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# The relationship between pay day and violent death in Guatemala: a time series analysis

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## Abstract

**Objective—**To assess if violent deaths were associated with pay days in Guatemala.

**Design—**Interrupted time series analysis.

**Setting—**Guatemalan national autopsy databases.



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**Contributors**

DER, DJW and CCB conceived and designed the study. DER and MV-T acquired the data. DJW and DER analysed the data. DER, DJW, TSR, KB and DX interpreted the data. KB, MV-T and DER drafted the manuscript. All authors critically revised the manuscript for important intellectual content; all approved the final version to be published and all agreed to be accountable for all aspects of the work. DER, DJW and CCB as guarantors accept full responsibility for the work and the conduct of the study, had access to all the data, and controlled the decision to publish. The manuscript's guarantors affirm that the manuscript is an honest, accurate and transparent account of the study being reported; that no important aspects of the study have been omitted and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

**Competing interests** DER, TSR and CCB had financial support from the US NIH (grant number D43TW008972) and TSR, DJW and CCB had financial support from the US CDC (grant number R49CE002474) for the submitted work.

**Ethics approval** The study protocol was approved by the Institutional Review Board of the School of Medicine at Universidad Francisco Marroquín, Guatemala, Central America.

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**Data sharing statement** No additional data available. Data were provided by the National Institute of Forensic Sciences (INACIF), a governmental institution of Guatemala's justice system. The INACIF carries out all forensic medicolegal investigations throughout Guatemala, including for all violent deaths. The INACIF provides the Guatemalan justice system with forensic evidence from autopsies, so that the courts can assess the intentionality of each violent death (eg, intentional homicide, unintentional death). The data it collects are also available to interested researchers. Interested parties could contact the INACIF directly in Guatemala City to obtain the same data that were used for our study.

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**Participants—**Daily violence-related autopsy data for 22 418 decedents from 2009 to 2012. Data were provided by the Guatemalan National Institute of Forensic Sciences. Multiple pay-day lags and other important days such as holidays were tested.

**Outcome measures—**Absolute and relative estimates of excess violent deaths on pay days and holidays.

**Results—**The occurrence of violent deaths was not associated with pay days. However, a significant association was observed for national holidays, and this association was more pronounced when national holidays and pay days occurred simultaneously. This effect was observed mainly in males, who constituted the vast majority of violent deaths in Guatemala. An estimated 112 (coefficient=3.12; 95% CI 2.15 to 4.08; p<0.01) more male violent deaths occurred on holidays than were expected. An estimated 121 (coefficient=4.64; 95% CI 3.41 to 5.88; p<0.01) more male violent deaths than expected occurred on holidays that coincided with the first 2 days following a pay day.

**Conclusions—**Men in Guatemala experience violent deaths at an elevated rate when pay days coincide with national holidays. Efforts to be better prepared for violence during national holidays and to prevent violent deaths by rescheduling pay days when these days co-occur with national holidays should be considered.

## INTRODUCTION

Violence negatively impacts the health and economy of individuals, families and societies. More than 1.5 million people die each year due to violence around the world, mainly young males from low-income and middle-income countries. Yet more individuals suffer non-fatal violent injuries, making violence a major cause of morbidity and mortality in low-income and middle-income nations.[1] In 2012, the homicide rate was 6.7 per 100 000 population worldwide, four times higher in Latin America (28.5),[2] fivefold in Guatemala (34.2)[3] and 10-fold in Guatemala City alone (68.6).[4]

Despite having emerged from a 36-year civil war, Guatemala currently faces one of its most violent times. Violence is a leading threat to Guatemalan democracy, human development, economic growth and public health.[5] From 1999 to 2006, homicides increased 120%.[6] Homicide rates steadily increased from 25.9 per 100 000 population in 2000 to 46.5 in 2009, and decreased to 39.9 in 2012.[7] In 2011, Guatemala was ranked by the Global Peace Index (GPI) as one of the least peaceful nations in the world with the largest annual deterioration in GPI.[8] The most recent data reveal that 5253 homicides occurred in Guatemala in 2013 and 4998 in 2014, with homicides rates of 33 and 31 per 100 000, respectively.[9]

Factors affecting violence have been studied from numerous perspectives.[1011] Some studies suggest that the incidence of violence can be influenced by temporal factors that seem to affect people in different circumstances, spaces and times.[12–14] It is important to identify factors playing a significant role in the timing of violence for specific populations, in order to anticipate the occurrence of violence and guide prevention strategies.

