8% of deaths occurred during regular daily activities at home, work or on the street. Deaths at home accounted for 63.1%, while 3.5% of deaths occurred during physical activity, with the mean age of death being 23.0 (11.2) years. Additionally, 9.5% of deaths were related to surgery during the perioperative period, with an average age of 35.4 (16.5) years and 11% died during a stressful or specific event. These events include car accidents without visible trauma, falling without visible injury, police arrests, childbirth and medical visits.[7] In an investigation of the cardiovascular events after major earthquakes, a significant increase in SD was observed on the day of the natural disaster compared with the prior week.[8] It was reported that three of the 24 cases were due to physical injury, proposing that emotional stress was a potential preconditioning factor of SD. Interestingly, a decline in SD cases was observed approximately one week after the disaster, dropping below baseline levels before the earthquake. The findings above demonstrate the impact of stress and stressful situations on SD. Unfortunately, in the geographic region under study, the mortuary does not always receive information that might indicate if deaths occurred during or after stressful events.

In Africa, SD is associated with false suspicions, accusations and blame, frequently related to poisoning or witchcraft.[9] Anecdotally, the mortuary under study has seen an increase in such cases. In some developing countries, under-registration of cases of SD is noted.[10] The investigators aimed to understand the demographics, circumstances and causes of death in the community served by the Garankuwa Medico-Legal Mortuary (the mortuary). The mortuary serves Regions 1 and 2 (excluding Montana) of the Tshwane Municipality, which has a combined population of approximately 1.4 million residents, the majority of whom are of black ethnicity.[11]

Methods

This descriptive, retrospective study aimed to analyse the epidemiology of SD cases at the Garankuwa Medico-Legal Mortuary, located in the Garankuwa Township, North-West of Tshwane Capital City in SA, over a two-year period from 1 January 2010 to 31 December 2011. The objective of this study was to establish the demographics, circumstances and causes of SD in the area. Based on the aim, objectives and literature, a data collection form was designed with relevant variables using a Microsoft Excel spreadsheet. These variables included the demographics of sudden death determined by age, sex and ethnicity; circumstances surrounding the deaths, including date, time, location and event and causes of death (inherited and/or acquired factors). The data was extracted from the relevant death register book and mortuary files. Figure 1 demonstrates the process of data collection.

In total, 2 094 post-mortem files were reviewed, representing all cases admitted to the facility during the study period. Data from these files was captured and analysed electronically using Microsoft Excel. It was found that 150 (7.16%) cases were due to SD and 1 944 were due to other causes (Fig. 1). Of the 150 cases, 100 (66.67%) had sufficient information, whereas 50 (33.33%) were excluded owing to incomplete data, specifically the absence of two key variables: location and time of death. Secondary data were collected from the 100 included cases, but only 26 (26%) had information on the circumstances surrounding the death.

Ethical consideration

The study was approved by the University Research Ethics Committee (ref. no. REC/M/57/2023:PG). Written permission was obtained from the Chief Executive Officer of the Gauteng Forensic Pathology Services and the Head of the Department of Forensic Pathology. All records were obtained from post-mortem files; thus, informed consent was not required. Anonymity was upheld by allocating a number to each case. All information was retrieved, collected and analysed by one researcher.

Results

The male-to-female ratio was 2:1, with men accounting for 66% of the sample. The average age for all the cases was 33.9 years. Ethnically, 95% of the sample were black, while 5% were white.

Among the age groups, the 40 - 49 age range exhibited the highest incidence of SD, comprising 21% of cases, followed by the 0 - 5 months category with 16 cases. Conversely, the 6 – 10-year age group displayed the lowest incidence rate at 1% (Fig. 2).

Most SD instances (40%) occurred between 06:00 and 11:59 in the morning. In 2010 and 2011, March had the highest prevalence of SD, with 10 cases reported each March (Fig. 3). The spatial distribution of SD cases is highlighted in Figure 4, showing that most occurred within private residences and yards.

Analysing the factors leading to death among a subgroup of 26 cases from a sample of 100 revealed that 10 cases (38.46%) were associated with acute illnesses. Additionally, in six (23.08%) cases, pain was experienced before death. Among the cases, five (19.23%) transpired during periods of rest, while two (13%) took place during sleep and three (11.54%) during physical activity (Fig. 5).

Regarding the causes of death, acquired factors contributed to 95% of cases, while a combination of acquired and inherited factors accounted for 2%. Cases attributed to inherited factors specifically constituted 3% of the sample. System analysis of SD revealed that the respiratory system was the significant contributor, accounting for 56% of cases, followed by the cardiovascular system at 15%.

