



## Original Article

## Seasonal and Time-Series Analysis of Road Traffic Accidents

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## ABSTRACT

Road Traffic Accidents (RTAs) contribute a significant and escalating rate in harm, hospitalization, and mortality. This study assesses the seasonal trend and time series analysis of RTAs cases brought to casualty department of Liaquat University Hospital, Hyderabad, Pakistan. **Objective:** To conduct seasonal and time series analysis of RTA cases at Casualty Department of Liaquat University Hospital Hyderabad. **Methods:** Nine hundred and sixty-six road traffic accidents-related cases were examined through prospective study at casualty department, Liaquat University Hospital, Hyderabad, Pakistan from January 2020 to December 2022. The seasonal trend was demonstrated by drawing seasonal index plot and time series plot. **Results:** The largest occurrences of RTA-related cases were reported in the month of December, having 103 total cases with a mean of  $34.33 \pm 18.92$ . July had the second highest frequency of RTAs-related cases, with a total of 94 cases having a mean of  $31 \pm 5.43$  cases. The second-highest number of cases was observed in July and November with approximately equal mean number of RTAs. The time series analysis demonstrated an increasing trend of RTAs-related cases in the last three months of the year. **Conclusions:** The number of cases connected to RTAs increased during seasons of extreme weather, such as the summer and winter, and it also showed an increasing tendency in the last quarter of 2022.

## INTRODUCTION

Cases involving inquiries or concerns about medicine are known as Medico-Legal Cases (MLCs). Personal injury claims, criminal proceedings, medical malpractice lawsuits, and workers' compensation claims are some of the many possible settings in which such instances might emerge [1]. Furthermore, MLCs might result in substantial repercussions for everyone concerned [2]. Road Traffic Accidents (RTAs) pose unique challenges for MLCs due to the high prevalence of RTA-related injuries requiring medical attention, the high prevalence of RTA-related severe injuries leading to long-term disabilities, and the fact that RTAs are among the top causes of death [3]. There

have been a lot of papers and studies dealing with the topic of road accidents since they have become a worldwide problem [3, 4]. However, the rate of fatalities caused by RTAs differs across industrialised and developing nations. Developing countries have an exceptionally high rate of RTAs. Governments also announce victim compensation in Road Traffic Accidents (RTAs) based on the medico-legal evaluation report [3]. Since mortality and seasonality is a hot topic in epidemiological research, many studies have examined the complex relationship between the seasons and various causes of death [5-7]. Seasonal variations in mortality rates have been seen across several populations

and regions, indicating that various factors such as climate, ecosystems, social norms, and personal actions play a role [8]. Conversely, heat-related mortality rates may rise throughout the summer in regions that are already very hot and do not have adequate cooling facilities. Mortality rates can vary throughout the year due to a number of factors, including changes in the amount of outdoor activities, air pollution, allergen exposure, and the transfer of infectious diseases [9]. Much like mortality rates, MLCs can fluctuate in type and frequency from one area to another, perhaps influenced by cultural norms and seasonal shifts [10]. Seasonal changes can aid in medico-legal evaluations by revealing contributing elements to particular injury or occurrence types. In order to decrease the occurrence of accidents, it is helpful to understand the seasonal trends of RTAs. This will allow us to identify risk factors and create focused interventions. By estimating and comparing different risk and severity of accidents, the accident patterns of different populations, vehicles, and geographic groups in each season can also be revealed [11]. To determine seasonal variation, time series analysis is utilized as a simple method. This method studies the dynamic observations from time point 1 to time point t and helps determine the seasonal or periodic trend of particular events. Time series analysis is also used for forecasting events in various fields, including medicine, such as predicting disease prevalence [12]. Herein, the seasonal trend of RTA-related MLCs was determined using three-year data from a leading tertiary care hospital in Hyderabad, Pakistan, employing a time series analysis method.

The objective of this study was to conduct seasonal and time series analysis of RTA cases at Casualty Department of Liaquat University Hospital Hyderabad.

