Original Article

Prospective Study of Sudden Natural Deaths in Youngand Middle Age Group at Tertiary care Hospital, Surat, Gujarat

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Abstract

In the post–COVID-19 pandemic period, an increasing number of sudden deaths have been observed, particularly among young and middle-aged individuals in India. This trend has created a major challenge for the healthcare system in understanding the underlying pathological mechanisms responsible for such unexpected fatalities. Sudden deaths frequently generate public concern, medicolegal scrutiny, and allegations, making accurate determination of the cause of death essential. A prospective study on sudden natural deaths was carried out at a tertiary carehospital in Surat from 1st January 2024 to 31st December 2024. The study demonstrated that most sudden deaths occurred in adults, with a higher incidence among individuals above 30 years of age. A clear male predominance was noted, with a male-to-female ratio of 6:1. cardiovascular diseases were identified as the leading cause of sudden natural deaths, accounting for 42.72% of cases. Respiratory system diseases were the second most common cause, contributing to 36.89% of deaths. These findings emphasize the significant contribution of cardiovascular pathology to sudden deaths in the adult population. The study also highlighted the importance of histopathological examination in establishing the definitive cause of death. Histopathology played a crucial role in correlating clinical history and autopsy findings, thereby improving diagnostic accuracy and strengthening medicolegal conclusions. Hence, comprehensive autopsy evaluation supported by histopathological analysis is vital in cases of sudden natural death.

Key Words: Sudden death, Natural Death, Unexpected Death, coronary artery disease.

Introduction

Natural deaths constitute a substantial proportion of cases subjected to medicolegal autopsy for the purpose of death investigation.[3] A forensic autopsy is a systematic scientific medical procedure carried out to determine the cause and manner of death, particularly in cases that are sudden, unexpected, or unexplained.[4] According to the World Health Organization, a death is considered sudden or unexpected when an individual who was not known to be suffering from any life-threatening disease, injury, or poisoning is found dead or dies within 24 hours of the onset of terminal illness.[1,2]

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The medicolegal importance of sudden death lies in the potential for suspicion, as such deaths frequently raise questions regarding the possibility of foul play.[5] Sudden natural deaths, especially those occurring in apparently healthy individuals, have a profound impact on society and often result in social concern, emotional distress among relatives, and legal scrutiny. In many instances, individuals with no known significant medical history are found dead at home or at the workplace, circumstances that naturally necessitate a thorough medicolegal investigation.[5] In such cases, a comprehensive forensic post-mortem examination, supported by detailed histopathological analysis, plays a crucial role in establishing the exact cause of death and excluding unnatural causes.

Although sudden natural deaths are encountered routinely in forensic practice, the underlying causes and their distribution show considerable variation based on demographic factors, lifestyle patterns, healthcare access, and geographical location. Most available data are derived from Western populations, and there is a relative paucity of region-specific studies from developing countries, particularly from urban and semi-urban areas of India. Moreover, limited literature is available that systematically analyzes sudden natural deaths using autopsy findings in the context of the local population of South Gujarat.

There is a lack of comprehensive autopsy-based studies evaluating the causes and system-wise distribution of sudden natural deaths in and around Surat. The absence of localized data hampers accurate assessment of population vulnerability and limits the usefulness of mortality statistics for public health planning and medicolegal decision-making.

A detailed evaluation of sudden natural deaths through forensic autopsy is essential to improve understanding of their underlying causes, enhance the accuracy of cause-of-death certification, assist legal authorities, and provide clarity to the relatives of the deceased. Additionally, identifying vulnerable population groups can contribute to better public health planning and preventive strategies. A prospective study was conducted at a tertiary care hospital in Surat, Gujarat, over a one-year period from 1st January 2024 to 31st December 2024.

Objectives:

1. To assess the effectiveness of post-mortem examination in determining the cause of death and its correlation with histopathological findings.
2. To identify the pattern and distribution of causes of sudden natural deaths.

Material and Methodology

A prospective study was conducted at a tertiary care hospital in Surat, Gujarat, over a one-year period from 1st January 2024 to 31st December 2024. During the study period, a total of 103 cases of sudden natural death were included. The study material comprised cases in which the deceased had died suddenly and/or unexpectedly and were subjected to medicolegal autopsy. In each case, a thorough post-mortem examination was performed following standard forensic protocols. All major organs were preserved and submitted for histopathological examination. The collected specimens were fixed in 10% formalin, after which gross examination was carried out and representative tissue sections were selected. Tissue processing was performed according to standard laboratory procedures. Routine Haematoxylin and Eosin staining was applied to all sections, and special stains were employed whenever indicated. Final opinions regarding the cause of death were formulated after receipt and correlation of histopathological findings with autopsy observations. All findings were systematically documented and subjected to statistical analysis.

