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**Original Article**

# Pattern of Mechanical Asphyxia Deaths in Forensic Autopsies at Medicolegal Section of Liaquat University Hospital, Hyderabad

**Nadia Aslam[1], Ishrat Bibi[1], Muhammad Rafique Shaikh[2], Ummara Munir[3], Mobin Inam Pal[4] and Abdul Samad[1*]**

[1]Department of Forensic Medicine and Toxicology, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan
[2]Department of Forensic Medicine and Toxicology, Chandka Medical College, Shaheed Mohtarma Benazir Bhutto Medical University, Larkana, Pakistan
[3]Department of Forensic Medicine and Toxicology, Sheikh Zayed Medical College, Rahim Yar Khan, Pakistan
[4]Faisalabad Medical University, Faisalabad, Pakistan

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***Corresponding Author:***
Abdul Samad
Department of Forensic Medicine and Toxicology, Liaquat University of Medical and Health Sciences, Jamshoro, Pakistan
drmemonmpk1970@gmail.com

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## ABSTRACT

Asphyxia is characterized by oxygen deprivation in cells resulting from insufficient or altered oxygen supply. Mechanical asphyxia refers to inadequate breathing caused by external forces. This study assessed the pattern of mechanical asphyxia-related autopsies carried out at a medico-legal section of Liaquat University Hospital, Hyderabad. **Objective:** To assess the pattern of mechanical asphyxia-related autopsies carried out at a medico-legal section of a tertiary care teaching hospital. **Methods:** This retrospective observational study was performed to analyze the forensic autopsy reports from January 2021 to December 2022 at Liaquat University Hospital. Hyderabad and 103 medico-legal cases of mechanical asphyxia were enrolled. All autopsy reports related to mechanical asphyxia were included. The data were collected on a predesigned pro forma. Autopsies of non-medicolegal nature and related to unnatural deaths apart from mechanical asphyxia were excluded. **Results:** Most of the cases (n=51) were identified as caused by the drowning. The hanging and strangulation occurred in an equal number of mechanical asphyxia-related autopsies (n=26 each). The male gender dominated the frequency of drowning and strangulation while hanging was more prevalent in females. **Conclusions:** Drowning was observed as the most prevalent mechanism of mechanical asphyxia in medico-legal autopsies conducted over a period of two years.

"This is a correction to the original article. For information about the changes made, please see the major corrections linked as a supplemental file on the article's landing page. The information will also be available at 10.54393/pjhs.v7i3.4596, on 31st March, 2026."

## INTRODUCTION

Postmortem examination research of the corpse is crucial in determining the cause of death. In order to ascertain the cause of death, a medical professional will conduct an autopsy, which involves a thorough inspection of the body's internal and external organs and cavities [1]. Conducting a clinical autopsy with the goal of clinical investigation allows for the identification of the underlying cause of death and is a crucial tool for assessing healthcare quality [2]. On the other hand, the goal of a medi-colegal autopsy is to positively identify the corpse and determine the cause of death in relation to any possible criminal actions [1]. In order to gather data for population-level healthcare planning and use as evidence in court processes, both kinds of autopsy are essential. The autopsy can also provide light on whether the death was accidental, homicidal, or suicide-related [3]. There are many facets to medical practice, including dealing with legal issues. Claims for personal injuries, medical malpractice, criminal charges, and workers' compensation are only a few examples of the many situations in which legal matters could emerge [4]. The term "asphyxia" encompasses the state of cells lacking oxygen as well as any and all


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consequences of an insufficient or changed oxygen supply [5]. When the airways are blocked or compressed from the outside, a condition known as mechanical asphyxia develops. Drowning, hanging, or strangling are some of the ways this might occur [6]. Death occurs when the respiratory system is unable to take up enough oxygen and release enough carbon dioxide, a condition known as mechanical asphyxia [7]. Mechanical hypoxia typically results in mortality because critical organs, including the brain, do not receive enough oxygen [8]. The word "drowning" is used in forensic asphyxia to describe a person's demise due to submersion in water. Most of the time, water is used as the immersion liquid [8, 9]. When submerged in water, oxygen is less available for respiration. The terms "strangulation" and "hanging" describe the same thing: the application of external pressure with a lead bullet that seals up the airways or the blood vessels in the neck, which blocks the airways and causes death [7]. When looking into unexpected suspicious deaths, medi-colegal autopsies play an important and vital role. In order to make sense of regional mortality data attributed to non-natural causes, it is crucial to profile and appreciate the profile of cases that undergo medico-legal autopsy.

