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Original Article

Seasonal Decomposition of Sexual Victimization-Related Cases in Hyderabad, Pakistan

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ABSTRACT

The issue of sexual assault is a serious concern that contributes to abuses of human rights and risks to public health. Evaluating situations like these is absolutely necessary in order to make the judicial process easier for both the victim and the person who committed the crime. When the seasonality of sexual assault-related incidents is determined, it can provide the community and law enforcement authorities with information that can help them implement preventative measures. **Objective:** To assess the seasonality of sexual assault-related cases at casualty department of a teaching hospital in Hyderabad, Pakistan. **Methods:** In current descriptive/prospective study, ninety two sexual assault-related medico-legal cases (MLCs) were included. This study based on the seasonality of sexual assault-related MLCs using seasonal decomposition of three-year from January 2020 to December 2022 data from a leading tertiary care teaching hospital in the Hyderabad region. **Results:** Most of the cases (N=42) were reported in the year 2021. The percentage of sexual assault-related MLCs was found to be concentrated from June to August (10.86% to 14.13%). The highest number of sexual assault-related MLCs occurred in July. The seasonal decomposition also showed pronounced peaks in summer, with intense peaks in July for rape and total sexual assault cases. **Conclusions:** The number of sexual assault-related cases was aggregated in mid-year, showing a higher trend in summer season. Efficient preventive measures in certain seasons and education of vulnerable groups can minimize sexual violence in the community.

"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.v7i3.4599, on 31st March, 2026."

INTRODUCTION

Medical practice involves various aspects of human activities. Among them, one important part is related to questions of legal matters. The situations related to legal issues arise in multiple contexts including personal injury claims, medical malpractice lawsuits, criminal cases, and workers' compensation claims [1]. Sexual abuse represents a public health and human right problem that is growing in cultures of silence [2]. The reporting of sexual assault and related medico-legal cases is influenced by the norms and socio-cultural taboos of Pakistan [3]. It is important to note that underreporting may not be constant across seasons. Seasonal variations in reporting behavior, such as increased willingness to report during certain times of the year or differences in hospital attendance patterns, could potentially bias the observed seasonal trends. Future studies should examine whether reporting rates themselves exhibit seasonal variation and whether this affects the interpretation of seasonal patterns in sexual assault cases. The medical examination of sexual violence-related crime incidence is crucial in facilitating the justice system for the victim and offender. Most forms of criminal activity are generally observed to display seasonal variations, although these patterns may vary among different types of crimes. Seasonality refers to a

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recurring cyclical trend that occurs at consistent intervals. The study of seasonality and temporal trends in crime a date back to the mid-19th century and remains a topic of research today [4]. Assessing the seasonal variations in crime patterns has theoretical and policy implications. Different seasons have been reported to be associated with different kinds of crime [5]. The study of the seasonality of crime can help identify the periodicity of crimes and the underlying factors behind various crimes. Moreover, it can also be utilized in forecasting the volume of crimes to reach an informed decision for taking offence preventive measures and activities required in each season [6]. Studies have shown seasonal fluctuations in sexual violence-related cases [7, 8]. It has also been reported that seasonal patterns of crime can be different between various regions and even between different parts of one country [6, 9]. The nature and frequency of MLCs can vary from region to region, possibly affected by different cultures and seasonal variations [10, 11]. However, the seasonality of sexual assault-related MLCs has not been widely reported in Pakistan. The impact of major public health events on violence patterns has been documented in other contexts, such as the COVID-19 pandemic in Australia [11]. The nature and frequency of MLCs can vary from region to region, possibly affected by different cultures and seasonal variations [10, 11]. Previous work from the same institution has documented the overall burden of medico-legal cases in the Hyderabad region [12]. In the present study, the seasonal decomposition was performed on sexual assault-related MLCs that were conducted in the medicolegal department of Liaquat University Hospital, Hyderabad from 2020 to 2022. The time series analysis method was adopted for seasonal decomposition.