## METHODS

This study was carried out at Casualty Department, Liaquat University Hospital, Hyderabad, Pakistan from January 2020 to December 2022. IRB approval was acquired for conducting this study (IRB approval number: LUMHS/FM/78/19 dated: 28 December 2019). The design of present study is prospective study. Non probability consecutive sampling technique was used. Nine hundred and sixty-six road traffic accidents related cases were examined. The seasonal trend was demonstrated by drawing seasonal index plot and time series plot. The monthly data of RTA-related cases were acquired from the casualty department. The inclusion criteria involved cases related to RTA-related injuries. The exclusion criteria were the cases identified as not related to RTA-caused injuries. All cases eligible as per inclusion criteria were included. The data were collected and analyzed using MS EXCEL and Stat graphics Centurion XIX software. The data were presented

as frequencies and their mean  $\pm$  SD. The seasonal trend and time series analysis were presented using data plots.

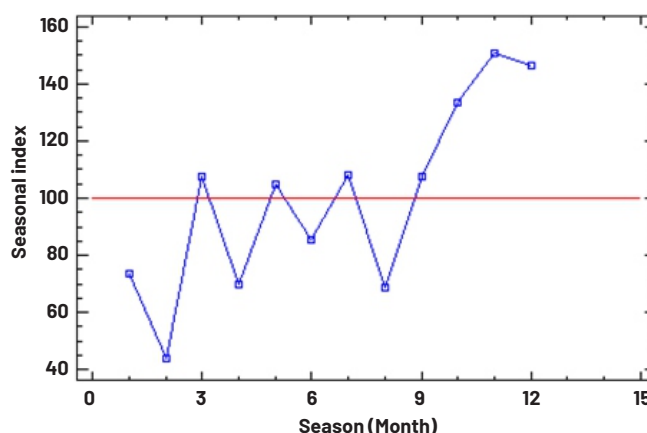
## RESULTS

Four hundred and eighty-nine RTAs-related cases were assessed in 2020, 283 cases in 2021, and 194 cases in 2022. The data showed that the highest number of RTA-related cases occurred in March, July, November, and December, with mean values of greater than 30 cases and a total number of more than 90 cases. The largest occurrence of RTA-related cases was reported in the month of December, having 103 total cases with a mean of  $34.33 \pm 18.92$  (Table 1).

**Table 1:** Month-Wise Frequency of RTA for Three Consecutive Years

Month	Year (Cases)			Mean $\pm$ SD	Total N (%)
	2020	2021	2022		
January	31	23	16	23.33 $\pm$ 6.12	70 (7.24%)
February	36	15	8	19.66 $\pm$ 11.89	59 (6.1%)
March	39	30	22	30.33 $\pm$ 6.94	91 (9.42%)
April	50	13	18	27 $\pm$ 16.39	81 (8.38%)
May	40	17	26	27.66 $\pm$ 9.46	83 (8.59%)
June	42	20	15	25.66 $\pm$ 11.72	77 (7.97%)
July	39	28	27	31.33 $\pm$ 5.43	94 (9.73%)
August	40	8	8	18.66 $\pm$ 15.08	56 (5.79%)
September	44	22	8	24.66 $\pm$ 14.81	74 (7.66%)
October	34	38	15	29 $\pm$ 10.03	87 (9%)
November	33	46	12	30.33 $\pm$ 14.0	91 (9.42%)
December	61	23	19	34.33 $\pm$ 18.92	103 (10.66%)

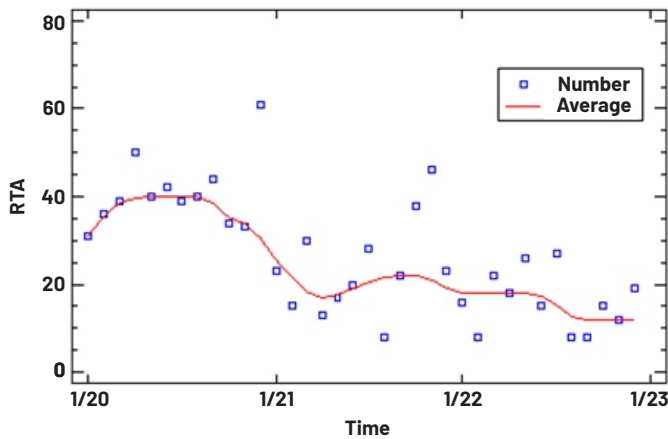
The seasonal index and time series plots of RTA-related cases are presented in Figure 1 and Figure 2, respectively. The seasonal index plot shows a variation of RTAs in certain months of the year. The index reveals higher than average RTAs in the last three months of the year, indicating the influence of the winter season (Figure 1).