In Guatemala, *los días de pago*, or pay days, are specific, regular and recurring days of each month when workers receive their allotted salaries. Unlike in developed nations, many

Guatemalans receive their salaries as direct cash, or decide to cash their pay cheques on pay days. There is a local sense that violent deaths escalate during the middle and the final days of every month, precisely when wages are paid.

This is plausible in terms of the theory of routine activities,[15–18] which proposes that three major elements pre-empt the occurrence of crime: (1) motivated offenders, (2) availability of targets and (3) an absence of capable guardianship (figure 1). A suitable target is any person or thing (such as money) that may evoke violent inclinations; a motivated offender is anyone with an inclination to commit violence and capable guardianship is a person, device or situation that can protect a target. Routine activities theory holds that violence results from the convergence of these elements, and the lack of any one of these may prevent the occurrence of violence. Homicide, a prime example of violence, has been previously studied using routine activity theory.[19–22]

In Guatemala, all three elements of routine activities theory are active around pay days. There are motivated offenders due to poor socioeconomic conditions as well as an active and organised criminal infrastructure.[23–26] Because working Guatemalans are often paid in and carry cash, they become suitable targets for violence while a fragile and undertrained law enforcement and security system offers little guardianship.[27] Media reports suggest that violence increases when wages are distributed on pay days,[28] but no scientific studies support this claim. In South America, specific interventions to reduce homicides have shown some success, but these programmes are unable to determine if cyclic time trends and recurring events, such as pay days, play a significant role in the continued occurrence of violence.[29] If these events were playing such a role, they could readily serve as modifiable opportunities for prevention.

Routine activity theory thus served as the primary conceptual framework for this study. In figure 1, suitable targets and motivated offenders are represented as ovals. Weak guardianship, along with alcohol abuse, gang activity and drug trafficking, is a contextual determinant represented by the large circle. Pay day is the hypothesised exposure, which theoretically makes victims more attractive targets to motivated offenders in the absence of guardianship, thereby hypothetically leading to increased violent deaths. Sex, age and holidays are potential confounders of this relationship.

Many researchers have used routine activities theory to study the seasonality of crime in the northern hemisphere.[133031] But studies on temporality of violence in tropical, low-income and middle-income nations, with different weather and economic conditions, are lacking. There are few studies assessing cyclic time trends in violent events in low-income and middle-income countries,[32] particularly the potential relationship between pay days and violent death in Latin American nations like Guatemala. Our aim was to determine if violent death incidence was associated with pay days and other important days in Guatemala. To the best of our knowledge, this is the first low-income and middle-income nation study to assess if the temporality of violent deaths is cyclic and related to pay days.

## METHODS

We performed an interrupted time series analysis on autopsy data of violent deaths in Guatemala. Data at the individual level were provided by the National Institute of Forensic Sciences (INACIF), a governmental institution of Guatemala's justice system. The INACIF carries out all forensic medicolegal investigations throughout Guatemala, including for all violent deaths. The INACIF provides the Guatemalan justice system with forensic evidence from autopsies, so that the courts can assess the intentionality of each violent death (eg, intentional homicide, unintentional death), although the data it collects are also available to interested researchers. Over 95% of all violent deaths in the country are investigated and recorded by INACIF, that is, the vast majority of cases. Coroners or fiscals collect data at the site of the event, medical examiners and other forensic experts perform the autopsies at the INACIF settings and record more data. Our time period of analysis was from 2009 to 2012. The INACIF dataset provided date, sex, age and mechanism of death for each decedent. Case identification and selection are presented in figure 2. Overall, 51 008 autopsies were considered for eligibility.

Inclusion criteria were all violent deaths with causes listed as: death by firearm, stabbing, strangulation or decapitation. Exclusion criteria were: (a) cases in which the decedent was <10 years old—the legal threshold for employment in Guatemala is over 14 years of age[33]; however, many children below 14 years of age labour in the informal sector,[34] (b) case with incomplete data and/or (c) deaths related to traffic or occupational injuries. A total of 22 418 cases were ultimately available for analysis. The causes of death in the dataset were not coded, instead they were free texted. In order to assign the cause of death, we searched the dataset for key words and local acronyms suggestive of homicide.

