



## OPEN The ecological impact of the COVID-19 pandemic on crime trends in Kerman Province of Iran

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The COVID-19 pandemic has significantly impacted crime rates in Kerman province, Iran, revealing divergent patterns compared to global trends. This ecological study utilized the Poisson regression model and interrupted time-series Poisson regression model to analyze data collected from the Iranian Legal Medicine Organization (ILMO) database and the Kerman Criminal Investigation Department of Police database, focusing on theft, conflicts, and homicide rates in this region. Our findings indicate that in 2020, the incidence rate ratio of conflicts increased compared to previous years. Before the pandemic, thefts were on the rise, while homicides were decreasing. However, with the onset of the pandemic, thefts initially decreased, and homicides experienced a notable increase. Subsequently, both thefts and homicides showed a declining trend. By the end of 2020, thefts were significantly lower than expected based on pre-pandemic data, while homicides were slightly higher. Initial fluctuations in crime rates may be related to quarantine measures and the challenges faced during the pandemic, while subsequent changes might be influenced by governmental interventions. Understanding the complex relationship between public health emergencies and criminal activities is crucial for informing policymaking and crime prevention efforts.

**Keywords** COVID-19, Crime, Pandemics, Homicide, Conflict, Theft

The COVID-19 pandemic has emerged as a major global public health crisis, drastically impacting daily life, the economy, education, and employment worldwide (1, 2). This pandemic has resulted in significant loss of life, economic disruption, and social upheaval, presenting unprecedented challenges<sup>1,2</sup>. In response, nations have implemented stringent measures such as closures, social distancing, and quarantine protocols to contain the virus<sup>3</sup>.

These widespread societal changes, along with alterations in daily routines and enforced social distancing, may influence the occurrence and distribution of crimes and disorders<sup>4,5</sup>. Crime is a complex phenomenon shaped by various factors, including economic variables, spatial and temporal patterns, environmental conditions, cultural context, and prevailing political dynamics<sup>2,6</sup>. Previous research indicates varied impacts of the COVID-19 pandemic on different crime categories across various global regions. For instance, some areas have reported increases in theft and burglary, while others have experienced declines<sup>5,7-18</sup>. While domestic violence and conflicts have risen in many regions, some locations have seen decreases in sexual offenses and assaults<sup>5,7,11,12,15,19-22</sup>.

Homicide rates have also shown mixed trends, with certain regions experiencing increases while others have observed decreases compared to pre-pandemic levels<sup>9,16,23-29</sup>. These divergent crime patterns underscore the need of analyzing the pandemic's impact on a regional and local level, as influential factors can vary significantly by country and locale.

Studying crime trends is crucial for informing effective policy responses and resource allocation for crime prevention and law enforcement in different regions. Iran, with its rich history and cultural diversity, has a complex social structure that significantly influences regional geopolitics in the Middle East. The interplay of these historical and cultural factors may shape the crime trends observed during the COVID-19 pandemic<sup>30</sup>. Furthermore, given the limited time-series research exploring the correlation between COVID-19 pandemic and crime trends outside of North America and Europe, this study aims to contribute meaningfully to the existing literature.

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Kerman Province, as Iran's largest and ninth most populous province, includes 23 cities as of 2016. It is significant in terms of industry, culture, politics, agriculture, higher education, and religion<sup>31</sup>. This research aims to examine how specific aspects of the COVID-19 pandemic, particularly lockdowns and economic disruptions, have impacted various categories of crime in this historically and culturally distinct region. By analyzing the nuanced changes in criminal patterns across different offense types, this study seeks to provide authorities with data-driven strategies to enhance crime prevention and response capabilities, ultimately strengthening community safety and resilience in the face of future challenges.

## Materials and methods

This ecological study was approved by the Research Ethics Committee of Rafsanjan University of Medical Sciences (IR.RUMS.REC.1400.013). The study involved the analysis of aggregated, population-level data collected from individuals living in Kerman Province between 2017 and 2020. Kerman Province consists of 23 counties, with a total population of 3,164,718 based on the 2016 national census<sup>32</sup>.

Due to the retrospective nature of the study and the use of anonymized data that does not include individual-level personal characteristics, the requirement for informed consent was waived by the Research Ethics Committee of Rafsanjan University of Medical Sciences. All procedures for data collection and analysis adhered to relevant institutional and national guidelines and regulations.

Data on conflicts and homicides were gathered from the Iranian Legal Medicine Organization (ILMO) database for the years 2017 through 2020. Conflict data were categorized by year and gender, while homicide data were classified by year, gender, and month. ILMO, an independent organization that provides expert opinions in forensic medicine, collaborates with academic and scientific institutions for the purposes of research and education<sup>33</sup>. Information on theft incidents was sourced from the Kerman Criminal Investigation Department of Police database, covering the years 2018 to 2020<sup>34</sup>. In this study, theft is defined as the encroachment on the "right of possession" of another's movable property<sup>35</sup>.

## Statistical methods

### *Poisson regression model (PRM)*

The PRM was utilized to estimate the incidence rate ratio (IRR) of thefts, conflicts, and homicides, including a 95% confidence interval for Kerman Province. The PRM is a generalized linear model specifically employed for count data analysis<sup>36</sup>. Assessing the assumption of overdispersion is crucial to ensure the appropriateness of the model. To evaluate this assumption, the rule of thumb is that the ratio of deviance to df should be 1 in each model. Index values close to 1 indicate equality between the mean and variance, suggesting that the PRM fits the data well for our study. The first year of the COVID-19 pandemic (2020) was used as a reference year, and the IRR of the other years was compared to that of 2020. Data analysis was conducted using SPSS software (version 24), with a significance level set at 0.05.

