

# ESTIMATION OF TIME SINCE INJURY IN MECHANICAL TRAUMA: FORENSIC CHALLENGES AND ADVANCES FROM A CROSS-SECTIONAL STUDY AT LIAQUAT UNIVERSITY HOSPITAL, HYDERABAD

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## Abstract

### Objective

The objective of this study was to observe the prevalence and distribution of musculoskeletal (MSK) pain among clinical Physical therapists, considering the physically demanding nature of their profession.

### Methodology

A cross-sectional study design was employed, with participants selected through a non-probability convenient sampling technique. A total of 125 clinical physiotherapists, aged between 25 and 40 years, were recruited from government hospitals in Lahore. Physiotherapists with a surgical history involving the shoulder, knee, elbow, hip, or wrist were excluded. Data were collected using the Standard Nordic Musculoskeletal Questionnaire (NMQ) and analyzed using SPSS version 25.0. Categorical variables were presented as frequencies and percentages, while continuous data were expressed as mean  $\pm$  standard deviation (SD).

### Results

The results obtained from the NMQ demonstrated a high prevalence of musculoskeletal pain among clinical physiotherapists. The distribution of MSK disorders was as follows: Neck pain: 28.80%, Shoulder pain: 20.00%, Elbow pain: 1.60%, Wrist pain: 0.60%, Upper back pain: 2.40%, Lower back pain: 32.00%, Thigh pain: 0.80%, Knee pain: 11.20%, Foot pain: 2.40%.

### Conclusion

The findings of this study indicate a high prevalence of musculoskeletal pain among clinical physiotherapists in Lahore, with the most commonly affected regions being the neck, shoulders, and lower back. The results highlight the need for preventive measures and ergonomic interventions to minimize work-related musculoskeletal disorders among physiotherapists.

## INTRODUCTION

Estimating Time since Injury (TSI) is a central consideration in forensic medicine. This is particularly true when dealing with incidences involving mechanical trauma, such as assaults, accidents, or abuse [1]. When the age of an injury is more accurately established, this can assist investigators and/or judges in reconstructing a possible sequence of events, authenticate or reject

statements made by victims and offenders, and establish approximations of timelines, all of which is especially important in suspects appearing before the court. Similarly, accurate TSI estimation provides support for the legal system in determining culpability and intention of the perpetrator which is also an important consideration in matters of justice [2].

Mechanical injuries (abrasions, contusions, lacerations, incised wounds) appear to demonstrate different patterns of healing depending on the mechanism of force, the kind of weapon used, the anatomical region where the injury occurred, as well as the individual's physiological state [3]. Generally, forensic practitioners have relied on gross morphological changes as well as clinical features (e.g., color of bruising, and degree of scab formation) to approximate time of injury [4]. While these features are an expected learning resource, they remain primarily subjective and may lack reproducibility, due in part to variability in observation, environmental factors (e.g., presence of moisture), pre-existing medical conditions (e.g., fragile skin), and lack of standardised assessment or observational protocols [5].

By virtue of being a developing country, it is especially important for investigators that reliable, scientifically validated estimates of TSI be possible in Pakistan. Unfortunately, these expectations are rarely considered in the peculiar world of the law, where a report may or may not specifically mention such terms as "fresh" or "recent." The study aims to evaluate existing practices of estimating TSI at Liaquat University Hospital, Hyderabad, to identify the forensic and procedural challenges faced by medical officers, and to suggest evidence-based measures that enhance the accuracy of reports on medico-legal injuries and improve their consistency.

Over the past few decades, several studies have investigated several methods of assessing Time since Injury (TSI) for forensic cases. Some of the above methods produce varying levels of accuracy and reliability. Traditional methods rely heavily on clinical assessments of the characteristics of the wound, specifically looking at swelling, scab development, healing, and changes in color. For instance, Sandhu et al. (2009) noted substantial differences between observers involved in a clinical trial operated in North India that sought to associate wound characterization with age [6]. Ahmad et al. (2015) investigated the predictions of the age of injury in live medicolegal cases in Pakistan, updated during their findings noted them subjectively categorizing and inconsistent documentation often led to wounds being documented as 'fresh' or 'recent' [7]. With recent developments surrounding the research into molecular and histopathological methods, Li et al.

(2020) focused on the use of transcriptomics and proteomics methods for forensic pathology [8]. Tomassini et al. (2024), who identified sequence lymphatic and immunohistochemistry and immunofluorescence markers for dating skin lesions within a clinical setting [9]. Despite the recent literature showing positive developments, these techniques are, overall, excluded from numerous traditional medicolegal investigations, primarily as a result of a lack of funding, training, and support in developing countries, further demonstrating the need for continued methods for TSI that are more objective, consistent, and attainable in terms of evidence in a forensic or clinical setting.