We treated violent death as the outcome, defined as deaths of people ≥10 years of age, by violent means that were not incidental/unintentional or self-inflicted/suicide. Sex-specific violent death time series were derived and analysed in separate models.

Data were aggregated by date so that the final analytic dataset was a time series of the incidence of violent deaths each day over the 4-year period (n=1460 days). Sex-specific violent death time series were derived and analysed in separate models. The analysis began by fitting the time series using autoregressive integrated moving average (ARIMA) modelling.[3536] ARIMA models are used in studies where the data are comprised of a long series of observations that are ordered chronologically. Because the observations in temporally sequenced data are not independent, the values of adjacent observations are typically more similar to one another than are observations that are further apart in time, thus making conventional statistical methods (eg, ordinary least squares (OLS) regression) inappropriate. ARIMA modelling manages this temporal autocorrelation by identifying the nature of the correlation between observations and controlling for it.

After fitting the model adequately, we added covariates to represent the timing of each of the hypothesised pay day and other interruptions and to test for the hypothesised impact of pay day on violence. Different pay-day definitions necessitated different lags in time. Some employees get paid the last day of every month, while some do twice a month, the 15th and

the last days. However, some employers prefer paying one or more days before those days. We also considered that some people may carry money some days after pay day. As a result, there is no fixed pay day for everyone in Guatemala. To operationalise 'pay day' for the purposes of analysis, we built a varying set of lagged predictor variables:

- Pay day: 15th and last day of each month.
- Pay day 1: 15th±1 and last day of each month±1 day.
- Pay day 2: 15th±2 and last day of each month±2 days.
- Pay day 3: 15th±3 and last day of each month±3 days.
- Pay day after 1: 15th+1 and last day of month+1 day.
- Pay day after 2: 15th+2 and last day of month+2 days.

It is reasonable to anticipate that the incidence of violent death on holidays may be more frequent than average.[37] Moreover, a holiday may fall on a pay day, potentially enhancing the likelihood of fatal violence. It is plausible from the routine activity theory, that a holiday that coincides with a pay day would provide the perpetrators with more chances to find a suitable target. Thus holidays, occurring in isolation as well as co-occurring with pay days, were analysed as confounding covariates and also as predictor variables to account for this possibility and to test for evidence of any related effect (see the coding scheme in online supplementary appendix).

By modelling each of these six predictor variables sequentially in separate models, we were able to test whether the mean number of violent deaths daily was significantly higher on pay days only, on pay days and on the preceding and subsequent days, or on pay days and on only subsequent days, compared with the mean number of daily violent deaths that occurred on other days. We also tested for the effects of holidays and pay days occurring on a holiday.

The goodness of fit of the original ARIMA model, and the model after including each of the predictor variables, was evaluated using conventional techniques including plots of the autocorrelation function of the residuals, the Q statistic where smaller values indicate a better model fit, and the root mean square error (RMSE) of the residuals where smaller values indicate a better fit.[35,36]

## RESULTS

Of the 22 418 violent deaths, 2408 (10.7%) were females and 20 010 (89.3%) were males. An average of 15.34 violent deaths per day occurred over the study period. A total of 88.4% of the violent deaths were due to firearms. Descriptive statistics are presented in table 1.

There were 3 days each year during the study period on which a holiday and pay day occurred on the same date: 30 June, 15 September and 31 December. Easter is the only Guatemalan holiday that is variable across date. However, no Easter during the study period occurred on a payday.

Basic analyses demonstrated a changing mean over time. After a sustained increase in homicide rates observed from 1999 to 2009,[6] an annual decline in the mean number of violent deaths per day was observed from 2009 to 2012.

Results of the ARIMA models that sequentially tested each of the six pay-day predictor variables are reported in table 2. The incidence of violent deaths was neither more nor less common during the study period on days when pay days occurred. This null finding was observed in each of the six different classification schemes that were used to establish pay-day lags.

