

Relationship between lunar phases and serious crimes of battery: a population-based study

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Abstract

Objective: The hypothesis of a lunar influence on human abnormal behavior is still widespread, although research has led to conflicting findings. Therefore, a population-based study to assess the influence of lunar phases on violent crimes was conducted.

Methods: The study included all serious crimes of battery (aggravated assaults) committed in Middle Franconia (Bavaria, Germany) between 1999 and 2005 ($n = 23\,142$). Data were analyzed regarding lunar phase, sex, and place of crime scene (outdoor vs indoor).

Results: No significant associations between full, absent, and the moon's interphases and serious crimes of battery could be detected. Furthermore, a Fourier analysis was conducted that failed to produce an association between violence and the moon's phases.

Discussion: Several possible explanations for the presented results are discussed including biological and social mechanisms.

Conclusions: The present study fails to find a significant association between lunar phases and crimes of battery.

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1. Introduction

The assumption that lunar phases exert an influence on human behavior remains a controversial one, although there has been little or at least contradictory evidence of this [1–3]. Philosophers, historians, and researchers have presumed that the influence of the moon might change or may have a negative impact on disorders of human physiology and behavior. The lunar cycle is characterized by periodic variation in the illuminated surface of the moon that is visible from the earth for a duration of 29.53 days. Historically, conditions such as sleepwalking, mental disturbances (“lunacy”) leading to psychiatric hospital admissions, as well as epileptic seizures [4] have been attributed to the influence of the moon.

The influence of lunar phases on the onset and frequency of seizures has been the main focus of research in this area

with conflicting findings [5–7]. Contradictory results have also been found concerning the time of births [8,9] as well as the cause and clinical outcome of myocardial infarction [10]. The most conclusive findings on the effect of lunar cycles on human behavior were based on an article by Lieber [11]. He found a correlation between self-destructive behavior and the full moon that he postulated was related to the biological process of human aggression.

Conflicting results have also been found in relation to self-destructive behavior, with some studies reporting no association between suicide and the lunar cycle [1,12], whereas others have found a statistically significant relationship between suicide and the new moon, the full moon, and the last phase of the lunar cycle [13].

Focusing on violent and aggressive behavior in a psychiatric setting, only an increase in number of medico-legal deaths as well as homicides has been ascribed to the days around the full moon with a peak during the full moon [14,15]. A study of crime in India reported a significant association with the full moon, which was attributed to “human tidal waves,” hypothetically causing physiologic and biochemical changes leading to an elevated impulse to

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commit crime [16]. A meta-analysis of several studies on human abnormal behavior (suicide attempts, crisis telephone calls, psychiatric emergencies, state and psychiatric hospital admissions, arrests or first-appointment phone calls) and its association with the moon's phases has also shown positive associations [17,18].

The aim of this study was to investigate possible associations between each of the 4 lunar phases and the occurrence of serious crimes of battery (solely aggravated assaults) taking into account sex differences as well as the location where the offense occurred (outdoors vs indoors) using 2 different statistical methods.

2. Materials and methods

The study included crimes of violent behavior (not including suicides) that were filed at the Police Department of Middle Franconia, Bavaria, Germany, between January 1, 1999, and December 31, 2005, and entered in the EVioS (Erlangener Violence Studies) database. Middle Franconia (population of 1.7 million) is 1 of the 7 administrative regions of Bavaria (total population of 12.4 million), the southernmost state of Germany. Further information about

the sister file ESuS (Erlangener Suicide Studies) can be obtained from previously published studies [1,19].

To analyze a more homogenous sample, crimes of aggravated assault included battery that were premeditated, severe, or dangerous (according to §§ 224/226 StGB of the German Criminal Law) were extracted from the EVioS file, only.

For each violent act involving the police force, information on sex, age of the victim(s) and offender(s), exact time, and classification of the committed crime were extracted from the files of the police department of Middle Franconia (Nuremberg, Bavaria, Germany) based on detailed enquiries of the criminal investigation department using a condensed version of a computerized database. Because of obligations of secrecy and data protection, information concerning the identity of the assailants, occupation, marital status, and impairment by alcohol or drugs as well as medical history were not available. Therefore, knowledge of repeat offenders was not accessible and could therefore not be incorporated into the analysis. In cases where more than one offender or victim were involved in the aggravated assault, only the data of the first offender were taken into account for clarity. Based on our hypothesis, any difference of timing and place of the crime as well as sex differences concerning