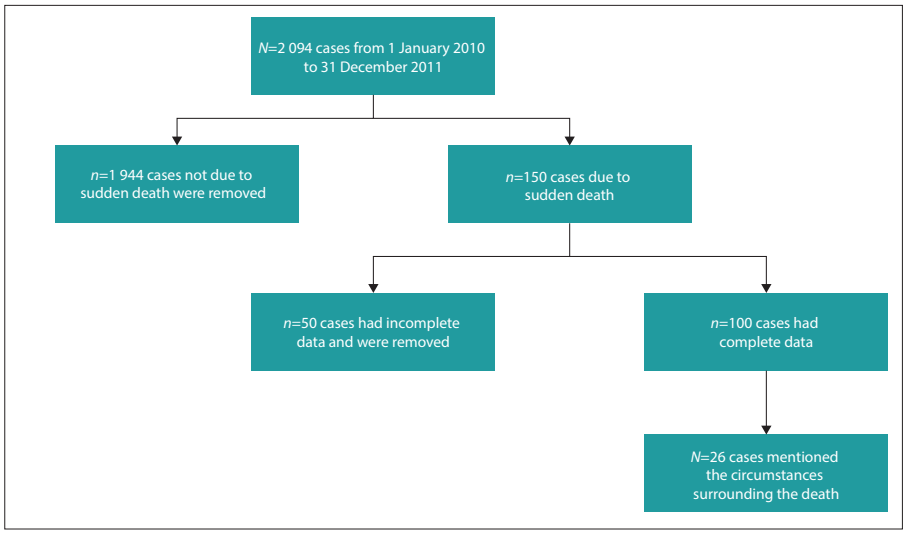

Fig. 1. Data collection procedure.

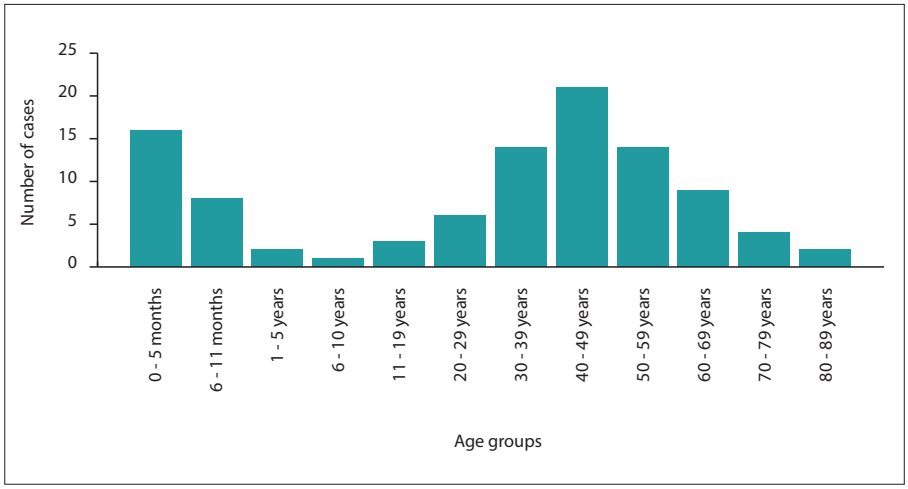

Fig. 2. Distribution of cases within different age categories.

The leading causes of death included pneumonia (39%), ischaemic heart disease (10%), pulmonary tuberculosis (9%) and emphysema (8%) (Fig. 6).

Discussion

This study explored the epidemiology of SD at Ga-Rankuwa Forensic Pathology Services medico-legal mortuary from 1 January 2010 to 31 December 2011. This study illustrated a higher susceptibility to SD among men compared with women, with men exhibiting twice as many cases. This pattern of higher incidence among men is consistent with a Tunisian study of SD in young adults, where men outnumbered women by a factor of 3.6.[12] The average age of SD cases in the current study was 33.9 years, which aligns with the reported mean age of 26.5 years in the Tunisia study.[12] The data suggest a bimodal distribution, with a primary peak in the 40 - 49 age category and a secondary, smaller peak in the 0 - 5 months category. This finding contradicts existing literature, indicating a need for further investigation, particularly in the SA context.

