Research Article

# Six-year analysis of postmortem examination records at a teaching hospital – demographic profile and causes of deaths

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Received February 07, 2016. Accepted February 18, 2016

**Abstract**

**Background:** Medicolegal postmortem examinations are performed as mandatory legal procedures for establishing the cause of death for people dying in circumstances where multiple causes of death could be ascribed.

**Objective:** To conduct complete-enumeration analysis of demographic details and causes of death from postmortem examination records at a municipal teaching hospital in Thane city, Maharashtra state, India.

**Materials and Methods:** Data recorded on the postmortem records from Jan 1, 2009 to Dec 31, 2014 (6 years) were analyzed.

**Result:** Of the 3,137 cases analyzed, 27.41% were females (mean age=32.95 years; SD = 20.43 years; and 72.59% were males (mean age = 37.42 years; SD = 16.78 years). The identity of 11.16% of the deceased could not be established. Major causes of death were trauma (27.26%), asphyxia and hanging (15.3%), coronary artery disease (11.59%), tuberculosis (11.04%), alcoholic liver disease (6.41%), lower respiratory tract infections (6.64%), and drowning (6.18%). Opinion about the cause of death was reserved and the viscera preserved for 30.41% cases and 41% infant deaths. The difference in proportion of deaths due to electrocution in various areas of Thane city was significant ($p$ = 0.00005; OR = 0.327).

**Conclusion:** Trauma, infectious and life-style diseases, and obstetric causes (postpartum haemorrhage and ruptured ectopic gestation) were major causes of deaths. Infant deaths occurred due to completely avoidable drowning and electrocution. A high percentage of postmortem examinations needed laboratory confirmation for establishing the cause of death.

**KEY WORDS:** Autopsy, demography, cause of death

## Introduction

Analyzing the ultimate, underlying and contributing causes of death is mandatory under Section 10(3) and 30 of the Birth and Death Registration Act, 1969.[1] In a substantial number of cases, the cause of death cannot be easily ascertained by the attending medical practitioner. This requires a special inquest into the cause of death. Medicolegal postmortem examinations are performed under the Section 174 of the Criminal Procedure Code, 1973[2] for establishing the cause of death in cases where persons die in possible unnatural circumstances.

Autopsy (also known as postmortem examination or necropsy) is performed to – (1) determine the identity of the deceased, when not known; (2) ascertain the time since death and the cause of death; and (3) find out whether the cause of death was natural or unnatural and if unnatural, whether it was homicidal, suicidal, or accidental.[3]

A "medicolegal" postmortem examination is performed when ordered by a legal authority responsible for the investigation of sudden, suspicious, obscure, unnatural, litigious, or criminal deaths.[3] These medicolegal autopsies do not require the consent of relatives of the deceased. A "clinical" or "academic" autopsy is carried out to reveal the medical cause

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| DOI: 10.5455/ijmsph.2016.07022016390 | |

of death in cases of unknown or uncertain death with the primary objective of determining the cause of death, antemortem health status and appropriateness of antemortem diagnosis and treatment.[3] Autopsies are also performed to ascertain whether deaths were due to iatrogenic errors. When autopsies are carried out for academic reasons, consent of relatives of the deceased is required. Causes of death ascertained by postmortem examination are a subset of the total number of deaths registered in an area.

This study aims to describe the demographic profile and analyzes the causes of deaths certified after postmortem examinations, in order to facilitate improved and more reliable certification of the cause of death.

## Materials and Methods

This study is a complete enumeration record-based analysis of data recorded from January 1, 2009 to December 31, 2014 (6 years) in the postmortem registers of the Forensic Medicine and Toxicology Department of a municipal medical college in Kalwa, Thane, located about 30 km from Mumbai city in the state of Maharashtra in Western India.

After obtaining permissions from the Institutional Ethics Committee (IEC) and institutional authorities for conducting the study, a total of 3137 postmortem examinations conducted during a 6-year period (January 1, 2009 to December 31, 2014) were analyzed for demographic details (age, gender, religion, place of residence), medicolegal categorization and cause of death.

The Kalwa creek is a natural geographical barrier that divides Thane Municipal Corporation area into Thane City and outlying areas of Kalwa, Mumbra, and Diwa (KMD). This natural division was also used for analyzing the geographical distribution in this study.