## Interrupted time series (ITS) analysis

Interrupted Time Series Poisson regression models were employed to model the monthly changes in thefts and homicides before and after the COVID-19 pandemic in 2020. Due to the absence of monthly data, this analysis was not performed for the conflict dataset.

In an ITS design, data are collected before and after an interruption (e.g., an intervention or exposure). By modeling the pre-interruption data, we can estimate the underlying trend and predict what would have occurred without the interruption. Differences between the predicted and observed data following the interruption can be assessed (e.g., immediate and long-term effects), taking the underlying trend into account to determine the effects of the interruption<sup>37</sup>.

This model examines the role of the IRR in assessing the effects of COVID-19 on various variables. The IRR before the pandemic reflects changes in the variable during the months leading up to the pandemic, demonstrating monthly variations prior to its onset. The IRR regarding the immediate impact denotes changes occurring at the onset of the pandemic. This immediate effect generally spans a short timeframe, typically a few days or weeks<sup>37</sup>. The IRR of sustained impact is calculated as the difference in the slope of the regression line before and after the pandemic, indicating how the trend of changes in the variables in the months following the onset of the pandemic has shifted compared to before. Data analysis was performed using R software (version 4.1.0).

Using both PRM and ITS methods allowed us to cross-validate our findings. The combination of these approaches strengthens the robustness of our conclusions, enabling us to triangulate our results and providing a richer interpretation of the data.

Following Iran's first confirmed case of COVID-19 in February 2020<sup>38</sup>, the number of infected individuals rapidly escalated, prompting the implementation of quarantine measures to mitigate the disease's spread<sup>39</sup>. This study considers March 20, 2020, as the official quarantine date, marking the beginning of the pandemic in Iran.

The data were categorized by year according to the Solar Hijri calendar (SH) from 1396 SH to 1399 SH<sup>40</sup>. The Solar Hijri calendar years were matched with the Gregorian calendar years as illustrated in Table 1.

## Results

A total of 135,159 thefts were reported in Kerman Province from 2018 to 2020, along with 90,562 conflicts and 482 homicides reported from 2017 to 2020. The highest frequency of thefts and conflicts occurred in 2020, while homicides were most frequently reported in 2017 (Table 2).

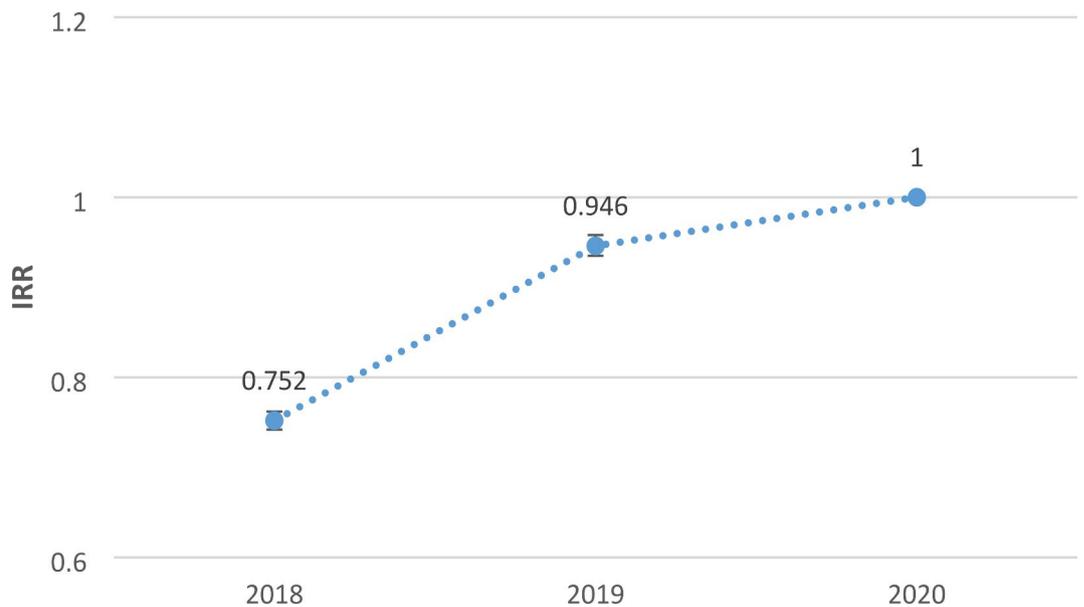
The Poisson Regression Model (PRM) was employed to compare the incidence rate ratios (IRR) of these variables in 2020, which marks the onset of the COVID-19 pandemic, to those observed in the preceding years.