Based on region-specific mortality rates, this information also helps in addressing demographic requirements. It is also crucial for studying local crime rates and avoiding needless fatalities in the future [10]. Legal and medical experts in Pakistan have documented instances of causes of death other than natural causes, such as gunshot wounds, but mechanical asphyxiation has gotten less research and attention. Studies from Peshawar have documented asphyxial deaths [11], and similar research from other regions of Pakistan is needed to understand the national pattern of these deaths. Therefore, the current study aimed to report the two-year frequency of mechanical asphyxia deaths in the medico-legal department of Liaquat University Hospital Hyderabad.

## METHODS

This study was approved by the Institutional Review Board of Liaquat University of Medical and Health Sciences (Ref. No. LUMHS/FM/68/20 dated 10-11-2020). Informed consent was waived as this was a retrospective record-based study. Data were anonymized before analysis to maintain confidentiality. All procedures were conducted in accordance with the ethical standards of the institutional research committee and with the Helsinki Declaration. The study included the autopsies related to mechanical asphyxia. Deaths due to mechanical asphyxia were categorized as follows: drowning (submersion in liquid resulting in respiratory impairment, diagnosed by presence of froth, water in lungs, and diatom test when performed), hanging (compression of neck by a ligature tightened by the weight of the body), and strangulation (compression of neck by external force other than hanging, including manual or ligature strangulation). All cases were classified based on autopsy findings by qualified forensic pathologists. Autopsies of non-medicolegal nature and related to unnatural deaths apart from mechanical asphyxia were excluded. This retrospective study enrolled all cases of mechanical asphyxia deaths (n=103) that underwent medico-legal autopsy at Liaquat University Hospital, Hyderabad, from January 2021 to December 2022. Sample size adequacy was determined using the precision-based formula $n = [Z^2 \times p \times (1-p)] / E^2$ with Z=1.96 (95% confidence), p=0.50 (expected drowning prevalence from previous studies [11,13]), and E=0.10 (10% margin of error). The calculation yielded a minimum of 97 cases ($n = [(1.96)^2 \times 0.50 \times 0.50] / (0.10)^2 = 96.04 \approx 97$), and our study exceeded this with 103 cases, ensuring adequate precision for estimating the prevalence of mechanical asphyxia mechanisms within ±10% at a 95% confidence level. A structured proforma was designed to extract data from autopsy reports, including: demographic details (age, gender), cause of death (drowning, hanging, strangulation), date of autopsy, and circumstances of death when available. Two independent reviewers extracted data from each autopsy report, and discrepancies were resolved by consultation with a senior forensic pathologist. All autopsy reports with complete documentation during the study period were included. The data that support the findings of this study are available from the corresponding author upon reasonable request. However, restrictions may apply due to the sensitive nature of forensic autopsy records and privacy regulation.

Data were analyzed using IBM SPSS Statistics for Windows, version 24.0. Descriptive statistics were calculated as frequencies and percentages for categorical variables. Mean and standard deviation were calculated for age. Chi-square test was used to compare gender differences across the three categories of mechanical asphyxia. A p-value of $<0.05$ was considered statistically significant.

## RESULTS

The predominant portion of the autopsies revealed drowning as the primary cause of death across both years under review. Notably, hanging and strangulation emerged as equally prevalent factors contributing to mechanical asphyxia, with each identified in 26 autopsies. Moreover, it is noteworthy that March exhibited the highest frequency of mechanical asphyxia-related autopsies (n=13, 12.62%), while December recorded the lowest number (n=2, 1.94%). This seasonal variation may be attributed to increased water-related activities during warmer months leading to more drowning cases, as well as potential psychosocial factors. Similar seasonal patterns have been reported in


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other studies of such cases, suggesting potential fluctuations in risk factors or external influences impacting mortality rates during this month. This comprehensive analysis underscores the significant burden of mechanical asphyxia-related fatalities within the studied population and highlights the need for targeted interventions and preventive measures to mitigate the associated risks and enhance public safety (Table 1).