Table 1

Summary of the results: the lunar phase in relation to sex and the crime scene (indoor vs outdoor)

		Absent moon (±48 h)	Crescent moon (±129.2 h)	Full moon (±48 h)	Decrescent moon (±129.2 h)	
Overall	Violence rate (vr)	1.004	0.991	1.010	1.003	
	n	3145	8358	3165	8459	
	95% confidence interval (CI)	0.97-1.04	0.97-1.01	0.97-1.04	0.98-1.03	
	Male offenders (vr)	1.001	0.991	1.007	1.003	
	n	2288	6096	2300	6170	
	95% CI	0.96-1.04	0.97-1.02	0.96-1.04	0.98-1.03	
Female offenders (vr)		0.986	0.977	1.058	1.007	
	n	466	1242	500	1280	
	95% CI	0.90-1.08	0.93-1.03	0.97-1.15	0.95-1.07	
	Indoor	vr	1.009	1.015	0.987	0.987
	n	1516	4104	1484	3992	
	95% CI	0.95-1.06	0.99-1.05	0.93-1.03	0.96-1.02	
Male offenders (vr)		1.008	1.020	0.974	0.983	
	n	1206	3284	1166	3167	
	95% CI	0.95-1.06	0.99-1.06	0.92-1.03	0.95-1.02	
	Female offenders (vr)	1.007	0.990	1.033	0.996	
	n	310	820	318	825	
	95% CI	0.90-1.12	0.93-1.06	0.92-1.15	0.93-1.07	
Outdoor	vr	0.986	0.961	1.049	1.026	
	n	1219	3198	1297	3415	
	95% CI	0.93-1.04	0.93-1.00	0.99-1.11	0.99-1.06	
	Male offenders (vr)	0.992	0.961	1.041	1.026	
	n	1066	2779	1118	2967	
	95% CI	0.93-1.05	0.93-1.00	0.98-1.10	0.99-1.07	
Female offenders (vr)		0.942	0.959	1.102	1.025	
	n	153	419	179	448	
	95% CI	0.8-1.10	0.87-1.06	0.95-1.27	0.94-1.13	
			<i>P</i> = .0025	<i>P</i> = .034	<i>P</i> = .030	
			<i>P</i> = .005		<i>P</i> = .039	

The violence rate (vr) is calculated for the whole period of the study from 1998 to 2005. Only statistically significant *P* values are demonstrated in the table.

the phases of the moon would relate to the offender and not the victims. Therefore, data on the victims were not included in the analysis.

The stage of the lunar cycle at the time of each crime was identified by the date and time of the crime of each case following the lunar phase calendar for the years 1999 to 2005 so that each event was associated with a single measure.

Cases with unknown time points or those spanning a time over a single moon phase were excluded ($n = 15$). The length of the lunar phase varies from cycle to cycle with an average duration 29.53 days (708.7 hours, respectively) [21].

The number of serious crimes of battery in a 2-day period (± 48 hours) centered on the full moon and those in a 2-day period (± 48 hours) centered on the absent moon were compared to the number of crimes occurring during the 2 remaining phases of the lunar cycle (crescent and decrecent moon, lasting 258.3 hours each). The rates were calculated as the quotient of the number of observed to the number of expected crimes, whereas the number of expected crimes was based on the length of each moon phase throughout the whole study period of 7 years (see Table 1) and for each year. The 95% confidence interval (CI) of the rate R was calculated as follows: $CI = R^{(1 \pm z/\chi)}$; $z = 1.96$ for 95% CI; $\chi^2 = (O - E)^2/E$, with O = observed number of crimes and E = expected number of crimes.

Furthermore, data were categorized by sex and the location of the crime (outdoor vs indoor). The significance level was set at $\alpha = .05$. Univariate analysis was performed by applying the χ^2 test statistic as well as the Mantel-Haenszel test.

Furthermore, a Fourier analysis was undertaken to detect temporal variation of serious crimes. Four series of measurement were calculated separately. Firstly, winter and summer seasons were addressed separately taking into account the place of the crime (outdoor vs indoor). The calculations were performed under the assumption that suicides are distributed equally so that the Fourier coefficients have to be distributed equally as well. An outlier test for Fourier coefficients was performed as well. In addition, the measurements were corrected for weekdays.

Calculations were performed using the statistical package SPSS 16 for Windows (SPSS Inc, Chicago, Ill).