Gregorian calendar	Solar Hijri calendar	Study period
21 March 2017–20 March 2018	1396 SH	2017
21 March 2018–20 March 2019	1397 SH	2018
21 March 2019–19 March 2020	1398 SH	2019
20 March 2020–20 March 2021	1399 SH	2020

**Table 1.** Matching years in the solar calendar and the gregorian calendar.

Variables	Category	Year				Total
	Sex	2017	2018	2019	2020	
Theft	Total	–	37,671 (27.9)	47,400 (35.1)	50,088 (37.1)	135,159
Conflict	Men	14,701 (23.9)	15,085 (24.5)	14,841 (24.1)	16,884 (27.4)	61,511
	Women	6933 (23.9)	7260 (25.0)	7162 (24.7)	7696 (26.5)	29,051
	Total	21,634(23.9)	22,345 (24.7)	22,003 (24.3)	24,580 (27.1)	90,562
Homicide	Men	119 (29.8)	92 (23.0)	82 (20.5)	107 (26.8)	400
	Women	22 (26.8)	15 (18.3)	20 (24.4)	25 (30.5)	82
	Total	141 (29.3)	107 (22.2)	102 (21.2)	132 (27.4)	482

**Table 2.** Frequency (percent) of thefts, conflicts, and homicides (2017–2020).



**Fig. 1.** Total IRR of thefts in Kerman Province from 2018 to 2020.

During 2020, the IRR of thefts, conflicts, and homicides increased compared to previous years. In these three models, the ratio of deviation to df was 1.768, 1.524 and 1.258, respectively, which indicates no overdispersion.

In 2020, the IRR of thefts increased by 25% compared to 2018 (IRR: 0.752; 95% CI: 0.742–0.762) and by 5% compared to 2019 (IRR: 0.946; 95% CI: 0.935–0.958) ( $P < 0.001$ ) (Fig. 1).

The IRR of conflicts in 2020 increased by 12% compared to 2017 (IRR: 0.88; 95% CI: 0.86–0.90), 9% compared to 2018 (IRR: 0.909; 95% CI: 0.89–0.93), and 10% compared to 2019 (IRR: 0.895; 95% CI: 0.88–0.91) ( $P < 0.001$ ) (Fig. 2).

The IRR of homicides in 2020 increased by 8% compared to 2017 (IRR: 0.920; 95% CI: 0.714–1.185;  $P = 0.519$ ) and by 24% compared to both 2018 and 2019 (IRR: 0.760; 95% CI: 0.582–0.992;  $P = 0.044$ ). However, the relatively large confidence interval for the IRR of homicides reflects a degree of uncertainty in these estimates. This uncertainty should be carefully considered when interpreting the results for this region (Fig. 3).

According to our data, 23 months before the pandemic, the average monthly number of thefts was  $3,515.04 \pm 644.34$ . However, 13 months after the onset of the pandemic, this figure increased to  $4,177.92 \pm 199.76$ . Similarly, the average monthly number of homicides also increased following the pandemic. Thirty-five months



Fig. 2. Total IRR of conflicts from 2017 to 2020.

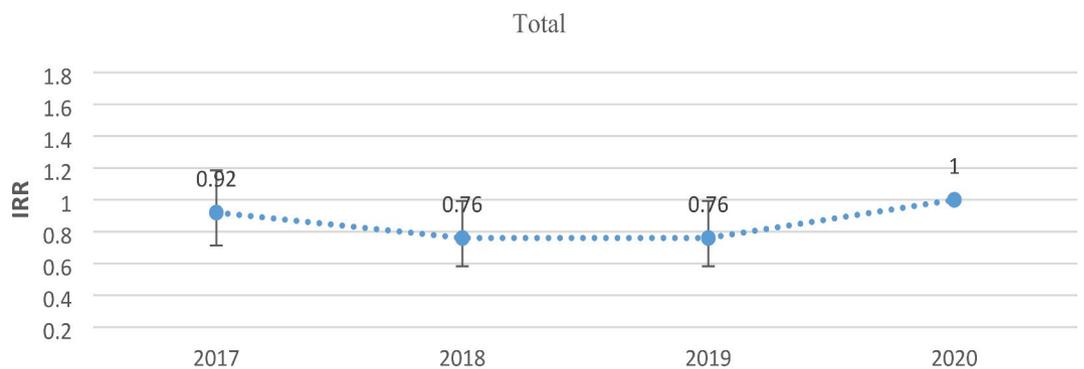


Fig. 3. Total IRR of homicides from 2017 to 2020.

Variable	Period	Month	Mean	SD	Median	Min	Max
Theft	Before	23	3515.043	644.342	3702	2006	4233
	After	13	4177.923	199.768	4225	3821	4482
Homicide	Before	35	9.63	3.40	9	3	18
	After	13	11.15	5.65	10	4	23

Table 3. The descriptive statistics for thefts and homicides before and after the COVID-19 pandemic.

before the pandemic, the average monthly number of homicides was  $9.63 \pm 3.40$ . However, 13 months after the pandemic, this number rose to  $11.15 \pm 5.65$  (Table 3).

The theft rate exhibited an increasing trend before the pandemic, with a monthly significant increase of 2.1% (IRR = 1.021;  $P < 0.001$ ). At the onset of the pandemic, the immediate effect resulted in a significant decrease of 4.1% in the theft rate (IRR = 0.959;  $P < 0.001$ ). The sustained effect of the pandemic led to a change in the theft rate trend in the following months, showing a significant decrease of 2.2% compared to before the pandemic (IRR = 0.978;  $P < 0.001$ ).

