ABSTRACT

Objective: Sudden natural death that occurred apparently to a healthy individual sometimes creates suspicions of foul play, thus subjected to medicolegal (ML) examinations. The present study aims to determine the age and sex-specific burden and identify the most typical cause of sudden natural death in ML autopsies at a tertiary care hospital. Materials and methods: A retrospective study were conducted in the Department of Forensic Medicine, Gauhati Medical College & Hospital, Guwahati, Assam, including all autopsy cases of sudden natural death conducted from Jan 1, 2018, to Dec 31, 2018. Circumstances surrounding the death were analyzed from the inquest report and hospital cause of death certificate. The distribution of the cases concerning various socio-demographic variables was presented as frequencies and percentages. The data were analyzed using Statistical Package for the Social Sciences (SPSS) version 16. Results: Out of the total of 3574 autopsies, 243 (6.8%) were sudden natural deaths, with a male predominance of 82.2%. Maximum deaths occurred in the 31 to 40 years (32.92%) age group. The present study affected the married individuals (181/243) and urban residents (68.34%). The cardiovascular (45.27%) and gastrointestinal systems (20.16%) were the most common organ system involved. Among the cardiac causes, chronic coronary insufficiency was the most common cause (34.16%). Conclusion: Cardiac causes were the most typical cause of sudden natural death, particularly among the young. Medicolegal examinations can solve most of the doubts arising out of sudden natural death.

Keyword: Sudden death; autopsy; cardio-vascular; cause of death.
INTRODUCTION

Death is an inevitable occurrence in the life of every person. Every human being wants to die naturally and peacefully. But sometimes, sudden death that occurred apparently to a healthy individual may raise many questions and create suspicion among the near and dear ones of foul play. Such incidents are most shocking and unexpected. Sudden natural deaths occupy a significant portion of deaths undergoing autopsy. As in case of sudden natural deaths, it is not usually possible to identify the cause of death by external examinations of the body, forensic medicine experts play a vital role in differentiating natural deaths from unnatural deaths and establishing an association of diseases with work, behaviour, trauma or any other events.

A death that is not known to have been caused by any trauma, poisoning or violent asphyxia and occurs suddenly or within 24 hours of the onset of terminal symptoms is defined as sudden death. According to the World health organization (WHO), sudden death is an unexpected non-violent death of a person usually seen within 24 hours of the onset of symptoms. Whereas, death occurring due to some natural diseases or pathological conditions where the death is not intended or attempted is attributed as a natural death. There is frequent or unexpected deaths with natural deaths, but sudden death is not always natural and vice versa. An autopsy can differentiate sudden natural death from sudden unnatural death.

Most reported causes of sudden natural deaths are related to the cardiovascular system followed by respiratory, neurological, digestive, infectious and genito-urinary conditions. Almost 40-50% of cardiovascular deaths are accounted for sudden cardiac deaths. As per the centre for global health research, cardiovascular diseases are the leading cause of death in India. Annually, an estimated 7-lakh sudden cardiac deaths occur in India. Studies suggest that unevaluated ischemic heart disease is the most significant cause of sudden cardiac deaths in developed countries.

The northeastern region of India constitutes diverse ethnic-tribal demography with varied lifestyles and food habits. However, studies on morbidity and mortality pattern are limited in this part of the country. Many studies are not available on the prevalence and cause of sudden natural deaths in northeast India.
The present study was undertaken to study the burden of sudden natural deaths among medicolegal autopsies in a tertiary care centre. The study aims to assess the socio-demographic profile of the sudden natural death cases brought for medicolegal autopsy and identify the commonest accountable cause of sudden natural death.

MATERIALS AND METHODS

The study was conducted retrospectively in the Department of Forensic Medicine, Gauhati Medical College & Hospital (GMCH), Guwahati, Assam taking all the cases of autopsy having the opinion of sudden natural death a cause of death from Jan 1, 2018, to Dec 31 2018.