However, significant associations were observed for holidays, and the effects were more pronounced when holidays and pay days occurred simultaneously. Table 2 shows that the incidence of violent deaths was significantly higher on holidays and was also significantly higher on pay days that occurred on holidays. When using the 'pay day 0' lag that treated only the one, actual pay day as the exposure and that also treated days when a holiday coincided with a pay day as a separate exposure, we found that 2.6 more violent deaths occurred on holidays ($p<0.001$) and 3.13 more occurred on pay days that coincided with a holiday ($p<0.001$) as compared with other days. Using the 'pay day 1' lag that treated pay days ±1 day as the exposure day we found that 4.8 more violent deaths occurred on pay days that coincided with a holiday ($p<0.001$) as compared with other days. This coding scheme produced the smallest Q and RMSE values, indicating a superior model fit, however, the Q and RMSE values produced by the six coding schemes were all very similar and statistically indistinguishable.

In the analysis by gender, evidence of a significant impact of pay days and holidays on violent deaths was observed in males and females (table 3).

Table 4 shows the number of female and male violent deaths that occurred, above and beyond the daily average, over the course of the study period according to each of the schema used to classify pay days and holidays. Among men, using the 'pay day 2' lag, an excess 25 more violent deaths than expected occurred on 'holidays only' (1.12×22 holidays only that occurred during the study period) and 121 more violent deaths occurred than expected on pay days that coincided with holidays (4.64×26 'both' days, ie, pay day 3 together with holiday).

Under the pay day 0 lag, an excess 112 more male violent deaths occurred on 'Holiday only' compared with the mean number of violent deaths expected. For the 'pay day after 2' lag there was the highest excess of male deaths on a holiday that coincided with the first 2 days following a pay day, 121 more violent deaths (table 4).

## DISCUSSION

The risk of fatal violence in this study was associated with holidays and holidays that occur on pay days and appears to impact men and women. Pay days per se do not appear to pose an increased risk of violent death. However, during the course of the 4-year study period, an average of approximately one more man died on holidays, and four more men died on pay days that coincided with holidays, than men died on days that were neither a pay day nor a

holiday. We believe this is the first study to identify evidence that pay days and holidays are associated with such an elevated risk of fatal violence.

Stratifying our analysis by sex served to identify that this effect was not limited to men, although its impact on the violent deaths of women was notably less. Using a coding scheme that differentiated between pay days and holidays served to identify that the risk of violent death was not elevated on pay days alone but rather only on days when a holiday occurred or when a pay day coincided with a holiday, which was found to contribute a novel risk beyond that which stemmed from a holiday alone.

In our analyses of men, the regression diagnostics indicated that the six different lags used to classify pay days and holidays essentially performed equally well. Perhaps this is not surprising given that the time series under study, at 1461 days, was relatively long, and the number of those days that were pay days or holidays were relatively few and ranged from 1 to 7 days in the six schemes. Therefore, the predictor variables differ little from one another in terms of the number of days that they each classified as exposed.

In terms of determining which, if any, results were of primary interest, we focused on what might have been implied about violent deaths from the coding of each predictor variable. Whereas one variable treated only exact days as exposed and two variables treated one and two subsequent days as exposed, one variable treated exact days as well as the preceding and the subsequent 3 days as exposed. Thus, the novel contribution of this bundle of predictor variables was to reveal that days preceding pay days, in addition to pay days themselves and subsequent days, were also associated with an elevated risk of violent death. Because these variables indicated that the window of elevated risk was relatively long, spanning a full week, we focus on this as our finding of interest. As indicated in the summary table 4, we ultimately found that in Guatemala, up to 121 more violent deaths occurred during the 4-year study period than would have occurred had holidays and coinciding holidays and pay days not occurred.

A counterfactual scenario for consideration here are days where pay days and holidays are somehow eliminated, although that scenario, of course, is impractical. However, whereas it is obviously unreasonable to abolish pay days and holidays, it is possible to change the timing of pay days. One way that, in the future, we might prevent the exposure found here to be associated with violence is to stagger the days on which pay is delivered to employees.