**Table 1:** Month-Wise Frequency of Deaths due to Mechanical Asphyxia

| Month | Drowning | | Hanging | | Strangulation | | Total |
|---|---|---|---|---|---|---|---|
| | 2021 | 2022 | 2021 | 2022 | 2021 | 2022 | |
| **January** | 0 | 1 | 3 | 2 | 3 | 1 | 10 (9.7%) |
| **February** | 0 | 1 | 2 | 1 | 0 | 1 | 5 (4.85%) |
| **March** | 6 | 0 | 3 | 0 | 2 | 2 | 13 (12.62%) |
| **April** | 2 | 1 | 2 | 1 | 0 | 1 | 7 (6.79%) |
| **May** | 2 | 2 | 1 | 3 | 1 | 0 | 9 (8.73%) |
| **June** | 5 | 3 | 0 | 1 | 1 | 2 | 12 (11.65%) |
| **July** | 5 | 2 | 1 | 1 | 0 | 1 | 10 (9.7%) |
| **August** | 3 | 3 | 0 | 2 | 0 | 3 | 11 (10.67%) |
| **September** | 2 | 6 | 0 | 1 | 3 | 0 | 12 (11.65%) |
| **October** | 1 | 0 | 1 | 0 | 1 | 2 | 5 (4.85%) |
| **November** | 3 | 2 | 0 | 0 | 1 | 1 | 7 (6.79%) |
| **December** | 0 | 1 | 1 | 0 | 0 | 0 | 2 (1.94%) |
| **Total** | 29 | 22 | 14 | 12 | 12 | 14 | **103** |

As shown in figure 1, drowning was the most common mechanism, accounting for 51 cases (49.5%) of all mechanical asphyxia deaths. Hanging and strangulation each accounted for 26 cases (25.2%). Figure 2 presents the gender distribution across the three mechanisms. Drowning and strangulation were more common in males, while hanging was more common in females. However, statistical testing was not performed to determine the significance of these differences. Drowning n=51, Hanging n=26, Strangulation n=26), the gender distribution can be presented as follows. Among drowning cases, males accounted for 88.2% (n=45) and females for 11.8% (n=6). Among strangulation cases, males accounted for 84.6% (n=22) and females for 15.4% (n=4). Among hanging cases, males accounted for 34.6% (n=9) and females for 65.4% (n=17). The difference in distribution across genders was statistically significant ($\chi^2 = 24.18$, $p < 0.001$). These findings suggest gender-specific patterns that warrant further investigation.

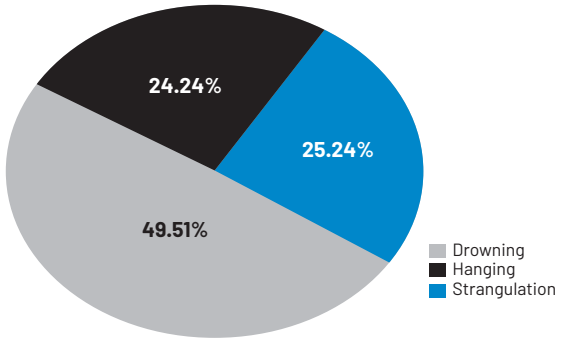



**Figure 1:** Proportion of Mechanical Asphyxia Cases by Mechanism

On the other hand, autopsy performed on males showed a lower frequency of hangings than on females, although the latter still had a considerable incidence (Figure 2). This gender-specific disparity in the manifestation of different modes of mechanical asphyxia underscores the importance of considering gender-sensitive approaches in designing preventive strategies and interventions aimed at reducing the incidence of such fatalities.