2.1. Subjects

Overall, 23 127 aggravated assaults were included in the study. Of these, 82.9% were committed by male and 17.1% by female offenders. The mean age of the offender was 31.4 years (SD, 13.7); the mean age of male offenders was 31.1 years (SD, 13.5) and of female offenders was 32.7 years (SD, 14.5).

3. Results

A total of 23 127 aggravated assaults in a defined catchment area (Middle Franconia, Bavaria, Germany) were analyzed. Overall, 13.7% of these crimes took place

during the absent moon, 13.7% during the full moon, 36.1% while there was a crescent moon, and 36.6% under the decrecent moon. Of these crimes, 50.5% occurred indoors (in the apartment, or an otherwise closed environment), whereas 48.8% happened outdoors mainly on the streets or open places. In 0.6% of cases, information on location was missing.

Table 1 shows the distribution of the data based on the locality in which the crime was committed and sex of the offender. Only statistically significant P values are shown in the table.

The violence rates of all crimes and rates of sex and crime scene (indoors vs outdoors) strata did not differ significantly from the expected rates.

There was a significantly smaller ratio of violent crimes committed outdoors during the waxing moon ($P = .0025$), especially by male offenders ($P = .005$). Furthermore, significantly more crimes were committed outdoors during the full moon ($P = .034$) as well as outdoors during the waning moon ($P = .030$) and especially among male offenders ($P = .039$). Applying the Mantel-Haenszel test, no evidence for a significant difference between the remaining moon phases and the place of offense in male as well as female offenders (data not shown) could be found.

There was no significant association between age (old vs young offenders) and moon phases with regard to sex (data not shown).

Applying the Fourier analysis, there were no significant Fourier coefficients for 29-day periods. After correcting for seasonal and weekday variations, no significant influence of the lunar phases on the incidence of serious crimes of battery could be detected. There were no differences regarding sex

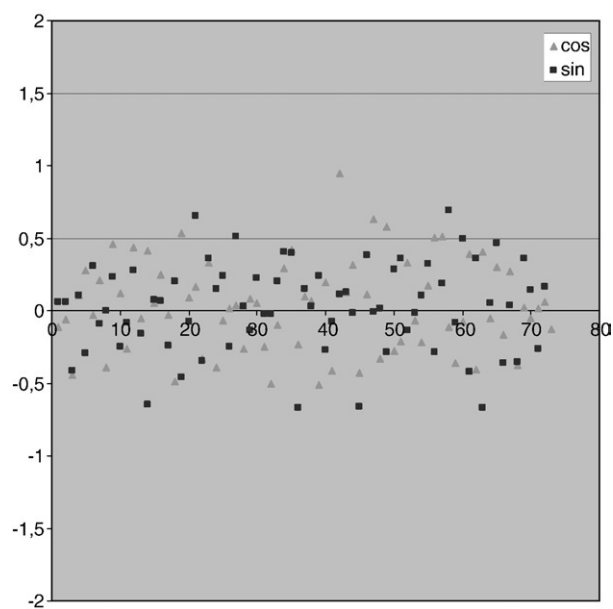


Fig. 1. Fourier analysis of serious crimes of battery after correction for seasonal and weekday variations committed indoors.

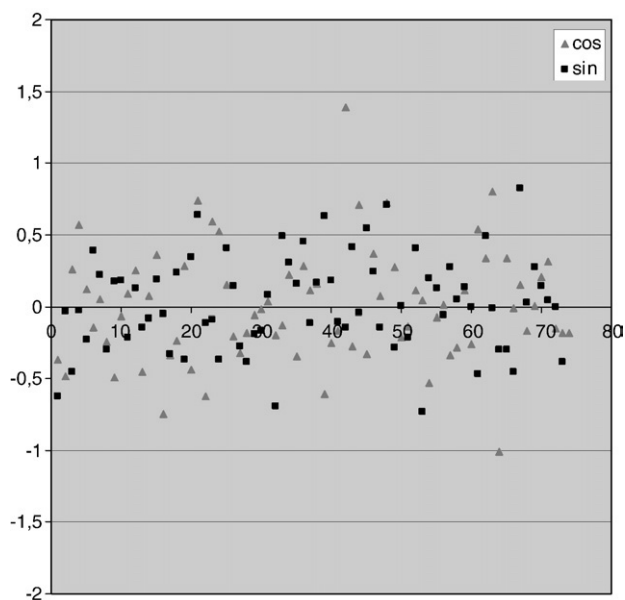


Fig. 2. Fourier analysis of serious crimes of battery after correction for seasonal and weekday variations committed outdoors.

or place of the crime (outdoors vs indoors). The results are shown in Figs. 1 and 2.