A 2019 meta-analysis found that individuals of African descent (specifically from Cameroon) exhibited higher incidence rates compared with individuals of Caucasian and Hispanic backgrounds.[5] Additionally, findings from the CPR Chicago Project demonstrated higher rates of sudden death among black individuals than their white counterparts across all age groups, with relative risks greater than 2 in the younger age categories.[13] Notably, this study revealed that black individuals accounted for a significant majority, making up 95% of the sample, while white individuals comprised only 5% of the sample. This demographic distribution can be attributed to the predominantly black community in the region.

Further, this study demonstrated that the 40 - 49 age range exhibited the highest incidence of sudden death, comprising 21% of cases with the 0 to 5-month category following closely with 16 cases. Conversely, the 6 to 10-year age group displayed the lowest occurrence rate at 1%. This aligns with a study conducted by the Pretoria Medico-Legal Laboratory, where children aged 1 - 5 years old comprised 51% of deaths. The lowest occurrence of death was observed in the 6 to 10-year age group, which was 10.2%.[6]

Concerning the timing of these SDs, the majority was found to occur between 00:00 and 09:00 AM.[9] It was also found that a majority of cases during the summer season.[12]

When analysing the events preceding death, it was found that most cases (38%) were linked to acute symptoms, such as vomiting, flu-like symptoms or faintness. In contrast, an Ethiopian study found that 70.8% sought medical help, with the most common terminal signs and symptoms being chest pains, followed by dyspnoea and syncope.[14] The findings of our study also showed that 19.23% of cases occurred during rest, while 13% occurred during sleep. In contrast, fewer cases (11.54%) occurred during physical activity. This is comparable with findings from another study investigating the circumstances surrounding SDs, where only 3.5% of deaths were reported during physical activity.[7]

The findings of this study indicate that the majority of SDs occurred in private residences. This observation can be attributed to the fact that private residences serve as the primary location where a significant portion of the population spends most of their time.

The analysis of underlying causes of SD revealed that the respiratory system was the main contributing factor, accounting for 56% of cases. Within the respiratory system, the primary causes of death were pneumonia, tuberculosis and emphysema. The cardiovascular system emerged as the second most prominent contributor, representing 15% of cases, with ischaemic heart disease being the specific cause of death within this system. Conversely, the Ethiopian study reported a different pattern, with the cardiovascular system being the primary contributor to SD at 36.1%, followed by respiratory system causes at 32.6% and gastrointestinal system causes at 19.5%, a pattern similar to that found in the Togo study.[14]