With regard to the relationship found between holidays and violent deaths, policymakers could think of interventions including the intensification of guardianship, stepped up law enforcement or perhaps informal guardianship, during holidays on a regular basis. This would modify one of the three components of the routine activity theory (ie, weak guardianship). On the other hand, regarding the apparent synergistic effect of pay day and holidays on violent deaths, policymakers might also, for instance, consider spreading pay days equally across each day of the week so that of one-seventh of the population gets paid on any given day of the month. That essentially makes the ‘dose’ of the exposure less concentrated than it is currently, and could serve to help reduce the incidence of violent

death in Guatemala. This approach could also be considered for other nations in the Americas, where rates of homicide are comparably high.

These findings are consistent with the routine activity theory. While pay day itself did not represent an increase in risk, the 2 days following pay day suggested a trend consistent with routine activity theory. Greater occurrence of violent deaths occurred during national holiday periods and holidays that occurred on pay days. In Guatemala, these co-occurring days were 30 June, 15 September and 31 December. These 3 days in particular could be important opportunities for prevention. Nevertheless, we should keep in mind that violence is a multi-factorial problem. A recent study found that the rate of homicides decreased during periods of stronger restriction of alcohol sales and consumption.[38] Similarly, gang activity, narcotics trafficking, intimate partner violence, among others, have been found to be related to violence.

## Study limitations

While the increased risk on co-occurring holidays and pay days may be hypothesised to be a synergistic relationship, the observed effect only occurred on 3 days each year and those days were fixed each and every year during the 4-year study period. There may be other variables tied to the social or cultural meaning of those 3 days that better explain our findings. This limitation, however, does not undermine the value of our statistical findings in terms of potential prevention strategies and action.

According to the Guatemalan National Survey on Employment and Income, 30.7% of the country's overall population and 56.1% of its urban population, work in the formal economy.[39] The fact that a large proportion of workers are part of the informal economy in Guatemala could have biased our results to the null, since the informal labour force has no fixed pay days such as those defined for this study.

Our data only include INACIF-investigated deaths, which could create a selection bias. Nevertheless, over 95% of all violent deaths in Guatemala are examined by INACIF, so this bias is likely minimal. Our data also may include cases that were injured and then hospitalised, who died some days after, and whose autopsy date did not coincide with their date of violent injury. This misclassification could also bias our results to the null as we would expect a larger effect if these data were known. Ultimately regarding data quality, it is reassuring that our counts of violent deaths are similar to those reported by United Nations Office on Drugs and Crime (UNODC).[9] For the period 2009–2012, we identified 876 fewer homicides and, on average, we counted 5604 homicides per year, 219 below UNODCs average (5823).

The inclusion of homicides that may not have been mechanistically tied to pay days in the analysis could have led to misclassification (for instance, familicides), may have been outside our study's theoretical framework and influenced our findings. In addition, non-fatal violence and assaults, often emerging from arguments that may evolve from situations related to increased resources around pay day, such as greater alcohol consumption, were outside the scope of our study. Future studies of homicide subtypes and non-fatal violence

are certainly warranted given that the data available to us did not include sufficient information to ascertain the type of homicide or its circumstances or non-fatal violence.

No specific geographical areas or age strata were considered in our analyses. Future studies may take into account these two stratifications. In addition, future subanalyses based on social, economic (eg, unemployment) or indigenous/non-indigenous disparities may be important to undertake given prior nationwide findings on violence in Guatemala.[40]

## CONCLUSIONS

Biweekly standardised pay periods may create opportunities for prevention of violence in Guatemala. Men in Guatemala experience violent deaths at an elevated rate when pay days coincide with national holidays. Efforts to be better prepared for violence during national holidays and to prevent violent deaths by rescheduling pay days when these days co-occur with national holidays should be considered.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**What is already known on the subject?**

- Violence is a leading threat to democracy, human development, economic growth and public health of low-income and middle-income countries.
- Males constitute the vast majority of violent deaths in Guatemala.
- Temporal patterns of violence result from varying natural and social variables that seem to affect people in different circumstances, spaces and times.

**What this study adds?**

- The occurrence of violent deaths was not associated with pay days in this study, but a significant association was observed for national holidays, especially when these concurred with pay days.
- In Guatemala, these co-occurring days were 30 June, 15 September and 31 December.
- These 3 days in particular could be important opportunities for prevention and control strategies.