### Methodology

This study is designed to assess retrospective, cross-sectional data at Liaquat University Hospital, Hyderabad. Data collection was from June 2023 to July 2024. 200 medico-legal cases with mechanical trauma were included in the study sample. The inclusion criteria included only mechanical injuries, e.g., abrasions, lacerations, contusions, and incised wounds. Any non-mechanical injuries, e.g., burns, poisoning, chemical exposures, and electrocution, were excluded from this study to keep the research specific. The research purpose was to assess how well Time since Injury (TSI) is estimated and record what documentation practices were seen in real-time medico-legal work.

Data were collected from medico-legal case (MLC) records and included details of the patient's age, sex, the nature of the injury sustained, type of weapon used, estimation of TSI, times of arrival at the medico-legal centre and examination, and a brief description of the injury itself. Once data were collected they were entered into Microsoft Excel and analysed using the Statistical package for the social sciences (SPSS, version 26). A set of descriptive statistics (including mean, median, standard deviation and range) were calculated, alongside independent samples t-tests, Mann-Whitney U tests and Pearson's and Spearman's correlation coefficients to evaluate relationships between variables. Ethical approval was obtained from the Institutional Review Board of Liaquat University of Medical & Health Sciences. All patients' data was anonymised, and patient data was secured, with access only to the team of researchers involved in the study,

and this was done to ensure confidentiality and compliance with ethical standards.

### Results

A total of medical legal cases of mechanical trauma were evaluated in the current study. When classifying cases by some record of time from occurrence, it was apparent there was significant inconsistency in the recording of this temporal factor. Of the 200 cases included in this analysis, 80 of the cases were simply identified as "fresh", 34 cases were identified as occurring "within 2 hours"; 7 cases were identified as occurring "within 3 hours"; 6 cases were noted as simply "2-3 hours"; and 8 cases were described as having occurred "in the last 4-5 hours". The remaining 65 cases were categorized as having unclear or ambiguous classifications, including general terms like "recent" and "undefined." This variation in terminology across cases suggests considerable irregularity in the medico-legal documentation of the temporality of injury.

The assessment of the time period from patient arrival to the time of medico-legal examination showed large

inconsistency, for example, the average time from patient arrival to the time of medico-legal examination was 224.3 minutes, but it had a huge standard deviation of 20,388.7 minutes. The lowest recorded value was -175,680 minutes and the highest was 220,326 minutes. The median was 0 minutes which speaks to the inconsistency with time recording. Overall, these observations imply there could have been clerical/data entry errors that may be inhibiting the reliability of medico-legal reporting. The observations noted only partial compliance with the Injured Person (Medical Aid) Act 2004 as there were repeated instances whereby there were excessive time delays in delivering first aid or executing the medico-legal documentation. There are considerable concerns over compliance with emergency response servicing which relate to the timeliness of service and reliability of service.

The majority of the cases were comprised of individuals aged 20 to 35, as demonstrated in the histogram of the distribution of age, which was right-skewed indicating fewer cases in older age groups (Figure 1).

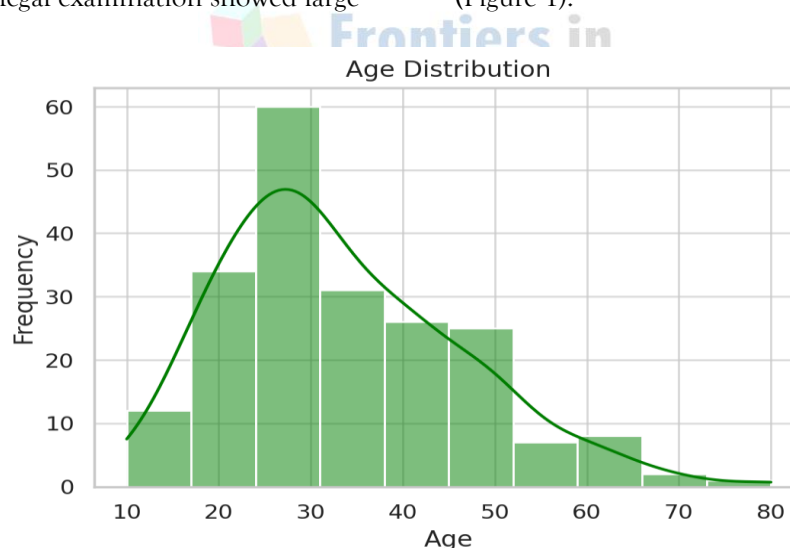
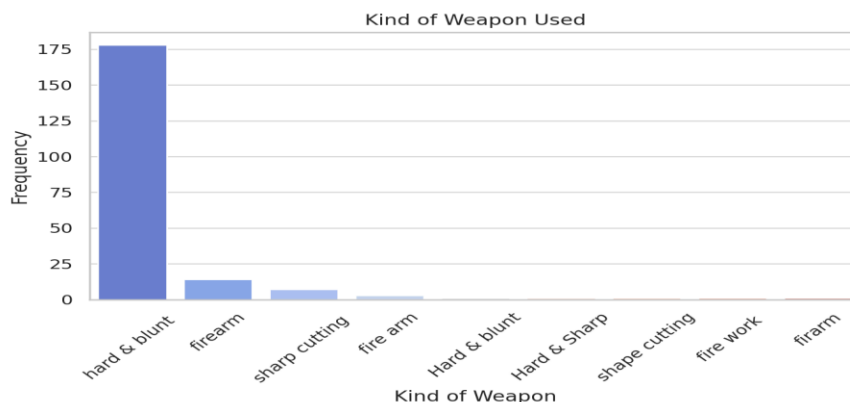