4. Discussion

Although the present study did not identify a significant association between lunar cycles and the frequency of violent crimes in general, there seemed to be an increase in violent crimes committed during the full moon and in outdoor locations during the waning moon, especially among male offenders. It is likely that these significant associations were caused by multiple testing as by applying a different statistical approach (in this case the Fourier analysis) no significant results were obtained [20].

Overall, women committed less crime than men, which might be due to sex differences concerning violent behavior in general, due to a predominance of male aggression [21]. However, no lunar influence on sex differences in general could be detected in the present study even after application of 2 different statistical methods.

The possible relationship between human behavior and the lunar cycle has aroused the interest of many authors in discussions around the various mechanisms underlying positive and negative findings.

Firstly, geophysical aspects, such as terrestrial magnetism, the gravitational pull of the moon upon the earth as well as solar corpuscular radiation, among others, have been proposed [8]. Kay [22] reported an association between geomagnetic disturbances and a subsequent increase in the incidence of psychotic depressive illness in men. The author attributed this to an alteration in pineal circadian rhythm of melatonin synthesis and a dysfunction of the 5-hydroxytryptamine and adrenergic system dysfunc-

tion, both of which are associated with aggressive behavior [23,24]. Other studies found no influence of environmental mechanisms, for example, tidal effects, weather patterns, magnetism, or polarization of the moon's light, to account for any association between the moon phases and human behavior [3].

Secondly, variations of lunar light were found to affect retinal receptors of some animals and melatonin levels, the latter playing a part in sleep quality, fertility, and even aggressive behavior [8]. Nevertheless, the present findings of higher criminality during full and crescent moon might also be attributable to improved visibility during nights of full moon as well as possible perceptions of offenders themselves that they are influenced by the moon [1], at least in part. It has been speculated that a brighter night sky might deter criminal acts and better illuminate roadways, thereby preventing traffic accidents and higher crime rates [24,25]. In this study, the possible influence of the lunar illumination on the occurrence of serious crimes was tested indirectly by comparing crimes committed outdoors to those taking place in closed environments not exposed directly to the light of the moon. Nevertheless, it remains questionable whether the moon exerts an immediate or delayed influence on human behavior by affecting hormonal and neural transmitter systems or perceived sleep quality [26]. A perceived lunar influence may exist, although it is not detectable by statistical methods [27].

Thirdly, an influence of the moon on psychologic well-being and behavior may have implications due to changed social or work activities [28]. It has also been suggested that spare-time activities are relevant risk factors for getting involved in criminal assaults [29]. Larger numbers of people being outdoors for a longer period are more prone to violence in general [30]. Nevertheless, a belief in the moon's influence on human behavior still persists particularly among mental health professionals, nurses, and physicians [27,31].

4.1. Limitations of the study

Many violent crimes are not reported or not recorded by the police, especially domestic or stranger violence [32]. To reduce the fact of underreporting, only defined serious assaults were included in the present study as they are considered to be less easily concealed than offenses of simple bodily harm.

Furthermore, despite thorough investigation by the Police Department of Middle Franconia, sometimes the sex of the offender was not recorded and therefore could not be included in the present analysis. However, the distribution of the strata with known sex and locality is assumed to be similarly spread in comparison to the strata with unknown data thereby minimizing relevant information bias.

Unfortunately, additional information, for example, the offender's level of alcohol intoxication, marital status, nationality, or employment, could not be included in the present study because of the obligations of secrecy and data protection of German Law.

Former studies have been criticized for the use of a relatively small sample for a short period, making it difficult to detect weak effects [27]. The present study aims at minimizing statistical errors and confounding effects of other periodic cycles using a large sample for a comparably long period of 7 years.

A disadvantage of former studies of lunar influence on human conditions has been the application of certain statistical methods that revealed spurious associations [20]. In contrast, the present study used a large sample for a long period and used 2 different statistical approaches.

5. Conclusions

Despite the lack of evidence of a lunar influence on serious crimes of battery, belief in the moon's effect on human behavior persists. Beyond determining a negative result of an association between lunar phases and the occurrence of aggravated assaults in a large and complete database, this work might help to discard some alleged associations as scientifically unjustified beliefs, such as, for example, the overestimation of the effect of a full moon on human aggressive behavior. As violence constitutes a serious health problem concerning society as a whole, further studies into other modifiable risks are warranted to develop preventive strategies.

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