All the cases of autopsy having the opinion of natural death as a cause of death and cases brought dead in casualty without evidence of unnatural cause were included. Unnatural death cases, unknown cases, natural death cases with recorded chronic illness, poisoning and decomposed cases were excluded. Circumstances surrounding the death were analyzed from the inquest report and hospital cause of death certificate. All instances of sudden natural death were analyzed irrespective of age and sex.

The distribution of the cases concerning various socio-demographic variables was presented as frequencies and percentages. The data were analyzed using Statistical Package for the Social Sciences version 16. Ethical clearance for the study was obtained from the Institutional Ethics Committee of Gauhati Medical College and Hospital, Guwahati, vide no. MC/190/2007/Pt-11/Jan-2019/10.

RESULTS

During the study period total of 3574 cases were brought for medicolegal autopsies to GMCH mortuary, out of which 243 cases were found to be sudden natural death constituting an overall burden of 6.8%.

Male predominance was observed among the sudden death cases as out of 243 cases, 195 cases (82.2%) were male, and 48 cases were female with a sex ratio of 4:1.

The age and gender distribution of the cases showed that most of the cases were reported from the adult age group and the commonly involved age group was 31 to 40 years (32.92%) followed by 41 to 50 years (30.86%) in both male and female. One case of sudden natural death was reported from the lowest age group of 0-10 years and the highest age group of 80-90 years. The majority of the cases were married (74.4%), as shown in Table 1.

| Age group | No. of cases (n=243) | Percentage (%) | Male (n=195) | Percentage (%) | Female (n=48) | Percentage (%) |
|-----------|---------------------|----------------|-------------|----------------|---------------|----------------|
| 0-10      | 1                   | 0.41           | 1           | 0.41           | 0             | 0              |
| 11-20     | 7                   | 2.88           | 6           | 2.47           | 1             | 0.41           |
| 21-30     | 34                  | 13.99          | 27          | 11.11          | 7             | 2.88           |
| 31-40     | 80                  | 32.92          | 64          | 26.33          | 16            | 6.58           |
### Table 2 Distribution of cases according to the place of death

| Place of death | Number of cases (n=243) | Percentage (%) |
|----------------|-------------------------|----------------|
| Brought dead   | 131                     | 53.9           |
| Hospital       | 34                      | 14.0           |
| Roadside       | 8                       | 3.3            |
| Home           | 70                      | 28.8           |

Among all cases, 53.9% of cases were brought dead to the hospital (Table 2).

Among the causes of sudden death, the most commonly involved organ system was the cardiovascular system (45.27%), followed by the gastrointestinal system (20.16%), respiratory system (18.11%), central nervous system (14.4%) and genitourinary system (2.06%), as shown in Fig. 1.

### Table 2 Distribution of cases according to the place of death

| Marital status | Number of cases (n=243) | Percentage (%) |
|----------------|-------------------------|----------------|
| Married        | 181                     | 74.4           |
| Unmarried      | 48                      | 19.7           |
| Status not known | 14                     | 5.8            |

Sudden death is more common among the cases brought from urban residential areas, with 167 out of 243 cases (68.7%). The majority of the cases were average body mass index (BMI) with 153 (63.0%) cases. Out of the 243 cases, 24.3% (59/243) were obese, and only 12.7% had low BMI.

### Table 2 Distribution of cases according to the place of death

| Place of death | Number of cases (n=243) | Percentage (%) |
|----------------|-------------------------|----------------|
| Brought dead   | 131                     | 53.9           |
| Hospital       | 34                      | 14.0           |
| Roadside       | 8                       | 3.3            |
| Home           | 70                      | 28.8           |

Among all cases, 53.9% of cases were brought dead to the hospital (Table 2).