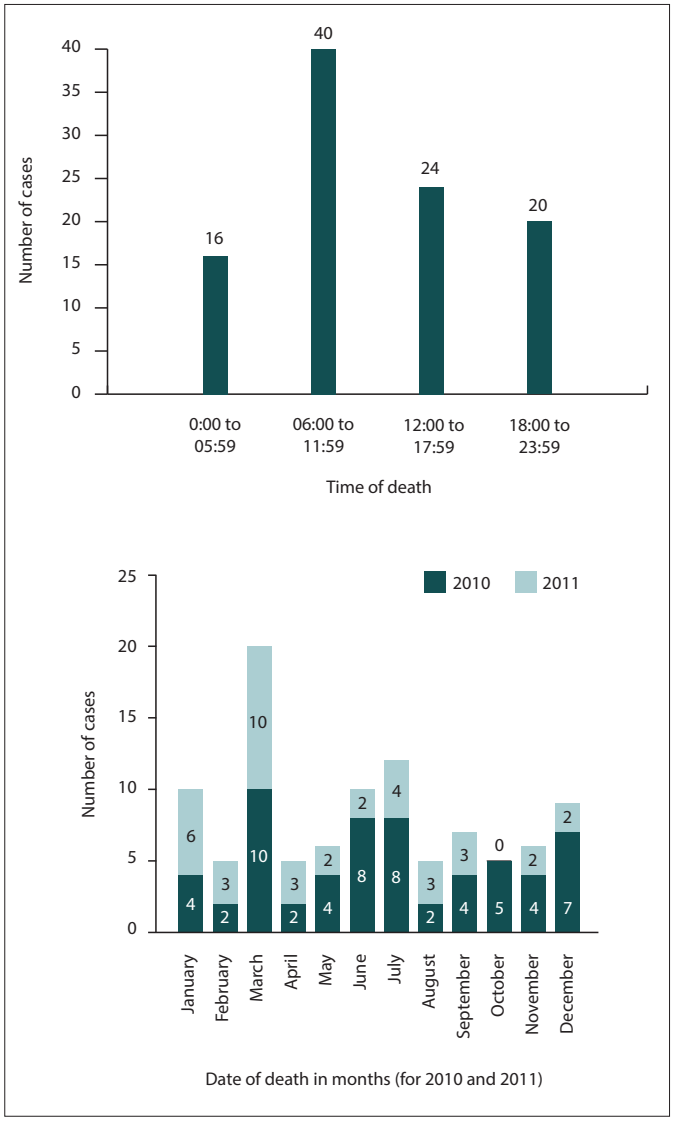

Fig. 3. Time and date at which sudden death occurred

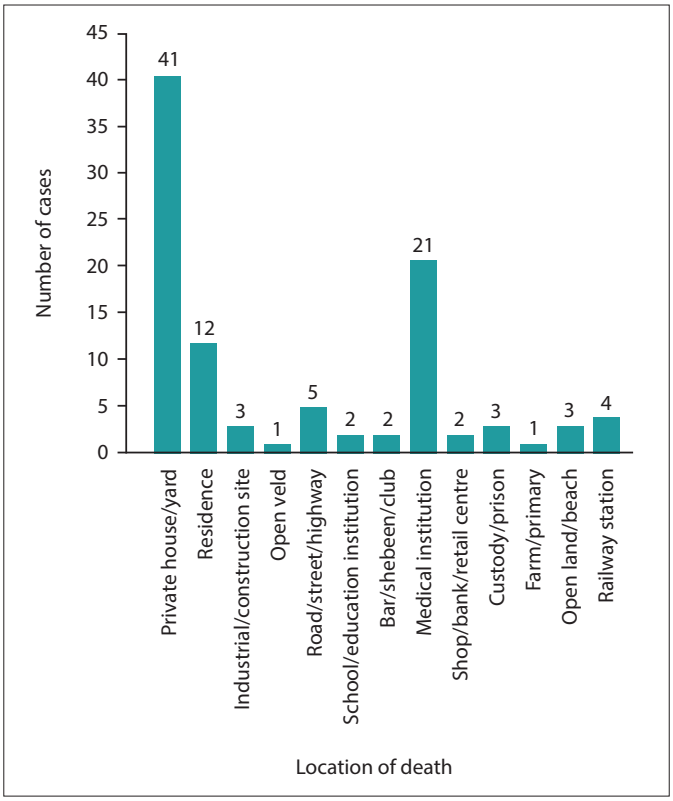

Fig. 4. Locations at which sudden death occurred

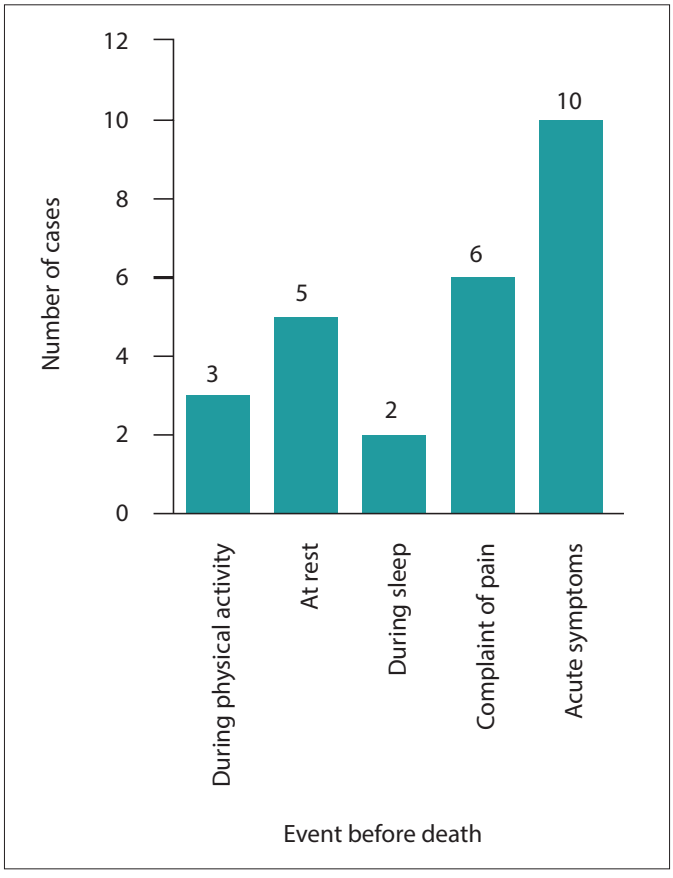

Fig. 5. Circumstances prior to sudden death

In this study, acquired factors were identified as the primary causes of death, making up 95% of cases, while inherited factors were responsible for only 3% of the sample. This finding is in keeping with most studies on SD conducted in developing countries.[9,10,12,14] This might be because in low-income countries like SA, deaths are often ascribed to communicable diseases.