Figure 1: Histogram showing the age distribution of victims in medico-legal trauma cases\

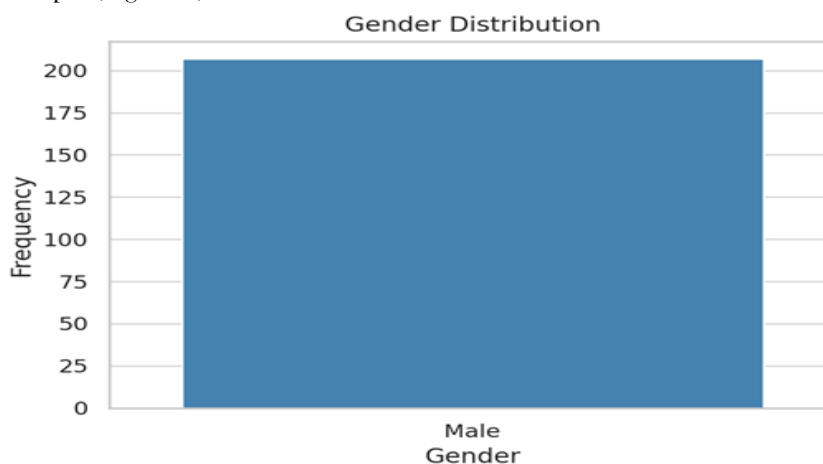
The common weapon of use among mechanical trauma instances was hard blunt objects, which was the overwhelming bulk of cases used the weapons of hard blunt object, whereas firearms and cutting

weapons made up a minute amount of case instances (Figure 2).



**Figure 2: Bar chart illustrating the type of weapons used in mechanical injuries**

All 200 medico-legal cases included in this study involved male victims, highlighting a complete male predominance in the sample (Figure 3).



**Figure 3: Bar graph showing gender distribution; all cases involved male victims**

### Discussion

The determination of Time since Injury (TSI) remains a significant difficulty in forensic practice given the subjective nature of clinical descriptions and lack of standardized terminology. In the current study with time intervals described as 'fresh' or vague timeframes like 'within 2 hours', it is essentially impossible to create a consistent timeline. Furthermore, unique biological characteristics among individuals (e.g., age, health status, time to clot, and host immune response) and environmental factors (e.g., temperature) all influence the appearance and healing of wounds, therefore visual assessments become less reliable. All these discrepancies could not only undermine forensic accuracy, but also interfere with the

likelihood of legal value of medico-legal assessments if the assessments were produced in a court context.

The average delay of more than 224 minutes between hospital arrival and medico-legal examination in this study indicates operational delinquencies and the failure to accurately document the timing of injury, where some entries had even been recorded with negative time intervals owing to clerical errors. Further consideration is given to delayed reporting by victims, often attributable to fear, ignorance, and barriers to access, which only serves to complicate the accurate estimation of TSI. While sophisticated approaches (for example, artefactual methods using MRI, CT scans, or histological staining) offer a tendency for improved accuracy, such methods are rarely applied in every day medico-legal applications,

particularly in locations where resources are scarce. This reinforces the critical need for standardized documentation of injury (to include time and manner), more professional development of Medico-Legal Officers (MLOs) and the phased assimilation of new forensic technology to improve the objectivity and consistency of injury age estimation.

### Conclusion

The study illuminates the independent difficulties in the development of an estimate of Time since Injury (TSI) in mechanical trauma cases in standard medico-legal practice. General use of unspecific and inconsistent terminology support by erroneous data entry and time delays in practice, cast doubt over the reliability of medico-legal documentation. These aspects generate consequences that may cause failure of justice in court, as it becomes complicated proving the timing of injuries. In order to facilitate more accurate TSI estimates, we recommend that new standards are developed for documenting information, that there is ongoing training provided to medico-legal practitioners, and that alternative modern forensic modalities including modern imaging and histopathological analysis are used. These recommendations would have a huge impact upon the scientific utility of any medico-legal reports that could be used to allow for the possibility of more accurate, timely, and just outcomes in court proceedings.

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