Among the causes of sudden death, the most commonly involved organ system was the cardiovascular system (45.27%), followed by the gastrointestinal system (20.16%), respiratory system (18.11%), central nervous system (14.4%) and genitourinary system (2.06%), as shown in Fig. 1.
Among the cardiac causes, chronic coronary insufficiency is the most common cause (34.16%). Cardiac tamponade was observed in 2 (0.82%) cases. Among the gastrointestinal causes, chronic liver disease (13.58%) was reported in most cases. While among the respiratory causes, pneumonia (11.11%) was mainly observed (Table 3).

**Table 3** Distribution of cases according to various types of the cause of death

| System               | Disease                                  | Number of cases | The percentage among total sudden death | The percentage among total autopsies |
|----------------------|------------------------------------------|-----------------|----------------------------------------|-------------------------------------|
| Cardiovascular       | Chronic coronary insufficiency           | 83              | 34.16                                  | 3.08                                |
|                      | Cardiomyopathy                           | 25              | 10.29                                  |                                      |
|                      | Cardiac tamponade                        | 2               | 0.82                                   |                                      |
| Gastrointestinal     | Chronic liver disease                    | 33              | 13.58                                  | 1.37                                |
|                      | Rupture of oesophageal varices           | 7               | 2.88                                   |                                      |
|                      | Acute haemorrhagic pancreatitis          | 5               | 2.06                                   |                                      |
|                      | Intestinal perforation                   | 4               | 1.65                                   |                                      |
| Respiratory          | Pneumonia                                | 27              | 11.11                                  | 1.23                                |
|                      | Tuberculosis                             | 17              | 6.70                                   |                                      |
| Central nervous      | Spontaneous intracranial haemorrhages    | 35              | 14.40                                  | 0.98                                |
| Genitourinary        | Chronic parenchymal disease of kidneys   | 5               | 2.06                                   | 0.14                                |

**DISCUSSION**

Deaths of unnatural, suspicious and unexpected manner necessitate an autopsy as a portion of the evidence-gathering process. In sudden death investigation, sequential autopsy examination investigates the underlying cause of death and answers the suspicion of foul play regarding those unexpected deaths.
Among 3574 autopsies during the study period, 243 were sudden natural deaths implying an overall burden of 6.8%. Other studies from northeast India reported the incidence of sudden natural death of 8.6% to 9.2%.\textsuperscript{14,15} Meanwhile, the incidence of sudden natural death in other parts of India is reported as low as 0.74 to as high as 13.5%.\textsuperscript{1,2,16-18}

Among all cases, males are seen to be affected mostly (80.2%) with an M: F ratio of 4:1. Male predominance in sudden natural deaths was observed in many other similar studies from India and around the globe.\textsuperscript{2,7,15,18-22} The majority of the deaths were observed among married males and from urban areas. A recent study reported marriage dissatisfaction as a significant risk factor of sudden cardiac deaths among males.\textsuperscript{23} Urbanization as a factor of cardiovascular mortality was reported in a study from Brazil.\textsuperscript{24} This might be due to an increasingly sedentary and stressful urban lifestyle.

Maximum cases of sudden death in both sexes were in the 31 to 40 years age group followed by 41-50 years. Several studies reported a higher incidence of sudden natural deaths among young adults in the 30-50 years age zone.\textsuperscript{1,2,18,22,25}

Most cases were reported in average BMI persons (62.96%), followed by obsessed persons. A similar finding was observed in the study of Tyagi et al.\textsuperscript{26} According to the present study, most cases were brought dead to the hospital (53.91%) followed by death at home (28.81%). The majority of occurrence of sudden natural deaths outside the hospital setting was concordant with a review.\textsuperscript{27}

The majority of the sudden natural deaths in the present study was related to the cardiovascular system (45.27%). Various studies reported cardiac origin as the most common cause of sudden deaths in both genders, specifically among the adult male population.\textsuperscript{19,20,22,28,29} Chronic coronary artery disease was found to be the most reported cardio-vascular ailment (34.16%). The finding is in agreement with some other studies.\textsuperscript{2,19,22,25}