METHODS

This study based on the seasonal trend of sexual assault-related MLCs in Hyderabad region of Pakistan. The relevant data were collected from the casualty department of Liaquat University Hospital, Hyderabad. Ethical approval for the study was obtained from the Institutional Review Board vide letter # LUMHS/FM/44/20, dated: 17-09-2020. The study utilized retrospective data from January 2020 to December 2022, and the Institutional Review Board granted approval for the review of existing medical records. As this was a retrospective analysis of routinely collected hospital data, the requirement for individual patient consent was waived by the IRB. The casualty data included all cases presenting to the emergency department that were classified as sexual assault-related medico-legal cases (MLCs) based on the following criteria: (1) patient history or allegation of sexual violence, (2) physical examination findings consistent with sexual assault (e.g., genital or anal injuries, tears, bruising, presence of semen or spermatozoa), and (3) formal police or medico-legal officer referral for forensic examination. Cases were categorized as rape (penetrative vaginal or oral sexual assault) or sodomy (penetrative anal sexual assault) based on the medicolegal examination report. Cases with unclear history or inconclusive examination findings were excluded from the analysis. After arrival of cases of sexual victimization to casualty department, a thorough initial assessment of cases was performed to determine extent of the injury and identify any life-threatening conditions. This involved assessment of vital signs, airway, breathing, and circulation. Any fractures, soft tissue injuries, and other traumatic injuries were provided with treatment for clinical care. In case of unstable or life-threatening conditions, immediate interventions were initiated in order to stabilize the patient, such as controlling bleeding, ensuring adequate oxygenation and ventilation, and addressing any serious injuries. Following prompt trauma care, the subsequent steps included the plan to prioritize addressing sexually transmitted infections, pregnancy concerns, and psychosocial issues. Empiric treatment for sexually transmitted infections was provided, including, ceftriaxone 500 mg IM injection plus azithromycin 1 g PO (single dose) or metronidazole or tinidazole 2 g PO (single dose). Data on victim demographics, including gender, age, and relationship to the perpetrator, were collected where available. Table 1 presents the monthly distribution of cases by type of assault (rape vs. sodomy). Subgroup analysis by victim gender is presented in Supplementary Table S1; however, due to the small sample size, gender-specific seasonal patterns should be interpreted with caution. Future research with larger samples is needed to examine whether seasonal patterns differ between male and female victims. All subjects were excluded if their nature was judged to be non-sexual violence-related. The data were collected and analyzed using MS EXCEL.

Seasonal decomposition was performed using Statgraphics Centurion XIX software (Statgraphics Technologies, Inc., The Plains, VA, USA). An additive decomposition model was employed, assuming that the seasonal component is constant over time and independent of the trend. The seasonal indices were calculated using the ratio-to-moving-average method, where the original time series data were first smoothed using a 12-month moving average to remove seasonal fluctuations. The seasonal component was then isolated by averaging the actual values minus the trend for each month across the three-year period. The final seasonal indices were normalized so that their sum equals zero. The model assumptions were validated by examining the residual (irregular) component for randomness using the

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Ljung-Box Q-test. A p-value <0.05 was considered statistically significant." The data e presented as frequencies and their mean ± SD. The seasonal trend and time series analysis were conducted using seasonal decomposition and were presented as plots.

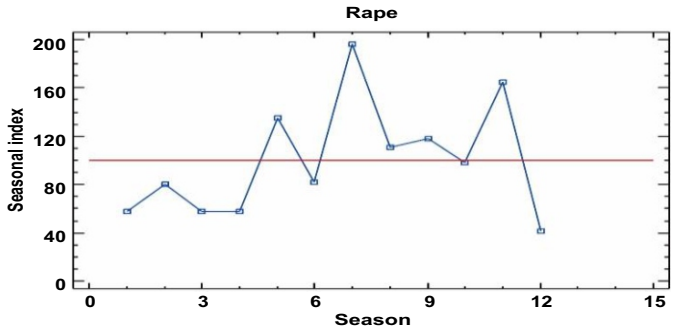
RESULTS

Most of the cases (N=42) were reported in year 2021. The percentage of total sexual assault-related cases occurring in different months of the year shows that a substantial percentage of such cases were aggregated in mid-year, i.e., June, July, and August (10.86% to 14.13%). The highest numbers of sexual assault-related MLCs were performed in July (Table 1).