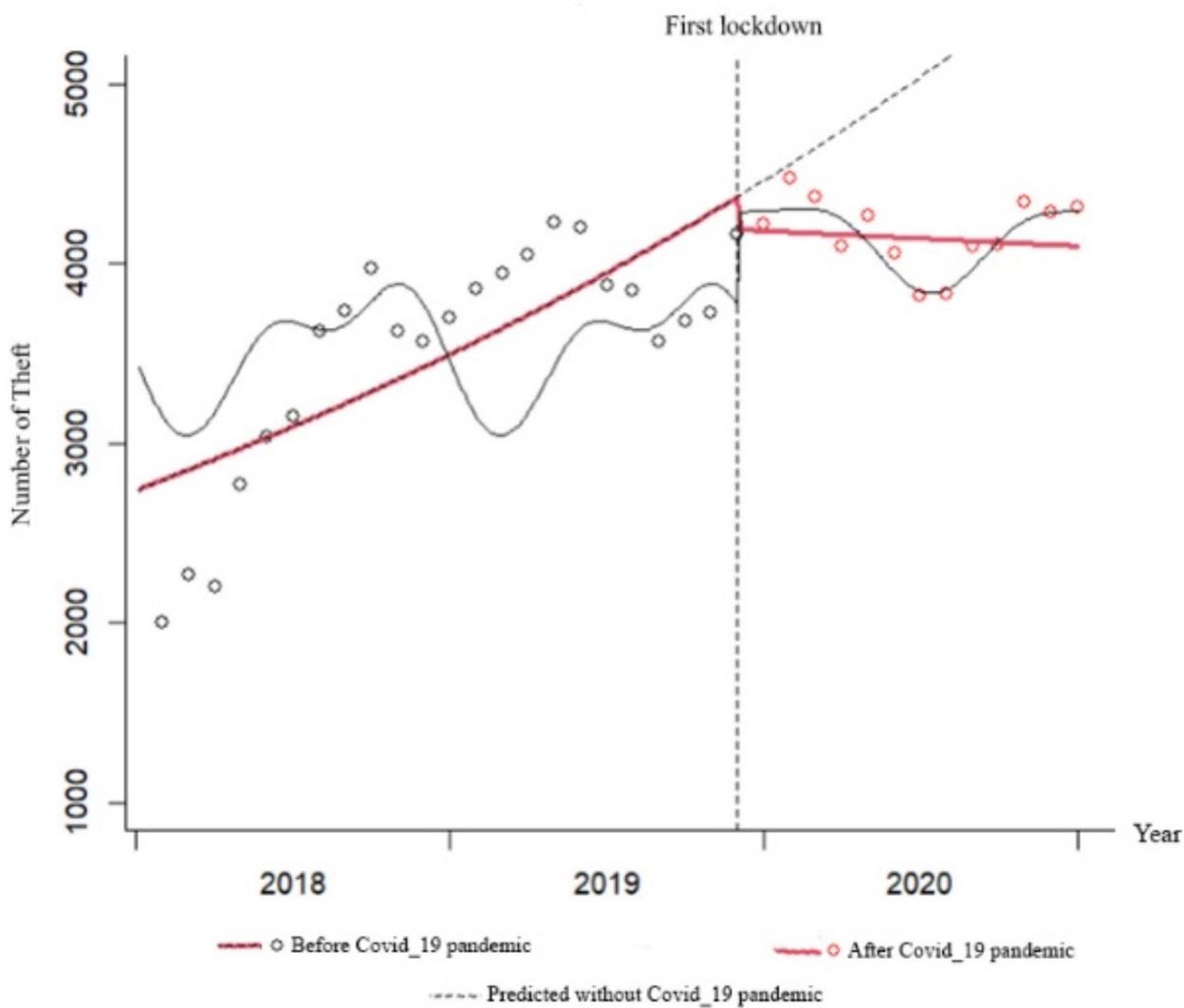
Conversely, the homicide rate had a decreasing trend before the pandemic, with a significant monthly decrease of 2.8% (IRR = 0.982;  $P = 0.001$ ). However, at the beginning of the pandemic, the immediate effect caused the homicide rate to experience a significant increase of 140.7% (IRR = 2.407;  $P < 0.001$ ). The sustained effect of the pandemic resulted in a significant decrease of 4.7% in the homicide rate, compared to the period preceding the pandemic (IRR = 0.953;  $P = 0.04$ ) (Table 4).

The trend of thefts was increasing prior to the pandemic, but after the initial lockdown, the number of thefts decreased and continued to decline slightly. Moreover, had the pandemic not occurred, the monthly number of thefts would have been significantly higher compared to the end of 2020 (Fig. 4).

In Fig. 4, the gray dots represent the monthly number of theft cases prior to the COVID-19 pandemic, while the red dots indicate the monthly number of cases during the pandemic. The red dashed line prior to the first lockdown illustrates the trend of thefts before the pandemic, whereas the solid red line represents the trend after the pandemic onset. The dashed gray line demonstrates the anticipated trend based on pre-pandemic data. The slope of these lines reflects the changes in the number of monthly theft events.

Variable	Time	IRR	CI for IRR		P-value
			2.5%	97.5%	
Theft	Before the pandemic (1–23 months)	1.021	1.019	1.022	$P < 0.001$
	Immediate effect	0.959	0.938	0.980	$P < 0.001$
	Sustained effect (1–13 months)	0.978	0.976	0.981	$P < 0.001$
Homicide	Before the pandemic (1–35 months)	0.982	0.972	0.993	0.001
	Immediate effect	2.407	1.632	3.549	$P < 0.001$
	Sustained effect (1–13 months)	0.953	0.911	0.998	0.04

**Table 4.** Change in IRR of theft and homicide before, immediately, and during the first year of the COVID-19 pandemic.