Several studies\textsuperscript{2,20,22,28,30} reported respiratory system ailments as the second prevalent cause of sudden death; however, in the present study, gastrointestinal system problems, particularly chronic liver diseases (13.58%), were reported second most cause of death. Pneumonia was the most common respiratory cause (11.11%). The cause of death in the only child below ten years old is pneumonia. Pneumonia is considered the prime cause of death among children below five years, accounting for almost 16% of child deaths.\textsuperscript{31}

**CONCLUSION**

The present study reveals that cardiac causes are the most common cause of sudden natural death among the adult population in the study site. Increased frequency of sudden deaths among urban, married and adult male populations might be due to sedentary lifestyles in urban areas and increased stress among married individuals due to workload and family responsibilities, indicating a physical and mental disequilibrium in modern times resulting in this type of unexpected deaths. A thorough postmortem and histopathological examination can solve most of the doubts arising from sudden death among the common population.
**Conflict of interest**: No conflict of interest is associated with this work.

**Contribution of authors:**

1. The article is original with the author and does not infringe any copyright or violate any other right of any third party.

2. The article has not been published (whole or in part) elsewhere and is not being considered for publication elsewhere in any form, except as provided herein.

3. All authors have contributed sufficiently in the article to take public responsibility for it and

4. All authors have reviewed the final version of the above manuscript and approved it for publication.

**Ethical clearance**: Taken.

**REFERENCES**

1. Khetre RR, Batra AK, Shrigiriwar MB, Kuchewar S V, Jambure MP. A prospective autopsy based study of sudden natural non-traumatic deaths in a rural district. Int J Recent Trends Sci Technol. 2014;12(2):243–6.

2. Chaudhari SH, Mugadlimath A, Sane M, Zine KU, Ingale DI, Hiremath R. STUDY OF SUDDEN NATURAL DEATHS IN MEDICOLEGAL AUTOPSIES WITH SPECIAL REFERENCE TO CARDIAC CAUSES. Int J Curr Res Rev. 2013 Feb;5(3):37–42.

3. Nandy A. Principles of Forensic Medicine including Toxicology. 3rd ed. Kolkata: New Central Book Agency (P) Ltd; 2010. 226 p.

4. ICD-10 Version:2019 [Internet]. [cited 2021 Jun 4]. Available from: https://icd.who.int/browse10/2019/en#/R96

5. Vij K. Textbook of Forensic Medicine & Toxicology: Principles & Practice. New Delhi: Reed Elsevier India Private Limited; 2014. 97 p.

6. Ozdemir B, Celbis O, Onal R, Mizrak B, Karakoc Y. Investigation Multiple Organ Pathologies Underlying in Sudden Natural Deaths. Med Sci. 2012 Mar 1;1(1):13–26.

7. Ugiagbe E, Ugiagbe R. CAUSES OF SUDDEN NATURAL DEATH: A MEDICOLEGAL AUTOPSY STUDY OF MEDICAL CASES IN AN AFRICAN REFERRAL CENTRE. East Afr Med J. 2012;89(10):332–8.

8. Mehra R. Global public health problem of sudden cardiac death. J Electrocardiol. 2007 Nov;40(6 SUPPL. 1).

9. CAUSES OF DEATH IN INDIA. 2004.

10. Rao BH. Global burden of Sudden Cardiac Death and insights from India. Indian Heart J. 2014;66(SUPPL. 1):S18.
11. Prakash A, Saxena A. Health in northeast region of India – The new focus of attention. Indian J Med Spec. 2016 Jul;7(3):93–4.

12. Menezes RG, Monteiro FN. Forensic Autopsy. 2020 Sep 10;

13. Sheppard M, Davies MJ. Investigation of sudden cardiac death. In: Practical cardiovascular Pathology. Arnold. London; 1998. p. 191–204.