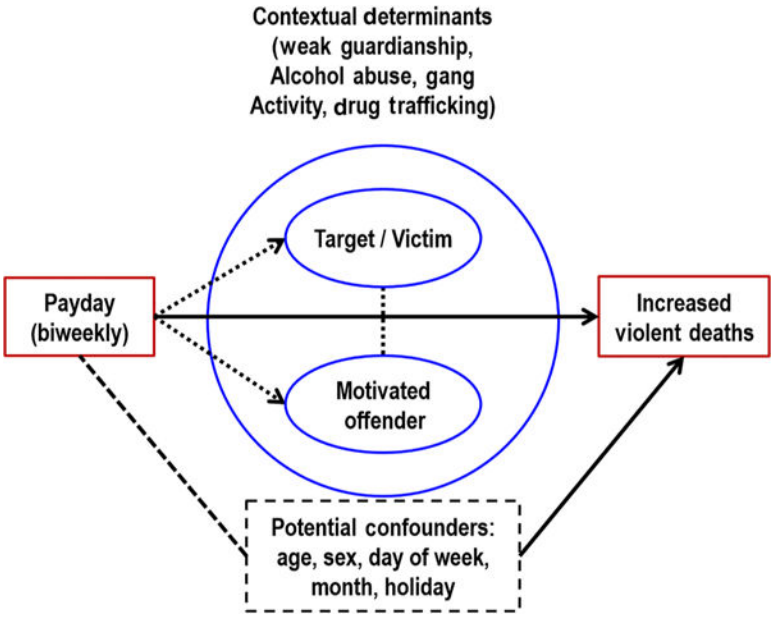


**Figure 1.**
The conceptual framework for this study is based on the routine activity approach.

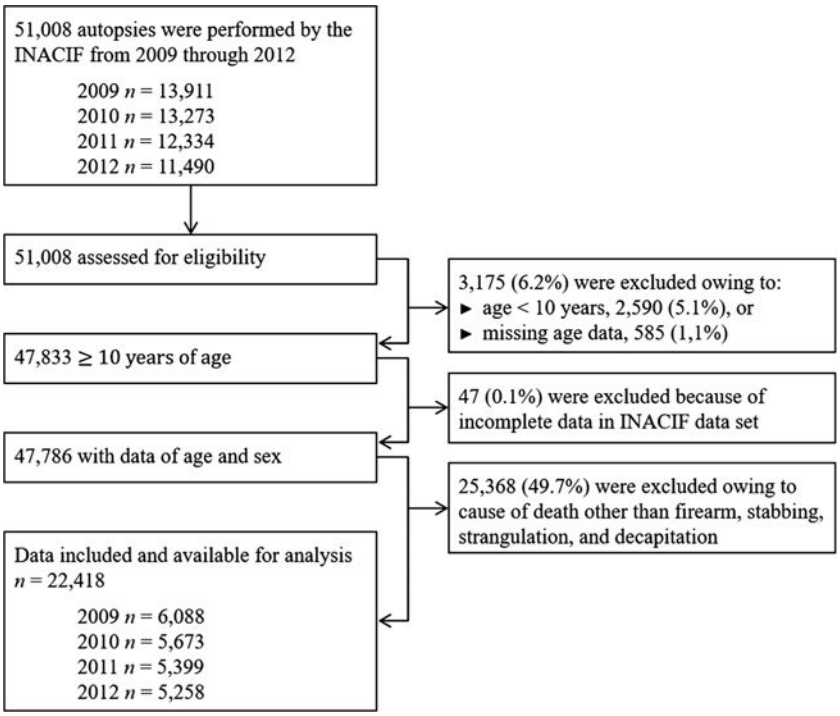


**Figure 2.**

Numbers of autopsies included in and excluded from the study. INACIF, National Institute of Forensic Sciences.