**Fig. 4.** Monthly frequency of thefts before and after the COVID-19 pandemic.

Similarly, the trend of homicides was decreasing before the pandemic, but a significant increase was observed in the months immediately following it, followed by a steep decline. Additionally, had the pandemic not occurred, the monthly number of homicides would have been slightly lower at the end of 2020 (Fig. 5).

In Fig. 5, the gray dots represent the monthly number of theft cases prior to the COVID-19 pandemic, while the red dots indicate the monthly number of cases during the pandemic. The red dashed line prior to the first lockdown illustrates the trend of homicide before the pandemic, whereas the solid red line represents the trend after the pandemic onset. The dashed gray line demonstrates the anticipated trend based on pre-pandemic data. The slope of these lines reflects the changes in the number of monthly homicide events.

**Discussion**  
**Impact of COVID-19 on crime rates**

The COVID-19 pandemic significantly impacted crime rates in Kerman Province, resulting in notable variations in theft, conflict, and homicide rates.

**Theft rates**

From early 2018 until the end of 2019, a substantial increase in theft cases was observed, marking the pre-pandemic period. However, the onset of the pandemic led to a rapid and significant decline in theft rates during

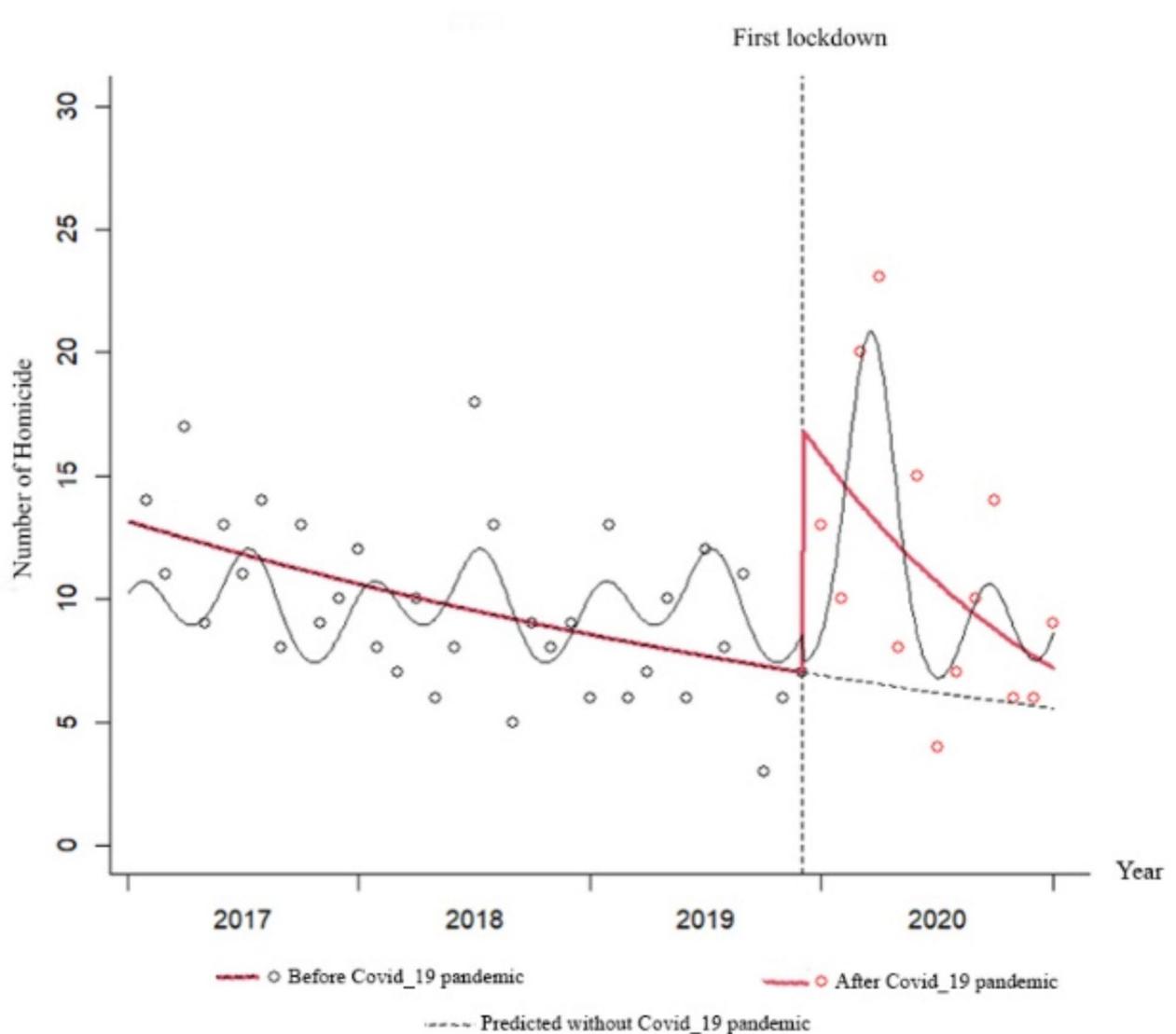


Fig. 5. Monthly frequency of homicide before and after the COVID-19 pandemic.

its early stages. This downward trend continued through the end of 2020, resulting in monthly theft counts that were lower than those projected based on pre-pandemic data.