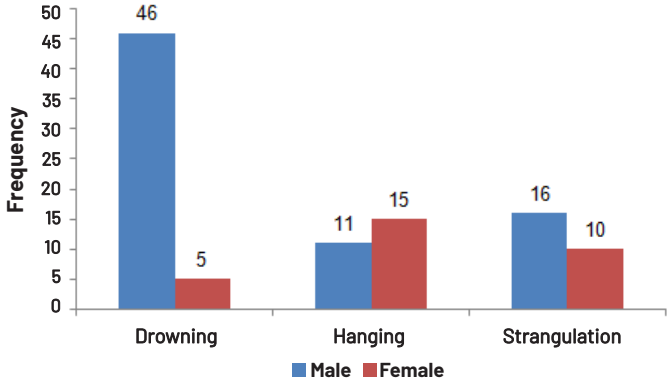



**Figure 2:** Gender Distribution across Different Causes of Mechanical Asphyxia

Drowning emerged as the predominant mechanism of mechanical asphyxia, disproportionately affecting young adult males (aged 19–40 years) from lower-middle socioeconomic backgrounds, with accidental circumstances accounting for nearly three-quarters of these cases. Hanging was overwhelmingly associated with suicidal intent and showed a female predominance, while strangulation was predominantly homicidal, primarily involving males. The geographical concentration of cases in Hyderabad and adjacent districts underscores the need for region-specific preventive strategies targeting water safety, mental health support, and violence prevention.

**Table 2:** Comprehensive Demographic and Clinical Characteristics

| Characteristic | Drowning (n=51) | Hanging (n=26) | Strangulation (n=26) | Total (n=103) |
|---|---|---|---|---|
| **Age Groups, n (%)** | | | | |
| ≤18 years | 4 (7.8%) | 3 (11.5%) | 3 (11.5%) | 10 (9.7%) |
| 19–40 years | 30 (58.8%) | 15 (57.7%) | 13 (50.0%) | 58 (56.3%) |


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| | | | | |
|---|---|---|---|---|
| 41–60 years | 14 (27.5%) | 6 (23.1%) | 8 (30.8%) | 28 (27.2%) |
| >60 years | 3 (5.9%) | 2 (7.7%) | 2 (7.7%) | 7 (6.8%) |
| Mean Age ± SD | 33.1 ± 13.2 | 30.8 ± 11.9 | 31.9 ± 12.5 | 32.4 ± 12.7 |
| **Gender, n (%)** | | | | |
| Male | 45 (88.2%) | 9 (34.6%) | 22 (84.6%) | 76 (73.8%) |
| Female | 6 (11.8%) | 17 (65.4%) | 4 (15.4%) | 27 (26.2%) |
| **Geographical Distribution, n (%)** | | | | |
| Hyderabad District | 22 (43.1%) | 10 (38.5%) | 9 (34.6%) | 41 (39.8%) |
| Matiari District | 8 (15.7%) | 5 (19.2%) | 5 (19.2%) | 18 (17.5%) |
| Tando Allahyar District | 8 (15.7%) | 4 (15.4%) | 3 (11.5%) | 15 (14.6%) |
| Tando Muhammad Khan District | 5 (9.8%) | 3 (11.5%) | 4 (15.4%) | 12 (11.7%) |
| Other Districts | 8 (15.7%) | 4 (15.4%) | 5 (19.2%) | 17 (16.5%) |
| **Circumstances of Death, n (%)** | | | | |
| Suicidal | 5 (9.8%) | 21 (80.8%) | 21 (80.8%)* | 47 (45.6%) |
| Accidental | 38 (74.5%) | 2 (7.7%) | 2 (7.7%) | 38 (36.9%) |
| Homicidal | 1 (2.0%) | 1 (3.8%) | 14 (53.8%) | 12 (11.7%) |
| Undetermined | 7 (13.7%) | 2 (7.7%) | 2 (7.7%) | 6 (5.8%) |
| **Socioeconomic Status, n (%)** | | | | |
| Low | 16 (31.4%) | 8 (30.8%) | 7 (26.9%) | 31 (30.1%) |
| Lower-Middle | 30 (58.8%) | 14 (53.8%) | 14 (53.8%) | 58 (56.3%) |
| Higher | 5 (9.8%) | 4 (15.4%) | 5 (19.2%) | 14 (13.6%) |

***Note:** For hanging and strangulation combined, suicidal circumstances were overrepresented due to the high proportion of suicidal hangings