Table 1: Month-Wise Frequency of Sexual Assault-Related MLCs for Three Years

Month	Year			Mean ± SD	Total
	2020	2021	2022		
January	1	1	4	2 ± 1.41	6 (6.52%)
February	2	3	1	2 ± 0.81	6 (6.52%)
March	1	1	2	1 ± 0.47	4 (4.34%)
April	1	4	3	2 ± 1.24	8 (8.69%)
May	0	4	2	2 ± 1.63	6 (6.52%)
June	1	6	4	3 ± 2.05	11 (11.95%)
July	3	6	4	4 ± 1.24	13 (14.13%)
August	2	6	2	3 ± 1.88	10 (10.86%)
September	3	1	1	1 ± 0.94	5 (5.43%)
October	1	5	3	3 ± 1.63	9 (9.78%)
November	3	4	3	3 ± 0.47	10 (10.86%)
December	1	1	2	1 ± 0.47	4 (4.34%)
Total	19	42	31	42 ± 31	92

The trend of sexual assault-related MLCs that can be interpreted from data in Table 1 was also reflected by seasonal index plots of rape, sodomy, and total sexual-assault MLCs. As depicted in Figure 1, the sexual assault-related MLCs peaked in the third quarter of the year compared to other months. The seasonal time plot (Fig. 1) also shows that the incidence of rape assault peaks in July, consistent with data in Table 1. The seasonal plot of sodomy indicates a high frequency of sodomy in May; however, this is again followed by a higher peak in July.



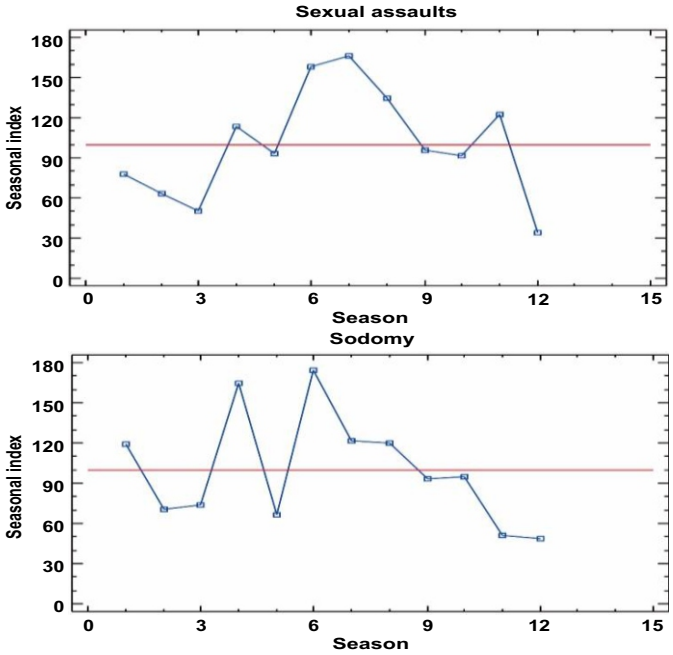
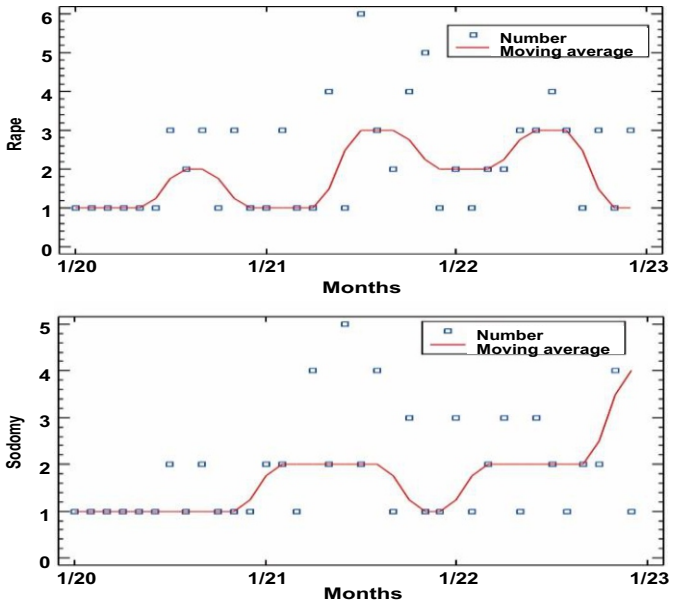