Diagnoses provided by postmortem examination were categorized.[4] The cause of death selected for categorization was the underlying cause of death agreed upon at the Sixth Decennial International Revision Conference.[5] The underlying cause of death was selected in accordance with recommended procedure.[4]

### Statistical Analysis

Categorical data were presented as frequencies and continuous data as mean and standard deviation (SD). Significance of difference in parameters was calculated by Karl Pearson's $\chi^2$-test at 95% confidence interval ($p < 0.05$). EpiInfo Version 7.0 (public domain software package from Centers for Disease Control and Prevention, Atlanta, GA, USA) was used for calculating the $\chi^2$-test (with Yates' correction where applicable) and odds ratio (OR).

## Result

The mean number of postmortem examinations conducted during the 6-year period of study (January 1, 2009 to December 31, 2014) was 523 per year with a SD of 67.87. The solitary postmortem case excluded from study was that of a 32-year-old Hindu, phenotypically a true hermaphrodite, resident of Kalwa, who had died due to pulmonary tuberculosis. This case was excluded from analysis due to lack of confirmation of gender by genotypic studies.

Of the 3137 postmortem examination records analyzed, 27.41% were females (mean age = 32.95 years; SD = 20.43 years) and 72.59% were males (mean age = 37.42 years; SD = 16.78 years). 80.3% cases were from the working-age population (15–60 years of age). Age, religion, and place of residence could not be determined in 350 (11.16%) cases whereas the religion and age could not be ascertained in 337 (10.74%) and 11 (0.35%) cases, respectively [Table 1].

Major causes of death were trauma (27.26%; Table 2 and Figure 1), asphyxia and hanging (15.3%), coronary artery disease (11.59%), tuberculosis (11.04%), alcoholic liver disease (6.41%), lower respiratory tract infections (6.64%; Table 2 and Figure 2), and drowning (6.18%). Other causes of death included septicaemia, peritonitis, malaria, jaundice, and pulmonary thromboembolism [Table 2]. Obstetric or gynecological causes accounted for 2.21% deaths in females [Table 2 and Figure 3].

The immediate cause of death was mentioned as "shock and haemorrhage" in 310 (9.88%) of the analysed autopsy records. The contributing cause of death was not mentioned in 2,967 (94.58%) cases. The contributing cause of death was alcoholic liver disease in 33 (0.9%) cases and trauma in 85 (2.74%) cases. All the five persons who died of firearm injuries were aged between 25-45 years. Opinion about the cause of death was reserved and the viscera preserved for 954 (30.41%) cases and 41% of infant deaths [Table 3]. There was significant ($p = 0.00005$; OR = 0.327) difference in proportion of deaths due to electrocution in various areas of Thane city [Table 4].

## Discussion

In this study, the annual number of postmortem examinations revealed an increasing trend from 2009 to 2014. Females were substantially fewer than males in the adult age categories [Table 4] but the gender difference was not significant ($p = 0.707$; OR = 1.73). Majority of the cases were Hindus followed by Muslims and then by other minority religions. The gender difference in the religion-based distribution was highly significant [Table 4]. The religion of 337 (10.74%) postmortem subjects could not be determined. The proportion of deaths due to trauma was significantly higher ($p = 0.0007$; OR = 1.47) in males (29.16%) as compared to that in females (21.83%). Deaths due to alcoholic liver disease were higher in males (7.86%) than in females (2.29%) with a highly significant ($p = 0.000006$; OR = 3.64) gender difference. Coronary heart disease was reported as the cause of death in 12.32% males and 9.5% females but the gender difference was not significant ($p = 0.071$; OR=1.33). Pulmonary tuberculosis was reported as the cause of death in 10.96% males and 11.26% females. Deaths due to drowning were significantly

higher among males ($p$ = 0.001; OR = 2.236) but the difference in geographical distribution was not significant ($p$ = 0.137; OR = 1.30). Of the total deaths due to drowning, infants and children aged 1–5 years comprised 4.4% and 7.40%, respectively. The gender difference in deaths due to electrocution was not significant ($p$ = 0.124; OR = 1.63). The cause of death could not be established in 41% infants. Of the infants subjected to autopsy, 45% belonged to KMD area. In all the areas, the gender difference among infant deaths was not significant. Lower respiratory tract infections (15%), still births (10%), drowning (6%), head injuries (6%) were leading causes of infant deaths. Non-viable fetus/abortus (7%) was a major cause of perinatal mortality. There were 19 maternal deaths.

