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## Does the Lunar Cycle Affect Birth and Deaths?

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There is a commonplace notion that full moons affect natality and mortality. To test this theory, we obtain daily births and deaths data from Australia, covering all 10,592 days from 1 January 1975 to 31 December 2003. We find that full moons are not associated with any significant change in the number of conceptions, births, or deaths. Moreover, our standard errors are sufficiently tight to make it possible to rule out even modest positive or negative effects of the lunar cycle.

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*Author Note:*

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## Introduction

It is frequently suggested that full moons may be associated with higher rates of conception, births or deaths. While past studies have mostly rejected the presence of full moon effects (e.g., Arliss et al., 2005; Chapman & Morrell, 2000; Kelly et al., 1996; Owen et al., 1998) some have found significant relationships (e.g., Bhattacharjee, 2000; Lieber, 1978). If the lunar cycle has significant effects on conception, birth rates, or death rates, then doctors would need to take it into account when advising couples hoping to fall pregnant, while hospital administrators ought to adjust their staffing in maternity wards and emergency departments. The effect of full moons is therefore more than a curio; if an effect exists, it has substantial implications for health policy.

### Does the Full Moon Affect Natality and Mortality?

To test the impact of the full moon on recorded births, we use daily data on the number of Australian births and deaths. These data are collected by state and territory registries, and compiled by the Australian Bureau of Statistics. The data cover all 10,592 days from 1 January 1975 to 31 December 2003, encompassing a total of 7,108,772 births and 3,707,146 deaths. We opt to focus on the raw number of births and deaths, rather than on the rate. This has the advantage that we do not introduce noise into our series through mis-measurement of the total population, which is only available on a monthly basis.

How best to code full moons? In a lunar cycle, there is one 24-hour period in which 100 percent of the moon's surface is illuminated. For the 24-hours before and the 24 hours afterwards, 98-99 percent of the moon's surface is also illuminated<sup>1</sup>. We, therefore, code as a full moon the day of 100 percent illumination, as well as the preceding and subsequent days. This gives us three days per lunar cycle that we code as full moons. Put another way, we code about 10 percent of days as full moons. Our results are unchanged if we code only one day per month as a full moon. Table 1 presents summary statistics.

**Table 1:** *Summary Statistics*

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Births per day (number)	10592	671.144	113.872	367	948
Deaths per day (number)	10592	327.082	43.139	210	490
Full moon (1 if yes, 0 if no)	10592	0.101	0.301	0	1

<sup>1</sup> See 'Fraction of the Moon Illuminated' on the website of the Astronomical Applications Department, U.S. Naval Observatory, available at <<http://aa.usno.navy.mil/data/docs/MoonFraction.html>>

When analysing the effect of full moons on conception, we assume that conception occurs 266 days prior to birth. There are two limitations in this strategy: many pregnancies are longer or shorter than 266 days, and not all pregnancies are carried to term. Nonetheless, using a large dataset covering 29 years of births, the presence of any substantial “full moon effect” on conception should show up as an increase in the birth rate nine months later.

We estimate the effect of full moons on conception using ordinary least squares regression, with robust standard errors. We first present results both without any controls, and then with indicator variables for the day of the year (366 values), the day of the week (7 values), and the year (29 values).

Our results are shown in Table 2. We find no statistically significant effect of the full moon on the number of conceptions, births or deaths. Including indicator variables to take account of day-of-year, day-of-week, and year fixed effects has little effect on the point estimates, but does reduce the standard errors.

Our 95 percent confidence intervals all span zero, and are quite tight, allowing us to reject substantial negative or positive effects of full moons. When we control for date effects, the 95 percent confidence intervals are, for conceptions  $\{-1.854$  to  $3.433\}$ ; for births  $\{-1.926$  to  $3.406\}$ ; and for deaths  $\{-1.577$  to  $1.191\}$ .

We can therefore rule out, at the 95 percent confidence level, effects on conceptions, births or deaths larger than 1/27th of a standard deviation.

**Table 2:** *Effect of the full moon on conceptions, births and deaths*  
*Ordinary least squares estimates, using daily births and deaths data*

	Conceptions	Births	Deaths
<b>Panel A: No controls</b>			
Full Moon	0.879 [3.715]	0.906 [3.710]	-0.027 [1.372]
Observations	10592	10592	10592
R-squared	0.00	0.00	0.00
<b>Panel B: Controlling for day-of-week, day-of-year, and year effects</b>			
Full Moon	0.790 [1.349]	0.740 [1.361]	-0.193 [0.706]
Observations	10592	10592	10592
R-squared	0.89	0.89	0.75

*Notes: Robust standard errors in brackets. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. Full moon is coded as occurring for three days per lunar cycle. Controls in Panel B are day-of-week, day-of-year, and year fixed effects. Conceptions are based on births count data 266 days later. Births are the births count on a given day. Deaths are the deaths count data on a given day.*

### **Conclusion**

A belief that lunar cycles affects fertility, births and deaths remains widespread. Analysis of births and deaths data for Australia over a 29-year period finds no effect of the full moon on conception, birth, and deaths. The large sample size allows us to reject even modest effects of the full moon on these outcomes.

Our results suggest that would-be parents, obstetricians, and emergency responders should ignore the lunar cycle when making their decisions. Many factors affect conceptions, births and deaths, but the full moon is not among them.

Our research adds to a significant literature that finds no effect of the lunar cycle where one has been hypothesized. For example, Billyard, McCallum and Collin (2014) find no correlation of any particular phase of the moon with the number of search and rescue incidents, Belleville et al. (2013) find no impact on anxiety and mood disorders, and Kelly, Lavery and Saklofske (1990) find no impact on traffic disasters. Systematic reviews by Rotton and Kelly (1985) and by Kelly, Rotton, and Culver (1996) suggest that we should be extremely skeptical about claims that the full moon has a tangible effect on important areas of human behavior.

Finally, we urge researchers who find null effects not to relegate them to the 'file drawer.' Were it not for the existence of the *Journal of Articles in Support of the Null Hypothesis*, this paper might never have been published. We thank the editors for creating a journal that acts as a counterweight to the tendency of researchers to only publish statistically significant findings. The absence of lunacy can be as interesting as its existence.

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