**Figure 1:** Seasonal Index Plot for RTA-Related MLCs

The RTAs are scattered across the average throughout the year, with most of the months taking place above the average. The seasonal index and time series plots of RTA-related cases appear in agreement with the data in table 1,

showing an increasing trend in November and December with a slight downward trend in year-wise total numbers of RTAs-related cases (Figure 2).



**Figure 2:** Smoothed Time Series Plot for RTA-Related Cases

## DISCUSSION

Medico-legal assessment assists the process of law enforcement by determining the causes and probable factors of injuries to individuals and population groups. Knowledge of seasonal factors associated with MLCs can be useful to improve the provision of medico-legal representation and medical care to victims of road accidents [12]. The timing and seasonal patterns of road accidents are considered as useful factors to significantly decrease the number of accidents [3]. The present study found a seasonal trend in RTAs-related MLCs with an upward trend in November and December, which comprises the winter season in most areas of the country. The findings are approximately similar to the study from Rawalpindi, Pakistan, by Malik *et al.*, which showed a slightly elevated number of RTAs from the months of October to January and from May to August [13]. A study from Faisalabad reported the highest number of road traffic accidents in the months of March and April [14]. This is consistent with the present study in terms of higher number of RTAs occurring in March but differs regarding most frequent RTAs-related MLCs in the months of November and December. A month-wise distribution of RTA victims brought to the Civil Hospital of Karachi showed a higher frequency of RTA-related deaths in December, in line with the present study [15]. A study of RTAs over 53 months reported the highest number of road accidents in the dry season, followed by the rainy season [16]. This could explain the results of the present study showing the highest number of RTAs in November-December and July as the weather in Sindh province of Pakistan is characterized by cold and dry winter, whereas summer is mostly hot and rainy. A study conducted in Pakistan investigated the impact of environmental conditions on road accidents and stressed the need to exercise caution

while driving in extreme weather [17]. Road accidents may occur more likely during intense heat, severe cold, rainfall, and fog, regardless of whether it is in urban or rural areas [17]. Various factors can influence RTAs, including poor infrastructure, vehicle conditions, distracted drivers, speeding, harsh environmental conditions, and noncompliance with road safety rules [18-20]. The present study suggested a slight decline in trend of RTAs-related MLCs in the Hyderabad region. However, this may not reflect any improvement with time in the factors associated with RTAs. Further exploration with increased data size and inclusion of data from other big hospitals of the region is suggested. Additionally, the data of the present study indicated that certain months of the year observe more than the average number of RTAs, implying the need to enhance the road safety, such as improving the infrastructure, street lighting, pedestrian crossings, road signage, and education and training about road safety. A recent study from Pakistan reported that most of RTAs occur at intersections of roads [21]. Such hotspots can be identified and managed specially to prevent surge in RTAs during months with harsh weather conditions leading to peaks in RTAs. Holidays, festivals, and celebratory events may see a higher prevalence of drunk driving incidents, contributing to seasonal spikes in RTAs [22, 23]. Therefore, public education campaigns and strict laws might be implemented to minimize seasonal peaks in RTAs. Additionally, the roads in Pakistan are considered among worst in the world [21]. The biological mechanisms and potential pathophysiological reasons of this link with seasonality are continually being filled in by researchers. This will influence research-based programs to enhance public health and reduce seasonal health inequalities.

## CONCLUSIONS

Seasons of harsh weather, including the summer and winter, saw a rise in the number of cases associated with RTAs; this pattern continued in the last quarter of 2022.

## Authors Contribution

Conceptualization: MS

Methodology: MS, AS

Formal analysis: MS, MAK

Writing, review and editing: HNA, IB, NK, AR

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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