A prospective study design was adopted to ensure systematic and uniform data collection with real-time documentation of autopsy and histopathological findings, thereby minimizing bias. Inclusion of histopathological examination was essential to accurately establish the cause of sudden natural deaths, especially in cases with inconclusive gross findings. Conducting the study at a tertiary care centre over one year ensured adequate case representation and seasonal variation.

Inclusion Criteria:

- Both male and female individuals were included in the study.
- Individuals belonging to young and middle-aged groups were considered.
- All cases of sudden natural death subjected to medicolegal autopsy were included.

Exclusion criteria:

Cases involving road traffic accidents, drug-related deaths, poisoning, blast injuries, deaths due to asphyxia (including suicides and homicides), and decomposed bodies were excluded from the study.

Results and Observations

Table 1: Distribution of cases according to Age and Sex

Age Range (Years)	MALE (%)	FEMALE (%)	Total
17-20	5(4.85%)	0 (0.00%)	5(4.85%)
21-25	8(7.77%)	3 (2.91%)	11(10.68%)
26-30	16(15.53%)	4(3.88%)	20(19.42%)
31-35	16(15.53%)	2(1.94%)	18(17.48%)
36-40	22(21.36%)	2(1.94%)	24(23.30%)
41-45	21(20.39%)	4(3.88%)	25(24.27%)
Total	88(85.44%)	15(14.56%)	103(100%)

A total of 103 cases of sudden natural death were analysed, comprising 88 males (85.44%) and 15 females (14.56%). The highest incidence was observed in the 41–45-year age group, which accounted for 25 cases (24.27%), followed closely by the 36–40-year age group with 24 cases (23.30%). The lowest number of cases was recorded in the 17–20-year age group, with only 5 cases (4.85%), all of whom were male. Male predominance was evident across all age groups. The gender disparity was most pronounced in the 36–40-year and 41–45-year age groups. Female cases were most frequently observed in the 26–30-year and 41–45-year age groups, with each group contributing 4 cases (3.88%). These findings are comparable with observations reported by Zanjad et al[3]., Gupta et al[4]., and Angam et al [8]., who also documented a higher prevalence of sudden natural deaths among males.

Table 2: Distribution of cases according to Habits and Co-morbidity

Age (Years)	Alcohol	Smokers	Tobacco chewing	Hypertension	Diabetes
17-20	0	0	0	0	0
21-25	2	0	5	0	0
26-30	13	6	15	1	1
31-35	11	2	16	1	0
36-40	18	6	20	5	0
41-45	17	7	21	5	2
Total	61 (59.22%)	21 (20.38%)	77 (74.75%)	12 (11.65%)	3 (2.91%)

Tobacco chewing was the most frequently reported habit, observed in 77 cases (74.75%), followed by alcohol consumption in 61 cases (59.22%) and smoking in 21 cases (20.38%). The highest prevalence of tobacco uses and alcohol intake was noted in the 36–40-year and 41–45-year age groups. Hypertension was documented in 12 cases (11.65%), predominantly among individuals aged between 36 and 45 years. Diabetes mellitus was identified in 3 cases (2.91%), all occurring in individuals aged 26 years and above, with the highest frequency in the 41–45-year age group. Overall, a progressive increase in lifestyle-related habits and associated comorbidities was observed with advancing age, particularly after the age of 30 years.

Table 3: Distribution of Cases according to the body system involved

Involved System	Male	Female	Total
Cardiovascular	38 (36.89%)	6 (5.83%)	44 (42.72%)
Respiratory	32 (31.07%)	6 (5.83%)	38 (36.89%)
Gastrointestinal	10 (9.71%)	0 (0%)	10 (9.71%)
Gastrourinary	5 (4.85%)	2 (1.94%)	7 (6.80%)
Other	3 (2.91%)	1(0.97%)	4 (3.88%)
Grand Total	**88 (85.44%)**	**15 (14.56%)**	**103 (100%)**