### Conflict rates

In the initial year of the COVID-19 pandemic, there was an average increase of 11% in the incidence rate ratio (IRR) of conflicts compared to the previous three years. Although conflict rates declined in 2019 relative to 2018, a resurgence was noted in 2020, with men's conflict rates consistently exceeding those of women throughout this period.

### Homicide rates

Homicide rates demonstrated a downward trend from 2017 until 2019, followed by an initial increase at the onset of the pandemic. Despite this initial rise, a significant decline in homicide rates occurred throughout the pandemic period. Notably, the monthly count of homicides at the end of 2020 surpassed projections based on pre-pandemic data, highlighting critical changes post-pandemic onset.

### Comparative analysis of existing literature

Comparative studies from various regions underscore the complexity of the pandemic's impact on crime rates. For instance, the effects on theft rates exhibited significant variability across different communities; while some areas experienced notable fluctuations, others maintained stable rates<sup>5,7-15</sup>. In Bangladesh, traditional crimes, such as vehicle theft and illegal arms dealing, saw little change post-pandemic, whereas illegal drug trafficking surged<sup>41</sup>. Conversely, Indonesia reported an overall decline in crime rates during the same period<sup>42</sup>. Similarly, in India, economically motivated crimes increased, while violent crimes largely remained unchanged<sup>43</sup>. Specific studies indicated a surge in various forms of violence and conflict in multiple countries<sup>7,15,19-22</sup>. Initial reports highlighted an increase in domestic violence; however, this trend eventually declined in certain regions<sup>44</sup>. Conversely, other types of offenses, including public harassment of women, assaults, sexual offenses, and drug-related crimes, exhibited declines in specific areas<sup>11-13</sup>. Moreover, another study showed a notable decrease in theft and homicide rates across various cities globally<sup>16</sup>. Additionally, existing literature indicates that some regions experienced increases in homicide rates<sup>23,24</sup>, while others reported no significant changes or even reductions<sup>9,25-29</sup>. To understand the fluctuations in crime rates during the pandemic, it is necessary to consider the underlying factors at play.

### Factors influencing crime rates

Numerous studies have documented reductions in property crime during the pandemic, particularly in crimes dependent on physical proximity, aligning with our findings. Factors such as increased home confinement, heightened awareness of personal belongings, and diminished opportunities for criminal activities likely contributed to this decline<sup>2,5,16</sup>. Additionally, the closure of businesses and public spaces further reduced potential theft targets, while social distancing measures may have enhanced urban oversight. The decline in vehicle theft and shoplifting could be linked to fewer interactions among individuals outside their homes<sup>16,45</sup>.

Despite the reductions in theft rates, the pandemic has generated significant socio-economic challenges, including rising unemployment, educational disruptions, reduced GDP, and increased public health risks<sup>46</sup>. These economic strains can adversely affect mental health, potentially leading to behaviors that contribute to crime<sup>47</sup>. Although a theoretical link exists between rising theft rates and issues such as hunger and poverty, further empirical investigation is needed to substantiate this connection<sup>7</sup>. Previous studies have indicated correlations between unemployment and property crimes<sup>48,49</sup>, yet establishing direct causation is critical for effective policy formulation.

Conflicts are influenced by multitude factors, including poverty, unemployment, inflation, and the overall socio-economic landscape<sup>50</sup>. The pandemic has significantly impacted mental health, which may correlate with changes in crime rates<sup>51,52</sup>. The restrictions imposed during this period have heightened stress and mental burdens due to concerns about safety, welfare, and financial stability, which could contribute to increasing tensions within households<sup>19</sup>. Extended close contact in restricted environments, particularly during lockdowns, may create various negative pressures and emotional responses, potentially leading to conflicts between individuals<sup>5</sup>.

However, the observed decrease in domestic violence reports may not accurately reflect the reality of the situation, as victims may avoid seeking help due to fears of monitoring by perpetrators<sup>44</sup>. Additionally, the decline in conflicts might relate to changes in daily routines, such as reduced interactions in urban settings<sup>45</sup>. Some individuals may have avoided contacting police due to health concerns related to illness transmission, resulting in unrecorded disputes. Furthermore, the closure of courts and dispute resolution centers may have deterred individuals from reporting conflicts.

Homicide is a complex phenomenon that can be influenced by multiple factors, including income inequality, financial disputes, and mental health issues<sup>53-55</sup>. Pandemic-specific factors that may have contributed to changes in homicide rates include increased gun sales, higher alcohol consumption, intimate partner violence, and child abuse<sup>56</sup>. Additionally, disruptions in law enforcement operations and decreased community supervision may have further influenced crime trends. Factors such as unemployment and economic difficulties arising from stay-at-home mandates, combined with increased interactions among household members, may have also contributed to heightened tensions and conflicts that could lead to violence.

Conversely, the observed reduction in homicide rates can be associated with fewer gatherings in venues such as bars, nightclubs, and shopping centers, as well as locations related to drug trafficking and prostitution<sup>14</sup>. Additionally, the decreased incidence of brawls, armed assaults, and homicides may reflect diminished social interactions in urban environments<sup>45</sup>. However, the effects of the pandemic varied significantly by region; cities

with stricter restrictions exhibited lower crime rates, although these levels began to return toward pre-pandemic figures as restrictions were relaxed<sup>17</sup>.