Unnatural deaths and medicolegal autopsies also showed an increasing trend. In an Indonesian study, though the number of unnatural deaths showed a decreasing trend, the number of medicolegal autopsies increased over the study period (2007–2011).[6] Children below 5 years constituted 180 (5.74%) of the total postmortem examinations whereas they constitute 10.7% of the total Indian population.[7] This could be due to the fact that major causes of death in that age group would have been certified without requiring a postmortem examination. 151 (4.81%) of the postmortem examinations were performed on senior citizens (65 years and above) while they comprise 4.8% of the Indian population.[7] This could be due to the fact that the fraction of the population brought for postmortem examination and the deaths certified would be comparable. Working-age population (15–64 years) constitutes 59.5% of the Indian population[7] while those belonging to the same age group brought for postmortem examination in this study constituted 85.08% of the total cases. This could be due to the fact that trauma, asphyxia, and drowning were major causes of death [Table 2] which required postmortem examination to confirm diagnosis and refute any other cause. The relatively higher number of female subjects among infants and neonates suggests a higher infant and perinatal mortality, as compared to males. It is also possible that if dubious circumstances of death are suspected, medical practitioners may refrain from certifying the death of a female infant and ask for a postmortem examination. The numbers of male and female subjects in the 1–15 year age group were comparable [Table 1]. The proportion of deceased with undetermined religion was significantly higher among males probably because as compared to males, more females wear identifiable symbols of religion and religious circumcision is a norm among Muslims and Jews only. Majority of the cases are from KMD area due to the jurisdiction of local police station, proximity of the tertiary care teaching hospital to these places and availability of expertise for conducting autopsies.

Opinion about the cause of death was reserved and the viscera preserved for 954 (30.41%) cases. In a cohort analysis of 400 consecutive perinatal and infant postmortem examinations in Wales, UK, the cause of death was disclosed only in 18% cases.[8] Trauma, a leading cause of death, is often obscure on external inspection of the body and is revealed only by a postmortem examination. The number of deaths due to trauma increased gradually with age to peak between 15 and 30 years and then gradually decreased as age increased. Similar findings were reported in a study conducted in Manipal, South India.[9] As bread winners in the family, more males venture out of their houses as compared to females and consequently, males are more at risk for trauma. In this study, firearm injuries comprised 0.84% while a Bangkok-based study[10] reported firearm injuries in 2.09% of all autopsy cases. Alcoholic liver disease was also another leading cause of death confirmed by postmortem examination. Alcohol consumption has been incriminated in more than one-fifth of traumatic brain injuries [11] and 60% of all injuries[12] and is associated with intentional self-harm.[13] In both sexes, frequent and heavy drinking was associated with 8 or less years of formal education and income below the 75th percentile.[14] The youngest subject dying of acute myocardial infarction was a 26-year old female and there were three persons aged less than 30 years of age. The deaths due to coronary artery disease increased with age, peaking between 50 and 60 years. Harveit [15] has emphasized that the changing spectrum of diseases in aging populations should be recognized and that deaths due to coronary artery disease have remained unchanged. Ischaemic heart disease accounted for 63% of sudden adult deaths in an Irish hospital and this rate remained constant over one decade.[16] Acute myocardial infarction constituted 63% of all natural deaths in rural Australia in a 7-year study.[17] In this study, the gender difference in deaths due to pulmonary tuberculosis was not statistically significant ($p$ = 0.840; OR = 0.969) and only one person (female) had died due to extra-pulmonary tuberculosis. In a Croatian hospital, clinically undiagnosed active tuberculosis was diagnosed on autopsy in 33 subjects (54%), of which 70% were male.[18] In a meta-analysis, about one-third of death certificates were found to be erroneous and about half of the autopsies revealed findings that were not clinically suspected when the subjects were alive.[19] The proportion of deaths due to electrocution in KMD area was significantly higher than that in other areas ($p$ = 0.00005; OR = 0.327). This could be ascribed to inadequate domestic electrical safety in these areas. Postpartum hemorrhage (52.63%) and ruptured ectopic gestation (15.79%) were major causes of maternal deaths. Shock due to hemorrhage was the immediate cause of death in both these conditions. In a Ghana-based study, 12.1% of all female deaths were due to pregnancy-related causes with hemorrhage, abortion, and hypertensive disorders as major causes of death.[20] In this study, the contributing cause of death was not mentioned in 94.58% of postmortem reports. Ravakhah[21] has reported inconsistencies in the causes of death mentioned in the death certificates and those determined by autopsies and have stated that death certificate-based vital statistics ought to be rectified in the light of autopsy findings. A systematic review[22] reported that autopsies enable detection of diagnostic errors; however, deaths due to iatrogenic errors are seldom investigated and thus corrective measures are not taken to prevent repetition of errors.