## Table 1

Demographic characteristics and autopsy-related data

| Variable | |
|---|---|
| Age in years, mean (SD) | |
| All | 31.60 (12.77) |
| Females | 32.63 (14.19) |
| Males | 31.48 (12.58) |
| Sex, n (%) | |
| Females | 2408 (10.74) |
| Males | 20 010 (89.26) |
| Mechanism of death, n (%) | |
| Firearm | 19 821 (88.42) |
| Stabbing | 1845 (8.23) |
| Strangulation | 670 (2.99) |
| Decapitation | 82 (0.37) |
| Violent deaths per day, mean (SD) | 15.34 (5.36) |
| Violent deaths during pay day, mean (SD) | |
| Pay day 0 | 15.53 (6.56) |
| Non-pay day 0 | 15.34 (5.25) |
| Pay day 1 | 15.88 (6.44) |
| Non-pay day 1 | 15.22 (5.04) |
| Pay day 2 | 15.64 (5.82) |
| Non-pay day 2 | 15.22 (5.10) |
| Pay day 3 | 15.40 (5.52) |
| Non-pay day 3 | 15.31 (5.20) |
| Pay day after 1 | 16.03 (6.72) |
| Non-pay day after 1 | 15.25 (5.10) |
| Pay day after 2 | 15.98 (6.08) |
| Non-pay day after 2 | 15.20 (5.14) |
| Violent deaths during holidays, mean (SD) | |
| Holiday | 18.00 (8.30) |
| Non-holiday | 15.26 (5.20) |
| Violent deaths by day of week, n (%) | |
| Monday | 3295 (14.70) |
| Tuesday | 2820 (12.58) |
| Wednesday | 2820 (12.58) |
| Thursday | 2902 (12.94) |
| Friday | 3257 (14.53) |
| Saturday | 3488 (15.56) |
| Sunday | 3836 (17.11) |

The time series was adequately fit with an ARIMA (0,0,0) (0,1,1,7) model. That is, a model that entailed differencing the time series at a lag of 7 days (ie, weekly) and including a weekly moving average component (Q=44.47, df=40, p=0.2891; RMSE=15.81).

ARIMA, autoregressive integrated moving average; RMSE, root mean square error.

**Table 2**

Results of ARIMA models estimating the impact of pay day on violent death in Guatemala, 2009–2012

| Variant of pay-day variable | Predictor | Coefficient | p Value | 95% CI | Q (p value) df=40 | RMSE |
|---|---|---|---|---|---|---|
| Pay day 0 | Pay day 0 only | −0.07 | 0.885 | (−1.0386 to 0.8960) | 44.54 (0.2865) | 15.813699 |
| | Holiday only | 2.62 | <0.001 | (1.5412 to 3.6986) | | |
| | Both | 3.13 | 0.005 | (0.9682 to 5.3047) | | |
| Pay day 1 | Pay day 1 only | 0.31 | 0.325 | (−0.3053 to 0.9210) | 44.09 (0.3028) | 15.804458 |
| | Holiday only | 0.62 | 0.384 | (−0.7882 to 2.0482) | | |
| | Both | 4.80 | <0.001 | (3.4652 to 6.1315) | | |
| Pay day 2 | Pay day 2 only | 0.24 | 0.397 | (−0.3135 to 0.7915) | 43.75 (0.3149) | 15.805906 |
| | Holiday only | 0.77 | 0.294 | (−0.6635 to 2.1954) | | |
| | Both | 4.56 | <0.001 | (3.2312 to 5.8949) | | |
| Pay day 3 | Pay day 3 only | −0.05 | 0.856 | (−0.5769 to 0.4792) | 44.86 (0.2753) | 15.805138 |
| | Holiday only | 0.79 | 0.280 | (−0.6463 to 2.2348) | | |
| | Both | 4.23 | <0.001 | (2.8963 to 5.5592) | | |
| Pay day after 1 | Pay day after 1 only | 0.21 | 0.569 | (−0.5129 to 0.9329) | 44.19 (0.2991) | 15.804065 |
| | Holiday only | 0.60 | 0.407 | (−0.8175 to 2.0157) | | |
| | Both | 4.77 | <0.001 | (3.4352 to 6.0995) | | |
| Pay day after 2 | Pay day after 2 only | 0.46 | 0.160 | (−0.1802 to 1.0954) | 44.01 (0.3055) | 15.805449 |
| | Holiday only | 0.77 | 0.286 | (−0.6469 to 2.1938) | | |
| | Both | 4.57 | <0.001 | (4.8800 to 5.1562) | | |

ARIMA, autoregressive integrated moving average; RMSE, root mean square error.