Homicides can be classified into two categories: those arising from involvement in criminal activities, such as drug trafficking, robberies, domestic disputes, and reprisals; and those resulting from motives such as sexual assaults, kidnappings, and unclear motivations<sup>29</sup>. The relatively stable homicide rates during the pandemic may indicate that many incidents occurred within household settings, which might have been less influenced by external lockdown policies. Furthermore, homicides resulting from conflicts between criminal factions or drug trafficking disagreements may be less influenced by alterations in individuals' daily routines<sup>16</sup>.

### Gender differences in homicides

A noteworthy gender disparity emerged in homicide trends during the pandemic: while male homicide rates decreased from 2017 to 2019, female homicide rates exhibited an increase from 2017 to 2020. This upward trend in female homicides in 2020 is intriguing, as it cannot be solely attributed to the pandemic. It indicates a need for further research to discern whether such increases would have occurred independently of pandemic circumstances. Overall, these findings highlight the complex interplay between the COVID-19 pandemic and homicide rates, emphasizing notable variations by gender.

### Overall findings

Our findings reveal that different types of crime evolved in distinct ways throughout the pandemic, aligning with existing literature while also uncovering unique regional dynamics. This inconsistency highlights the importance of considering local contexts when assessing crime trends. The observed discrepancies underscore the intricate interplay of various factors—criminal, social, economic, health-related, and demographic—that influence crime trends and vary by region<sup>17</sup>. Furthermore, a global analysis has indicated that stricter movement restrictions during the pandemic correlated with more substantial declines in crime rates<sup>16</sup>, further illustrating the multifaceted nature of crime dynamics in crisis situations. By elucidating these nuanced differences, our research provides valuable insights into the understanding of crime dynamics during crises, specifically within the context of Kerman Province. Our work addresses a critical gap in the literature concerning the socio-economic drivers that shape these crime trends, which is essential for informing future research and policy decisions.

Ultimately, research exploring these dynamics will be critical in developing tailored responses that meet the unique needs of communities grappling with the lasting impacts of the pandemic. Such inquiries can reinforce policy recommendations aimed at mitigating crime during both emerging and enduring crises.

### Recommendations for a comprehensive approach

To mitigate crime during and after crises like the COVID-19 pandemic, we propose the following multifaceted strategies:

#### Enhancing community policing

Strengthening community policing initiatives can build trust between law enforcement and residents, particularly in vulnerable neighborhoods. Increased police presence in these areas can foster relationships that facilitate intelligence-sharing and address the root causes of crime. Evidence from Liberia indicates that regular interactions between law enforcement and communities reduced mob violence by approximately 40%<sup>57</sup>. Similarly, police-community partnerships in Ethiopia have enhanced public confidence and effectively addressed crime-related issues through collaborative community programs<sup>58</sup>.

**Utilizing technology:** Law enforcement agencies are encouraged to adopt technological advancements to support crime prevention and response strategies. This includes employing data analytics to identify crime hotspots, establishing remote reporting systems, and utilizing video conferencing for court proceedings<sup>59</sup>. Such technologies can enhance public safety while adhering to social distancing protocols and can also improve overall police performance through swift investigative processes. Various countries have adopted technologies such as electronic surveillance and automatic ticketing, demonstrating their effectiveness in crime control<sup>60</sup>.

**Implementing targeted interventions:** Addressing crime exacerbated by pandemic conditions requires targeted interventions. Community-based violence intervention programs tailored to mitigate gun violence and violent crime through conflict mediation, mentorship, and support services have garnered positive results. Evidence from England demonstrates that specific interventions yield better outcomes than broad measures, minimizing potential collateral damage<sup>61</sup>.

**Investigating root causes of crime:** Investigating the socio-economic determinants of crime—such as unemployment, mental health issues, and substance abuse, along with investing in social services, job creation programs, and mental health resources, can help prevent crime in the long term. Research in the United States has indicated strong correlations between economic instability and delinquency, emphasizing the necessity for job creation programs to ease poverty and subsequently reduce crime<sup>62</sup>. Furthermore, addressing mental health and substance abuse treatment is vital, as youth engaged in such programs tend to exhibit lower rates of detention and criminal behavior<sup>63</sup>.

**Promoting international cooperation:** International cooperation is essential in combating transnational organized crime during the pandemic. This can involve sharing intelligence, coordinating law enforcement initiatives, and enhancing cross-border collaboration to disrupt criminal networks. A study within the U.S.-Canada context shows the effectiveness of collaborative transnational policing practices, which serve to prevent crime in the illicit economy through informal, ad hoc negotiations<sup>64</sup>.

### Policy implications and future research

Our findings indicate varied outcomes across different contexts, primarily presenting observed trends without establishing clear causal relationships. Since correlations do not imply causation, any policy recommendations should be approached with caution. However, our research identifies several potential areas for proactive measures, including enhancing communication, implementing crisis management protocols, supporting vulnerable populations, fostering community engagement, and strengthening law enforcement outreach. These initiatives may aid in conflict resolution and enhance overall community safety. Given the complexities surrounding crime during the pandemic, there is an urgent need for robust empirical research to inform effective policy actions. Future studies should focus on establishing empirically supported causal relationships and examining the socio-economic factors driving these crime trends. Additionally, further empirical investigations are necessary to validate these findings and address ongoing issues in this evolving context.