Limitations

This study's limitations stem from its exclusive focus on the sample collected from a medico-legal mortuary, thereby limiting its generalisability to other research contexts. The findings of the study are also limited by the lack of completeness of the mortuary files, especially information on the circumstance of death and the low number of SD cases identified. However, it does make a valuable contribution to the existing body of knowledge on SD and highlights the specific group in our region that is vulnerable to SD. This study holds significance because it adds to the existing body of knowledge regarding sudden death, particularly in low to middle-income countries where data is often lacking.

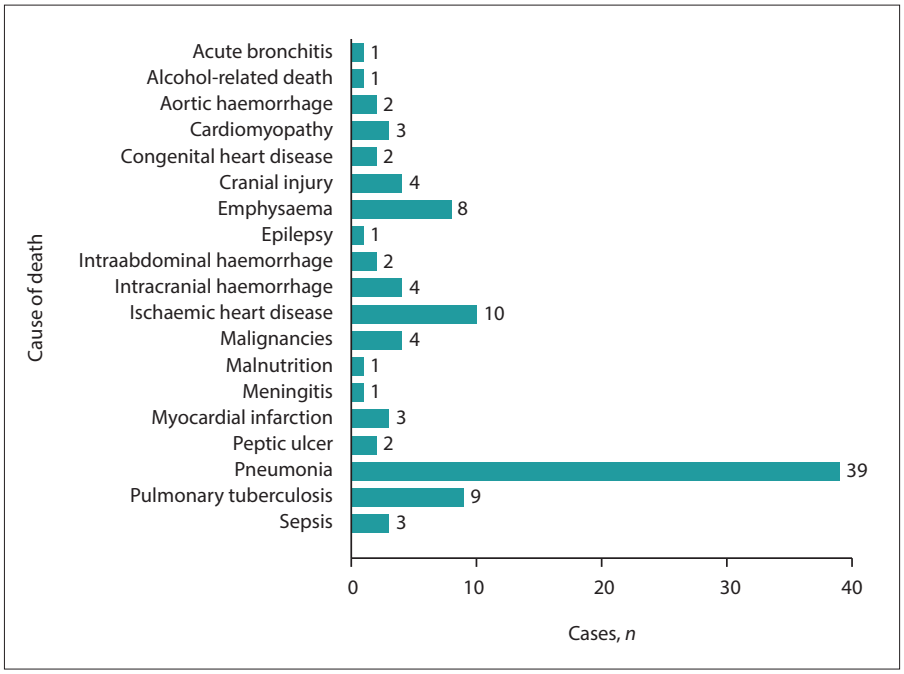

Fig. 6. The distribution of causes of sudden death.

Conclusion

The findings of this study indicate that men were twice as likely to experience SD. The majority of SD cases occurred among black individuals, accounting for 95% of the total. The average age at the time of sudden death was 33.9 years, with the highest incidence observed in the 40 - 49 age group. Most of the deaths occurred between 06:00 and 11:59 in the morning, and acute symptoms typically preceded the deaths. A significant majority of SD incidents took place in private residences. The respiratory system was the primary contributing factor to SD, followed closely by cardiovascular factors. The primary factors leading to SD included pneumonia, ischaemic heart disease, pulmonary tuberculosis and emphysema. Acquired diseases accounted for 95% of the cases, while genetic factors were responsible for three.

Further large-scale epidemiological studies in various regions and populations could help identify specific risk factors and trends associated with SD. This may contribute to a deeper understanding of the phenomenon, leading to improved prevention, early detection and interventions that can ultimately save lives.

Declaration. None.

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AI declaration. The authors acknowledge the journal policy on the use of AI, and the requirement to disclose the use of any AI tools in manuscript preparation.

Author contributions. RDS conceptualised the research, drafted and submitted the protocol for ethics approval, collected the data and did the data analysis. She submitted a research report to the Department of Forensic Pathology as part of the requirements for her degree. KH was the supervisor and CVW was the co-supervisor. KH, CVW and YB edited the research report for journal submission and made reviewer corrections as suggested.

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Data availability statement. The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

Conflicts of interest. None.

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