In the present study, the cardiovascular system was the most commonly involved system, accounting for 44 cases (42.72%) of sudden natural death. This was followed by respiratory system involvement in 38 cases (36.89%). Gastrointestinal system involvement was observed exclusively among male subjects, with 10 cases (9.71%) and no cases reported in females. Genitourinary system involvement was comparatively less frequent, with 7 cases (6.80%), showing a male-to-female ratio of approximately 2.5:1. Male predominance was observed across all organ systems, reflecting the overall sex distribution of the study population. Together, cardiovascular and respiratory system pathologies constituted more than 79% of all sudden natural deaths, indicating a disproportionate burden of cardiopulmonary disorders in the studied population. This pattern highlights the significant contribution of these systems to sudden mortality. Despite the wide range of conditions known to cause sudden death, cardiovascular diseases emerged as the leading cause in the present study. Of the 103 cases analysed, 44 cases (42.72%) were attributed to cardiovascular causes, of which 38 cases (36.89%) occurred in males and 6 cases (5.83%) in females. These findings are consistent with standard forensic literature, as described by K. S. Narayan Reddy and P. C. Ignatius, who reported that cardiovascular diseases account for approximately 45–50% of sudden deaths. Comparable results have also been documented in previous studies, including those by Zanjad et al. (49.55%)[3], Gupta et al. (58.73%)[4], Angam et al. (44.8%)[8], Dayananda R et al. (63%)[11], and BK et al. (39.18%)[12]. The consistency of these findings across multiple studies reinforces the dominant role of cardiovascular pathology in sudden natural deaths.

Table 4: Distribution of Cases according to the Cardiovascular System.

Cardiac Disease	Male	Female	Total
Atherosclerosis/Chronic coronary artery disease	16	2	18
Cardiac Tamponade	1	0	1
Myocardial Infarction/ Ischemic heart disease	18	4	22
Myocarditis	3	0	3
TOTAL	38 (36.89%)	6 (5.83%)	44 (100%)

In the present study, out of 103 cases of sudden natural death, cardiovascular system involvement was identified in 44 cases (42.72%), making it the most frequently affected body system. Among these cardiovascular cases, myocardial infarction/ ischemic heart disease was the predominant pathology, observed in 22 cases (50%), followed by atherosclerosis/chronic coronary artery disease in 18 cases (40.91%). Myocarditis was noted in 3 cases (6.82%), all of which occurred in males, while cardiac tamponade was identified in 1 male case (2.27%). Overall, males constituted 86.36% of cardiovascular deaths, whereas females accounted for 13.64%. The cardiovascular system contributed to the highest proportion of sudden natural deaths in this study, with 44 cases (42.72%). This observation is consistent with findings reported in multiple studies conducted across different geographical regions, where cardiovascular pathology has been identified as the leading cause of sudden death. Comparable results have been reported by G. Angam et al. (44.8%)[8], Zanjad N. P. et al. (49.55%)[3], Gupta S. et al. (58.73%)[4], Dayananda R. et al. (63%)[11], and Gunthethi B. K. et al. (42.55%)[12]. Theconsistent predominance of cardiovascular causes across these studies underscores the critical role of cardiac pathology in sudden natural deaths and highlights the need for early identification an management of cardiovascular risk factors in the adult population.

Table 5: Distribution of Cardiac cases of sudden death according to Atherosclerosis change

Cardiovascular disease	Classification of Coronary Atherosclerosis							
	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Total
Chronic Coronary artery Disease	-	-	3	7	5	2	1	18
Ischemic heart disease	-	1	1	2	5	2	-	11
Myocardial Infarction	-	-	-	2	4	1	4	11
Myocarditis	-	-	-	-	3	-	-	3
Cardiac Tamponade	-	-	-	-	1	-	-	1
Total	0	1	4	11	18	5	5	44

In the present study, the pattern of sudden cardiac deaths was analyzed in relation to the severity of coronary atherosclerosis. A total of 44 cardiovascular cases were evaluated and graded from Grade 1 to Grade 7 based on the extent of atherosclerotic changes. A progressive increase in the number of sudden death cases was observed with increasing grades of atherosclerosis, with a notable rise beginning from Grade 3 onwards. The highest number of cases was recorded in Grade 5 (18 cases), followed by Grade 4 (11 cases), indicating a strong association between moderate to severe coronary atherosclerosis and sudden cardiac death. Deaths due to chronic coronary artery disease and ischemic heart disease were predominantly seen in the higher grades of atherosclerosis. Myocardial infarction was mainly observed in Grades 4 to 7, suggesting its close relationship with advanced atherosclerotic disease. In contrast, myocarditis and cardiac tamponade were infrequently encountered and showed minimal correlation with the severity of coronary atherosclerosis. The marked increase in cases from Grade 3 onwards highlights a significant association between progressive atherosclerotic severity and the occurrence of fatal cardiac events.