### Conclusion

This study reveals that the COVID-19 pandemic significantly affected crime rates in Kerman Province, Iran, with notable fluctuations in theft, conflict, and homicide rates. Before the pandemic, theft cases had been on the rise, but they dramatically declined with the onset of the pandemic, resulting in theft rates consistently lower than previously expected. This decline may be associated with increased public awareness, intensified police monitoring, and fewer opportunities for crime. Nevertheless, some increases in theft during the pandemic could be linked to challenges such as hunger and unemployment.

Conflicts surged during the first year of the pandemic, likely due to quarantines and economic distress experienced by the community. Homicide rates initially rose but later declined, although monthly counts still exceeded pre-pandemic projections by the end of the year. Factors contributing to the early increase in homicides may include unemployment and mental health issues, while the subsequent decrease might be related to reduced gatherings in high-crime areas and diminished social interactions.

These findings resonate with existing global literature, highlighting both commonalities and divergences in crime patterns during the pandemic. While some regions experienced decreases in crime, others observed increases, underscoring the influence of local socio-economic, health-related, and demographic factors. Investigating underlying issues—such as heightened home confinement, economic strains, and shifts in social interactions—provides essential insights into the variability of crime trends worldwide.

Overall, this study contributes to the growing body of research focused on understanding the complex nature of crime in crisis situations. It emphasizes the necessity for nuanced and localized analyses to guide effective policy responses and intervention strategies. Acknowledging the uncertainties in linking crime trends directly to the pandemic further underscores the importance of ongoing empirical research to deepen our understanding of the intricate relationship between global crises and crime dynamics.

Future research should prioritize exploring relationships and the socio-economic foundations of these trends to devise effective preventive measures tailored to communities affected by similar crises. Understanding the pandemic's impact on crime is crucial for several reasons: it enhances our awareness of changing crime patterns, informs policy decisions, optimizes law enforcement resource allocation, improves public safety measures, and aids the development of targeted crime prevention strategies. This research is vital for formulating evidence-based responses to mitigate the effects of future public health crises on crime rates.

### Limitations and suggestions

This study has several limitations that must be acknowledged. As an ecological study, it lacks individual-level information and cannot establish definitive causal relationships.

Therefore, future research should investigate individual motives and reasons for crimes during the COVID-19 pandemic to provide authorities with a deeper understanding of the factors contributing to increased crime rates and to inform effective prevention programs.

The conflict and homicide data span from 2017 to 2020, while the theft data only covers 2018 to 2020. This discrepancy means our analysis of theft trends is not fully representative of the same temporal context as the conflict and homicide data. Variations in crime rates can be influenced by various socio-economic factors, policy changes, and other external conditions that fluctuate year to year. Consequently, the absence of 2017 theft data limits our ability to make direct comparisons or draw comprehensive conclusions about the relationship between homicides and thefts over the same period. Additionally, the differing time periods for the data on conflict, homicide, and theft complicate a comprehensive analysis of crime trends. Future research should aim to integrate more consistent temporal data to provide a holistic view of these trends.

Our analysis utilizes the ITS approach to examine crime trends during the COVID-19 pandemic. However, this method relies on a critical assumption that crime rates would have remained constant without the pandemic, which may not accurately capture the various socio-economic factors influencing crime during this time. While the data suggest a significant impact of the pandemic on crime rates, directly attributing these changes to the pandemic is speculative due to inherent uncertainties in the ITS model. This caution is particularly relevant given the strong assumptions underlying the model. Therefore, a comprehensive comparative analysis of different influencing factors is essential for a clearer understanding of these trends. Future research should focus on clarifying the complex interplay of factors affecting crime rates during this unprecedented period. Additionally, it is important to consider that the confidence interval for the IRR of homicides highlights a degree of uncertainty that should guide data interpretations.

Moreover, exploring the effects of factors such as remote working, the closure of entertainment and tourism venues, fear of disease, and mask-wearing on crime rates could yield valuable insights. It will also be essential to examine crime rates in the second year following the pandemic to determine whether the observed trends persist or change.

## Data availability

The data that support the findings of this study are available upon request. Please contact Professor Mohsen Rezaeian at moeygmr2@yahoo.co.uk for access to the data.

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## Author contributions

S.P: Conceptualization, Methodology, Formal analysis, Investigation, Resources, writing – original draft, Data curation, writing – review & editing., H.A: Methodology, Formal analysis, Investigation, Writing – review & editing. M.R: Conceptualization, Methodology, Formal analysis, Investigation, Resources, writing – original draft, Writing – review & editing. M.K: Investigation, Resources. All authors contributed to and have approved the final manuscript.

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## Declarations

## Competing interests

The authors declare no competing interests.

## Ethics approval

This ecological study survey was approved by the Research Ethics Committee of Rafsanjan University of Medical Sciences (IR.RUMS.REC.1400.013).

## Informed consent

This ecological study involved the analysis of aggregated, population-level data collected from individuals living in Kerman Province. Due to the retrospective nature of the study and the use of anonymized data without any individual-level personal characteristics, the need to obtain informed consent was waived by the Research Ethics Committee of Rafsanjan University of Medical Sciences. All data collection and analysis procedures adhered to relevant institutional and national guidelines and regulations.

## Additional information

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