**Table 1:** Demographic profile (*n* = 3,137)

| Parameter | | Males (*n* = 2277) | Females (*n* = 860) | Percent (*n* = 3137) |
|---|---|---|---|---|
| Age group (years) | 0–1 | 48 | 52 | 3.19 |
| | 1–15 | 120 | 106 | 7.20 |
| | 15–60 | 1,917 | 602 | 80.30 |
| | 60+ | 183 | 98 | 8.96 |
| | Unknown | 9 | 2 | 0.35 |
| Religion | Hindu | 1620 | 633 | 71.82 |
| | Muslim | 361 | 166 | 16.80 |
| | Christian | 8 | 6 | 0.45 |
| | Jain | 2 | 0 | 0.06 |
| | Sikh | 2 | 2 | 0.13 |
| | Unknown | 284 | 53 | 10.74 |
| Place of residence | Thane City | 223 | 78 | 9.60 |
| | KMD | 1091 | 455 | 49.28 |
| | Neighboring corporations | 538 | 233 | 24.58 |
| | Thane district (rural + tribal) | 64 | 31 | 3.03 |
| | Rest of Maharashtra | 27 | 5 | 1.02 |
| | Rest of India | 37 | 5 | 1.34 |
| | Unknown | 297 | 53 | 11.16 |

KMD = Kalwa, Mumbra, Diva area.

**Table 2:** Major causes of death (*n* = 2183)

| Major cause of death | Males (*n* = 1615) | Females (*n* = 568) | Percent (*n* = 2183) |
|---|---|---|---|
| Asphyxia due to hanging | 191 | 106 | 13.61 |
| Other asphyxial deaths | 15 | 22 | 1.69 |
| Tuberculosis | 177 | 64 | 11.04 |
| Trauma | 471 | 124 | 27.26 |
| Coronary heart disease | 199 | 54 | 11.59 |
| Drowning | 116 | 19 | 6.18 |
| Pneumonia | 71 | 33 | 4.76 |
| LRTI other than pneumonia | 21 | 20 | 1.88 |
| Alcoholic liver disease | 127 | 13 | 6.41 |
| Electrocution | 55 | 12 | 3.07 |
| Intracranial hemorrhage | 62 | 14 | 3.48 |
| Burns | 12 | 11 | 1.05 |
| Other causes | 98 | 76 | 7.97 |

LRTI, Lower respiratory tract infection.

**Table 3:** Analysis of infant and foetal deaths (*n* = 100)

| Causes of death | Males (*n* = 48) | Females (*n* = 52) | Total (*n* = 100) |
|---|---|---|---|
| ARDS | 1 | 1 | 2 |
| Foetal distress | 1 | 0 | 1 |
| LRTI | 5 | 10 | 15 |
| Drowning | 4 | 2 | 6 |
| Electrocution | 1 | 0 | 1 |
| Head Injury | 1 | 5 | 6 |
| Decomposed newborn | 1 | 0 | 1 |
| Non-viable fetus/abortus | 5 | 2 | 7 |
| ORVP | 22 | 19 | 41 |
| Others | 2 | 3 | 5 |
| Still birth | 4 | 6 | 10 |
| Asphyxia – aspiration/choking | 0 | 4 | 4 |
| Iatrogenic | 1 | 0 | 1 |

ARDS, Acute respiratory distress syndrome; LRTI, lower respiratory tract infection; ORVP, opinion reserved, viscera preserved (for chemical analysis).

**Table 4:** Statistical significance of various parameters

| Parameters | | Number | $\chi^2$-test value * | *p*-Value | Odds ratio |
|---|---|---|---|---|---|
| Religion | Male | 1943 | 40.97 | 0.00000014 # | 0.38 |
| | Female | 807 | | | |
| Age | Male | 2268 | 0.121 | 0.727 | 0.584 |
| | Female | 858 | | | |
| Pulmonary tuberculosis | Male | 177 | 0.041 | 0.840 | 0.969 |
| | Female | 64 | | | |
| Alcoholic liver disease | Male | 127 | 21.76 | 0.000006# | 3.64 |
| | Female | 13 | | | |
| Trauma | Male | 471 | 11.39 | 0.0007# | 1.47 |
| | Female | 124 | | | |
| Coronary heart disease | Male | 199 | 3.249 | 0.071 | 1.33 |
| | Female | 54 | | | |
| Drowning | Male | 116 | 10.666 | 0.001# | 2.236 |
| | Female | 19 | | | |
| | Other areas | 77 | 1.23 | 0.266 | 1.24 |
| | KMD | 58 | | | |
| Electrocution | Male | 55 | 2.361 | 0.124 | 1.63 |
| | Female | 12 | | | |
| | Other areas | 18 | 16.52 | 0.00005# | 0.327 |
| | KMD | 49 | | | |

*$\chi^2$-test with Yate's correction where applicable; # *p*-value significant; KMD, Kalwa, Mumbra, Diva areas.