Table 6: Distribution of sudden death cases according to System

System	Cause of death	Male	Female	Total
CVS	Chronic Coronary artery Disease	16	2	18
	Ischemic heart disease	8	3	11
	Myocardial Infarction	10	1	11
	Myocarditis	3	0	3
	Cardiac Tamponade	1	0	1
	Grand Total	38 (36.89%)	6 (5.83%)	44(42.71%)
RS	Chronic lung disease	2	0	2
	Intra-alveolar haemorrhage	3	2	5
	Pneumonia	13	4	17
	Pulmonary oedema	13	0	13
	Pulmonary Tuberculosis	1	0	1
	Grand Total	32 (31.07%)	6 (5.83%)	38(36.89%)
GIS	Chronic liver disease	4	0	4
	Cirrhosis	4	0	4
	Hepatitis	2	0	2
	Grand Total	10(9.71%)	0 (0)	10(9.71%)
GUS	Acute Tubular Necrosis	2	1	3
	Chronic kidney disease	2	0	2
	Chronic pyelonephritis	1	1	2
	Grand Total	5(4.85 %)	2(1.94%)	7(6.80%)
Other	Septicaemia	3	1	4
	Grand Total	3(2.91%)	1(0.97%)	4(3.88%)
TOTAL		88(85.44 %)	15(14.56%)	103(100%)

In the present study, the cardiovascular system was identified as the leading cause of sudden deaths, accounting for 44 cases (42.71%). Among cardiovascular causes, chronic coronary artery disease emerged as the most common individual pathology, observed in 18 cases, followed by myocardial infarction and ischemic heart disease, with 11 cases each. The respiratory system was the second most commonly involved system, contributing to 38 deaths (36.89%). Pneumonia was the predominant respiratory cause (17 cases), followed by pulmonary oedema (13 cases). Gastrointestinal system involvement was noted in 10 cases (9.71%), all of which occurred in male individuals, with chronic liver diseases being the principal cause. Genitourinary system disorders accounted for 7 cases (6.80%), involving both acute and chronic renal conditions. Septicaemia, categorized under miscellaneous causes, was responsible for 4 deaths (3.88%). Overall, males constituted 85.44% of the total cases, demonstrating a marked male predominance across all organ systems. The most commonly affected system was the cardiovascular system (42.71%), the most frequent individual cause was chronic coronary artery disease, and the leading non-cardiac cause was pneumonia. These findings highlight the dominant contribution of cardiovascular and respiratory diseases to sudden deaths, along with a significant gender disparity favouring male involvement.

Discussion

India has witnessed a noticeable increase in the incidence of sudden deaths in recent years, largely attributable to a rising burden of coronary artery disease (CAD). Sudden death continues to represent a major medicolegal and public health concern, particularly among young and middle-aged adults. The present study analyzed 103 cases of sudden natural death with emphasis on age and sex distribution, lifestyle habits, comorbid conditions, system-wise involvement, and cardiovascular pathology. A clear male predominance was observed, with males accounting for 85.44% of cases and a male-to-female ratio of approximately 6:1. This finding is consistent with earlier studies by Hajra K. Mehdi et al[5]. and Modi R. A. et al[10], who reported male predominance with ratios of 10:1 and 4:1 respectively. Similar observations across multiple Indian studies suggest that males are more frequently exposed to cardiovascular risk factors such as tobacco use, alcohol consumption, occupational stress, and sedentary lifestyles. The majority of cases in the present study belonged to the 36–45-year age group, with the highest incidence noted in individuals aged 41–45 years (24.27%), followed by 36–40 years (23.30%). This distribution indicates that sudden death predominantly affects individuals in their most productive years of life. Comparable age patterns have been reported by Zanjad and Nanadker[3], Gupta et al[4]., Mehdi et al[5]., Pandian et al[9]., and Modi et al[10]., where most victims were between 30 and 50 years of age. Standard forensic textbooks by K. S. Narayan Reddy, O. P. Murty[1], and P. C. Ignatius[2] also emphasize that sudden natural deaths commonly occur in the fourth and fifth decades, largely due to premature cardiovascular pathology. However, studies by Angam et al [8]. and Dayanandra et al[11]. have reported a slightly higher incidence in older age groups, which may reflect regional, dietary, and lifestyle variations.