Figure 1: Seasonal Index Plots for Rape, Sodomy, and Total Sexual Assault-Related MLCs

Smoothed time series plots of rape, sodomy, and total sexual assault-related MLCs are presented in Figure 2. The smoothed time series plot of sexual assault-related MLCs shows three peaks at the start of the second half of each of the three years. The graph for rape-related MLCs shows a similar trend to total sexual assault-related MLCs. However, the trend of sodomy varies slightly in comparison to rape and total sexual assault-related MLCs. This suggests that rape might dominate the seasonal trend of sexual assault-related MLCs. On the other hand, sodomy might present an additional peak of the seasonal trend with reference to the trend of rape-related assaults.



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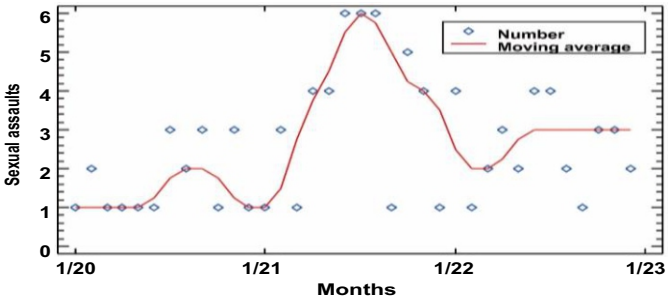


Figure 2: Smoothed Time Series Plot for Rape, Sodomy, and Total Sexual Assault-Related MLCs

DISCUSSION

Any society that upholds the principles of the rule of law and justice considers sexual violence a criminal act. Many types of crimes are periodic as they exhibit seasonal fluctuations in their volume. Often referred to as crime seasonality, this tendency can be captured in the form of time-series data with a recurring cycle [6]. The present study showed the seasonal fluctuation of sexual violence-related MLCs in the Hyderabad region of Pakistan. The data revealed that July, the hottest month in the region in terms of climatic temperature, presented the highest peaks of sexual assault-related MLCs in the region. The seasonal patterns observed in this study differ from those reported in other countries, highlighting the importance of regional context in understanding sexual assault seasonality. For example, a study from the mid-Atlantic region of the United States found the least cases of sexual assault in July, which may reflect different climate patterns, cultural norms, or reporting practices [7]. Similarly, a study from Tunisia reported spring as the most vulnerable season, followed by summer, suggesting that climatic factors alone cannot explain seasonal variation [2]. Studies from South Korea reported summer peaks similar to our findings [12, 13], indicating that certain cultural or social factors may contribute to summer vulnerability in some Asian contexts. These cross-country differences may be attributed to variations in climate (e.g., monsoon patterns, temperature ranges), cultural practices (e.g., holiday schedules, social gatherings), legal frameworks, and help-seeking behaviors. The highest trend of sexual assaults in summer was also found in three Regions of the Republic of Bulgaria [14]. In an Indian tertiary care hospital, the appraisal of sexual offence cases showed the occurrence of most cases during summer season [15]. It has been reported that the same type of crime can exhibit varying seasonal patterns between different countries and regions [4, 6]. Regional differences can occur even within the same nation [6]. Alam *et al.*, observed a major frequency of sexual assaults in Peshawar, Pakistan, occurring in winter in contrast to the present study's findings [16]. However, the number of sexual assault-related MLCs and assessment of their frequencies with reference to seasons has not been reported widely in Pakistan, suggesting the need for more studies. The peaks in violent crimes have been observed usually in relation to the summer season [17]. Several factors may contribute to the seasonal patterns observed in this study. Temperature-related behavioral changes, including increased outdoor activities and social interactions during summer months, may increase exposure to potential perpetrators [5, 17]. Additionally, physiological responses to heat, such as reduced impulse control and increased irritability, have been proposed as mechanisms linking warm weather to violent behavior [6]. However, the relationship between temperature and sexual violence is complex, and cultural, social, and reporting factors may interact with climatic conditions to produce region-specific patterns [2, 8]. For example, a study from Tunisia reported spring as the most vulnerable season, suggesting that factors beyond temperature, such as cultural practices or seasonal population movements, may influence seasonal patterns differently across regions [2]. One of the earliest discoveries in the field of criminology focused on the connection between warm weather and violent behavior. In the 18th century, studies were conducted that identified a significant link between high temperatures and crimes against individuals. Researchers even named this phenomenon 'the thermic law of delinquency' due to its consistent nature [18, 19]. Over the nearly two centuries since then, this foundational correlation has been extensively examined, questioned, and nuanced through a wide range of research studies [4, 17, 18]. Conversely, crimes against individuals appeared to be more common in summer, attributed to the warmer temperatures and heightened human emotions, while sexual offenses peaked in spring, a season associated with breeding [5]. Similar to the present study, a plenty of research conducted previously has generally identified peaks in summer for overall offenses like property crimes, violent crimes, and sex crimes [4]. A study in seven major US cities, demonstrated that every 5°C increase in daily mean temperature was associated with a 4.5% rise in sex offenses within the following 0–8 days. These associations were more pronounced during hot and cold seasons compared to moderate seasons and could be amplified by higher relative humidity and precipitation. The links were statistically significant for sodomy, fondling, and rape, particularly in specific locations such as open spaces, educational institutions, and streets rather than residences [19]. A cross-over study across Japan reported a nearly linear increase in the relative risk for self-harm and assault behavior as the temperature rose [20]. Likewise, it has been widely found that violent incidents exhibit a seasonal pattern, with the majority occurring during the summer or hotter seasons rather than in winter [17]. Some researchers have suggested that interpersonal violence during warm weather may increase with future