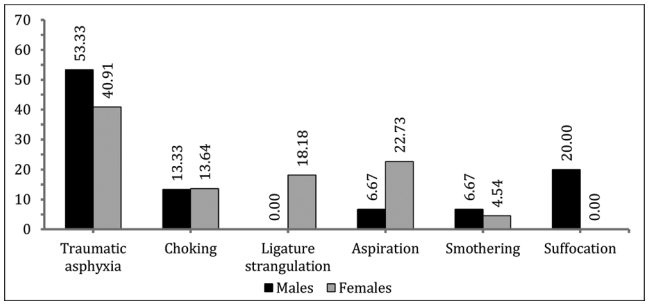



**Figure 1:** Percentage distribution of asphyxial deaths [other than hanging] in males (*n* = 15) and females (*n* = 22).

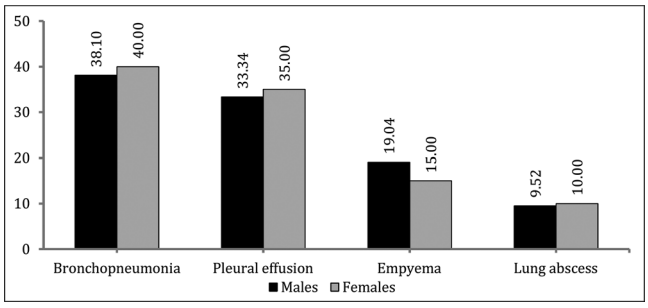
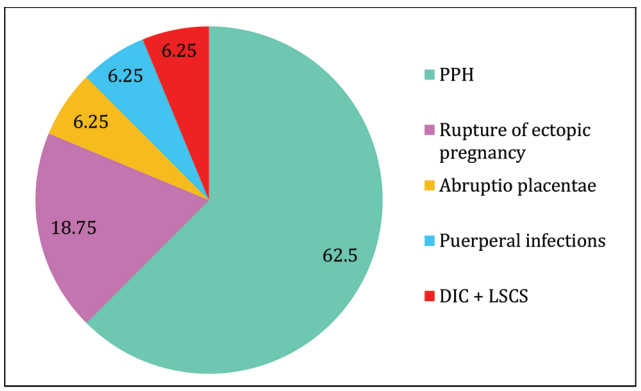



**Figure 2:** Percentage distribution of deaths due to lower respiratory tract infection [other than pneumonia] in males (*n* = 21) and females (*n* = 20).




PPH, Postpartum hemorrhage; DIC, disseminated intravascular coagulation; LSCS, lower segment cesarean section.

**Figure 3:** Percentage distribution of causes of maternal deaths (*n* = 19).

The strength of this record-based complete-enumeration study is that it portrays the profile of subjects in postmortem examinations, which is a specific subset of the mortality picture of the general urban population at large. The limitation of this study is that it lacks analysis of incidental factors leading to the underlying causes of deaths, owing to its record-based design.

## Conclusion

Though the identity of nearly one-tenth of the deceased could not be established, the postmortem subjects were

predominantly males; most were aged between 15 and 60 years. Major causes of death were trauma, asphyxia and hanging, coronary artery disease, tuberculosis, alcoholic liver disease, lower respiratory tract infections, and drowning. Postpartum hemorrhage and ruptured ectopic gestation were major causes of maternal deaths. Infant deaths occurred due to completely avoidable drowning and electrocution. A high percentage of postmortem examinations needed laboratory confirmation for establishing the cause of death. The contributing cause of death was not mentioned in considerable number of postmortem reports.

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**How to cite this article:** Kartikeyan S, Malgaonkar AA, Ghadge M. Six-year analysis of postmortem examination records at a teaching hospital – demographic profile and causes of deaths. Int J Med Sci Public Health 2016;5:1905-1910

**Source of Support:** Nil, **Conflict of Interest:** None declared.