Analysis of lifestyle habits revealed tobacco chewing as the most prevalent habit (74.75%), followed by alcohol consumption (59.22%) and smoking (20.38%). The high prevalence of these habits, particularly in the 31–45-year age group, suggests a strong association between lifestyle factors and sudden death. Similar associations have been reported by Gupta et al[4]., Bansal et al [6]., Bhagora et al[7]., and Angam et al[8]. While Western studies emphasize cigarette smoking as a major risk factor, Indian studies—including those by Mehdi et al[5]. and Guntheti & Mohsin[12]—highlight the role of smokeless tobacco, supporting the findings of the present study. Among documented comorbidities, hypertension (11.65%) was more frequently observed than diabetes mellitus (2.91%). This relatively lower recorded prevalence may be explained by the fact that many individuals remain undiagnosed or inadequately treated. Textbook references by Reddy & Murty[1] and Ignatius[2] emphasize that undetected or poorly controlled hypertension is a common contributor to sudden death, particularly through its role in accelerating atherosclerosis and precipitating fatal cardiac events.

System-wise analysis revealed that the cardiovascular system was the most commonly

involved, accounting for 42.72% of sudden deaths, followed by the respiratory system (36.89%). Gastrointestinal (9.71%), genitourinary (6.80%), and other causes (3.88%) constituted smaller proportions. These findings align with multiple Indian studies that have consistently identified cardiovascular pathology as the leading cause of sudden natural death, with reported rates ranging from 40% to 65%. Among cardiovascular causes, ischemic heart disease and myocardial infarction together constituted the majority of cases, followed by chronic coronary artery disease. Myocarditis and cardiac tamponade were relatively rare. These observations are consistent with studies by Gupta et al[4]., Mehdi et al[5]., Pandian et al[9]., Modi et al[10]., and Guntheti & Mohsin[12], all of whom identified ischemic heart disease as the most frequent cause of sudden cardiac death. According to Reddy & Murty and Ignatius, ischemic heart disease remains the single most common cause of sudden natural death in adults, strongly supporting the present findings. Grading of coronary atherosclerosis demonstrated that Grade 4 and Grade 5 lesions were the most frequently encountered, indicating that advanced coronary artery disease plays a pivotal role in sudden cardiac death. The presence of severe atherosclerosis even in younger individuals highlights the silent and progressive nature of coronary artery disease. Similar findings have been reported by Mehdi et al[5]., Modi et al[10]., and Pandian et al[9]. Textbook literature further emphasizes that severe atherosclerosis, even in the absence of acute thrombosis, can precipitate fatal arrhythmias, explaining sudden death in apparently stable individuals. Respiratory causes of sudden death were mainly due to pneumonia and pulmonary oedema, particularly among males. Gastrointestinal causes were largely related to chronic liver disease and cirrhosis, often associated with prolonged alcohol consumption. Genitourinary causes included acute tubular necrosis and chronic kidney disease, while septicaemia accounted for deaths categorized under miscellaneous causes. From a medicolegal perspective, sudden deaths in young and middle-aged individuals frequently raise suspicion of foul play. A meticulous autopsy examination, including detailed cardiac evaluation and coronary artery assessment supported by histopathological analysis, is essential for establishing the natural cause of death. Accurate identification of underlying disease not only aids in excluding unnatural causes but also assists legal authorities and provides reassurance to the bereaved family.

Limitations of the Study:

The present study was conducted at a single tertiary care centre with a relatively limited sample size, which may restrict the generalizability of the findings to the wider population. Information regarding premorbid conditions and lifestyle factors was limited in some cases due to reliance on available records and relatives' history. Additionally, advanced investigations such as molecular autopsy and genetic analysis were not performed.

Conclusion

Meticulous autopsy examination supported by comprehensive histopathological analysis plays a pivotal role in accurately determining the cause of sudden death. The present study demonstrated that a substantial proportion of sudden deaths occurred among adults, particularly those above 30 years of age, highlighting a growing public health concern in contemporary society. Cardiovascular causes accounted for the majority of cases, with coronary artery disease—primarily due to atherosclerosis—emerging as the leading underlying pathology. These findings underscore the urgent need to strengthen preventive strategies targeting non-communicable diseases. Effective implementation of the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NP-NCD), early screening for cardiovascular risk factors, promotion of healthy lifestyle practices, and increased public awareness regarding the hazards of tobacco and alcohol consumption are essential. Regular health check-ups for young and middle-aged adults, along with sustained community-level awareness programs, may significantly contribute to reducing the incidence of sudden deaths due to cardiovascular causes. Future multicentric studies with larger sample sizes are recommended to better understand regional and national patterns of sudden natural deaths. Incorporation of advanced diagnostic modalities, including molecular and genetic studies, may further aid in identifying occult causes of sudden death, particularly in young individuals. Long-term epidemiological studies integrating clinical,

pathological, and lifestyle data would be valuable for developing targeted preventive strategies.

Ethical Clearance: Obtained from the Institutional Ethics Committee SMIMER Medical College, Surat with reference number 20- 30/04/2024.

Conflicts of interest: Nil

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