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temperature rises as a result of climatic change [19, 20]. However, further research is needed to establish the precise relationship between climate change and sexual violence rates in different regions. For instance, a study in US estimated estimate that 2.6% of sex offenses can be attributed to temperatures exceeding city-specific median temperatures, equating to an average annual sex offense rate of 2.9 per 100,000 individuals. These results highlighted the potential increase in sexual crimes associated with climate change, offering valuable insights for targeted prevention efforts [19, 20]. Another possible reason is the relationship between temperature climates and the activities of people. People tend to spend their time outside in summer compared to other seasons, making them more vulnerable by staying in a non-protected environment. Moreover, the school-going children remain on holidays and stay out of school during July and August. Consequently, comparatively increasing people's movement out of the relatively protected environment may result in periodic peaks in sexual assaults and other offences [5]. The strategies to prevent violent and sexual crimes linked to hot weathers are yet unclear. One proposed solution is the implementation of heat-warning systems to notify law enforcement agencies about high temperatures and the potential increase in violence. Help lines and public security awareness programs can also play a significant role. However, the effectiveness of these approaches would require assessment in future research studies. Furthermore, more well-designed studies are required to further explore the seasonal decomposition of sexual assault-related MLCs in Pakistan.

The findings of this study should be interpreted in light of several limitations. First, the study was conducted at a single teaching hospital in Hyderabad, which may not be representative of other regions in Pakistan with different climatic, cultural, and demographic characteristics. Seasonal patterns may vary across different provinces and urban versus rural settings [6, 9]. Future multi-center studies across different regions of Pakistan are needed to validate these findings and establish regional-specific patterns. Second, the study period (2020-2022) was relatively short, and longer-term data would provide more robust seasonal estimates.

CONCLUSIONS

The seasonal fluctuations in sexual assault-related MLCs were assessed in the present study. The results showed the presence of seasonal changes in sexual assault-related MLCs. Smoothed time series and seasonal indices revealed a trend of peaks in sexual assault-related MLCs in summer, with July being the most vulnerable month.

Authors Contribution

Conceptualization: AR
Methodology: AR, UM, NA, AS, MRS, IB
Formal analysis: UM, NA
Writing-review and editing: AR, ASM, MRS, IB

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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