## DISCUSSION

We found that asphyxial deaths were more common in males which is consistent with other studies from Pakistan [11,12], India [3], Germany [13] and Brazil [14].This may be accredited to certain factors such as the higher likelihood of males being the primary breadwinners and being exposed to accidents, violence, and stress. Additionally, males are more prone to addiction and risky behaviour [15]. The study also revealed that the asphyxial deaths occurred in adults, which is in line with previous studies. More adults died from suffocation than younger or older people, according to a three-year retrospective research [15] and a four-year prospective research [11]. One possible explanation is because adults are more likely to be involved in a wide range of activities, which leaves them more exposed to hazards [15]. This study found that drowning was the primary cause of fatality related to mechanical asphyxia. The act of strangulation or hanging was the second most common cause of death due to asphyxiation. There were ninety percent male participants who drowned. This finding is in line with global figures from the World Health Organization [16] and the Centers for Disease Control and Prevention drowning information page [17]. On the other hand, the present study looked at more girls being hanged than males. Other research have shown a larger frequency of hangings in autopsy for men compared to females [18, 19], however our result contradicts that. Additional research is needed to determine if these variations reflect regional disparities in hanging-caused asphyxia. In Azad Jammu and Kashmir, Mehmood et al., also found results that were comparable to those of the current study. In this study, there was an increased risk of fatal asphyxiation occurrences among men and young people (ages 19–49). According to forensic investigations, the leading cause of death from asphyxiation was drowning, although hanging was also a major factor in many cases. A study aimed at identifying the various forms of mechanical asphyxia found that hanging was the most common (61.91%), followed by drowning (33.33%) and strangulation (4.76%) in medico-legal autopsies [14]. In another study of 320 medico-legal autopsies, hanging was found as the mechanism of asphyxia in more than 75% of cases, while drowning and strangulation followed the frequency of hanging [21]. Nonetheless, strangling was shown to be the most prevalent mode of asphyxial fatalities in Peshawar, Pakistan, according to a four-year prospective analysis [11]. According to a study that looked back over 20 years of data on violent deaths, accidents, and suicides in Hamburg, Germany, the most common cause of asphyxia was drowning [22]. Similarly, drowning was ranked as the second most common cause of death in India, after only automobile accidents [23]. Another research in India found that drowning and hanging were the leading causes of asphyxial mortality as determined by postmortem results [24]. These findings suggest that patterns of asphyxial deaths may vary on a national and international scale. Drowning remains a challenging diagnosis in forensic pathology, and in some cases, the diagnosis may be presumptive based on circumstantial evidence and exclusion of other causes. Hanging and strangulation are differentiated based on the nature of the ligature mark, the presence of petechial hemorrhages, and other characteristic findings. All autopsies were performed by experienced forensic pathologists, and the diagnosis was based on standard forensic criteria. Our finding that drowning was the most prevalent mechanism of mechanical asphyxia is consistent with global data from WHO [16] but contrasts with studies from India where hanging was more common [24]. This difference may reflect regional variations in risk factors, such as the presence of water bodies, cultural practices, and socioeconomic factors. However, direct comparison is limited by methodological differences between studies. Further research using standardized criteria is needed to clarify these regional patterns.

This study has several limitations. First, the findings are derived from a single institution in Hyderabad, which may not represent the national pattern of mechanical asphyxia deaths. Second, the sample size of 103 cases over two


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years is relatively small, though it exceeded the minimum required for precision. Third, socioeconomic status was inferred from available records rather than directly assessed, which may not accurately reflect individual circumstances. Fourth, details regarding psychiatric history, substance use, and marital/relationship status, which could provide further insight into circumstances of death, were not systematically recorded in autopsy reports. Fifth, the study may be affected by selection bias, as not all autopsy cases may have been referred to this institution. Future multi-center studies with larger sample sizes, standardized data collection protocols, and comprehensive demographic and clinical variables are needed to confirm these findings and enhance their generalizability.

## CONCLUSIONS

Drowning was the most common mechanism of mechanical asphyxia, followed by hanging and strangulation. The majority of cases occurred among young adults, with males predominating in drowning and strangulation, while females were more frequently affected by hanging. These findings highlight the significant burden of mechanical asphyxia and emphasize the importance of effective preventive measures to reduce such fatalities.

## Authors Contribution

Conceptualization: NA
Methodology: NA, MIP
Formal analysis: IB
Writing-review and editing: MRS, AS

All authors have read and agreed to the published version of the manuscript.

## Conflicts of Interest

The authors declare no conflict of interest.

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