**Table 3**

ARIMA estimates for the impact of pay day on violent deaths among females and males in Guatemala, 2009–2012

| | | Females | | | Males | | |
|---|---|---|---|---|---|---|---|
| **Variant of pay day** | **Predictor** | **Coefficient** | **p Value** | **95% CI** | **Coefficient** | **p Value** | **95% CI** |
| Pay day 0 | Pay day 0 only | −0.07 | 0.885 | (−1.0387 to 0.8960) | 0.04 | 0.933 | (−0.8372 to 0.9117) |
| | Holiday only | 2.62 | <0.001 | (1.5412 to 3.6986) | 3.12 | <0.001 | (2.1515 to 4.0814) |
| | Both | 3.14 | <0.001 | (0.9682 to 5.3047) | 2.54 | 0.019 | (0.4096 to 4.6759) |
| Pay day 1 | Pay day 1 only | 0.31 | 0.325 | (−0.3053 to 0.9210) | 0.18 | 0.532 | (−0.3921 to 0.7586) |
| | Holiday only | 0.63 | 0.384 | (−0.7882 to 2.0482) | 1.04 | 0.109 | (−0.2315 to 2.3196) |
| | Both | 4.80 | <0.001 | (3.4652 to 6.1315) | 4.80 | <0.001 | (3.5720 to 6.0280) |
| Pay day 2 | Pay day 2 only | 0.24 | 0.397 | (−0.3135 to 0.7915) | 0.20 | 0.450 | (−0.3158 to 0.7117) |
| | Holiday only | 0.77 | 0.294 | (−0.6635 to 2.1954) | 1.12 | 0.086 | (−0.1601 to 2.4080) |
| | Both | 4.56 | <0.001 | (3.2312 to 5.8950) | 4.64 | <0.001 | (3.4131 to 5.8758) |
| Pay day 3 | Pay day 3 only | −0.05 | 0.856 | (−0.5770 to 0.4792) | −0.02 | 0.926 | (−0.5181 to 0.4710) |
| | Holiday only | 0.79 | 0.280 | (−0.6463 to 2.2348) | 1.25 | 0.059 | (−0.0472 to 2.5575) |
| | Both | 4.23 | <0.001 | (2.8963 to 5.5592) | 4.28 | <0.001 | (3.0643 to 5.5020) |
| Pay day after 1 | Pay day after 1 only | 0.21 | 0.569 | (−0.5129 to 0.9329) | 0.18 | 0.594 | (−0.4878 to 0.8516) |
| | Holiday only | 0.60 | 0.407 | (−0.8175 to 2.0157) | 1.03 | 0.112 | (−0.2412 to 2.3056) |
| | Both | 4.77 | <0.001 | (3.4352 to 6.0995) | 4.79 | <0.001 | (3.5612 to 6.0140) |
| Pay day after 2 | Pay day after 2 only | 0.46 | 0.160 | (−0.1802 to 1.0954) | 0.50 | 0.091 | (−0.0812 to 1.0928) |
| | Holiday only | 0.77 | 0.286 | (−0.6469 to 2.1938) | 1.15 | 0.076 | (−0.1203 to 2.4274) |
| | Both | 4.57 | <0.001 | (3.2452 to 5.8911) | 4.67 | <0.001 | (3.4484 to 5.8936) |

ARIMA, autoregressive integrated moving average.

**Table 4**

Summary results and number of female and male violent deaths above the daily average for those statistically significant results from table 3, according to each of the definition used to classify pay days and holidays in Guatemala, 2009–2012

| Scheme of pay-day variable | Predictor | Number of days | Excess deaths, females | Excess deaths, males |
|---|---|---|---|---|
| Pay day 0 | Holiday only | 36 | 94.32 | 112.32 |
| | Both | 12 | 37.68 | 30.48 |
| Pay day 1 | Both | 25 | 120.00 | 120.00 |
| Pay day 2 | Both | 26 | 118.56 | 120.64 |
| Pay day 3 | Both | 27 | 114.21 | 115.56 |
| Pay day after 1 | Both | 25 | 119.25 | 119.75 |
| Pay day after 2 | Both | 26 | 118.82 | 121.42 |