14. Pandian JR, Laishram RS, Deepak Kumar L, Phuritsabam P, Debnath K. Autopsy review of sudden deaths in a tertiary hospital of northeastern India. JMS - J Med Soc. 2014 Sep 1;28(3):145–8.

15. Raoof AM, Meera T, Ph M, Saini A, Student P, Professor A. Sudden natural deaths in medicolegal autopsies in Imphal. Indian J Forensic Community Med. 2021 Jan 15;4(4):232.

16. Mehdi HK, Raju K, Raghuveer C. A Five Year Analysis of Sudden Death Cases at A Tertiary Care Hospital in South India – A Postmortem Study. J Clin DIAGNOSTIC Res. 2018;

17. Ashwinikumar S, Madhusudan P, Ajay G, Praveen A, Sandesh D. Autopsy profile of natural causes of sudden deaths and survival time. International J. of Healthcare and Biomedical Research. 2015.

18. Zanjad NP, Nanadkar SD. Study of sudden unexpected deaths in Medicolegal autopsies. J Indian Acad Forensic Med. 2006;28:27–30.

19. Särkioja T, Hirvonen J. Causes of sudden unexpected deaths in young and middle-aged persons. Forensic Sci Int. 1984;24(4):247–61.

20. Azmak AD. Sudden natural deaths in Edirne, Turkey, from 1984 to 2005. Vol. 47, Medicine, Science and the Law. Barnsbury Publishing; 2007. p. 147–55.

21. Akinwusi PO, Komolafe AO, Olayemi OO, Adeomi AA. Pattern of sudden death at Ladoke Akintola University of technology teaching hospital, Osogbo, South-West Nigeria. Vasc Health Risk Manag. 2013;9(1):333–9.

22. Choukimath DSM, Naik DMM. Causes of sudden death - autopsy review in a tertiary referral center. Trop J Pathol Microbiol. 2020 Dec 31;6(8):481–5.

23. Isiozor NM, Kunutsor SK, Laukkanen T, Kauhanen J, Laukkanen JA. Marriage Dissatisfaction and the Risk of Sudden Cardiac Death Among Men. Am J Cardiol. 2019 Jan;123(1):7–11.

24. Armstrong A da C, Ladera AMT, Marques J, Armstrong DMF de O, Silva AML da, Morais Junior JC de, et al. Urbanization is Associated with Increased Trends in Cardiovascular Mortality Among Indigenous Populations: the PAI Study. Arq Bras Cardiol. 2018;

25. Gupta S, Panchal R, Sondarva D. An Approach to Sudden Natural Deaths in Medicolegal Autopsies at Karamsad, Gujarat-Indian Journals. J Indian Acad Forensic Med. 2011;33(1):30–2.

26. Tyagi S, Sukhadeve RB, Pathak H. Autopsy Findings in Sudden Cardiac Deaths:
27. Pelemo OE, Sabageh D, Komolafe AO, Sabageh AO, Odesanmi WO. An autopsy review of sudden unexpected natural deaths in a suburban Nigerian population. Popul Health Metr. 2014 Oct 4;12(1):1–6.

28. Para R, Halmandge V. An Autopsy Study of Sudden Death Cases in a Tertiary Care Hospital. Indian J Forensic Med Pathol. 2017;10(3):215–9.

29. Belay M, Padubidri JR, Shetty P, Shetty BSK, D'souza HL, Jibril I, et al. Autopsy Profile of Sudden Natural Death in a Tertiary Care Center: A Retrospective Analysis. Indian J Forensic Med Toxicol. 2019;13(4):251.

30. Herath J, Liu O. Sudden Natural Deaths in Ontario, Canada: A Retrospective Autopsy Analysis (2012-2016). J Forensic Sci Med. 2020 Jan 1;6(1):18–26.

31. Child Health Care | Health & Family Welfare | Government Of Assam, India [Internet]. [cited 2021 Jul 3]. Available from: https://hfw.assam.gov.in/portlets/child-health-care