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Yearly and perhaps transyearly human natality patterns near the equator and at higher latitudes

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Abstract

Data on the daily numbers of births in Davao, Philippines, available from 1993 to 2003 are re-analyzed herein by linear–nonlinear rhythmometry, as are data from Italy and Japan. A transyear, characterizing the solar wind and other non-photic physical environmental factors, corresponds to a spectral peak of the near-equatorial natality series. This component with a period of about 1.3 years is found to have an amplitude larger than the calendar year, the amplitude ratio being 134%. Whereas the transyear is validated nonlinearly, the 95% confidence interval for the period extending from 1.21 to 1.38 years and the 95% confidence interval for the amplitude not overlapping zero ($P < 0.05$), the annual variation is only demonstrable by linear least squares analysis. The results bring added evidence for an influence of non-photic environmental effects on human physiology, in this case data collected near the equatorial region, Davao being situated at 7°N, 126°E. They are in keeping with some degree of generality of a rule of reciprocity among mutually supporting physical and biological periodicities. They do not detract from the fact that in other longer data sets at higher latitudes, the calendar year, presumably reflecting climatic influences, dominates the spectrum.

Keywords

Calendar year; Circannual; Latitude; Linear-nonlinear rhythmometry; Natality; Transyear

1. Introduction

Several earlier studies by physicists [1–7] have encountered spectral components with periods slightly longer than a year. But since some early findings had no counterpart in Wolf's relative sunspot numbers, these oscillations were viewed as if "they may not be related to anything connected with the sun" [2]. Then Richardson et al. [5] found an about 1.3-year component in the solar wind, which was confirmed and extended to cosmic rays [5–7].

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In the interim, on the basis of a counterpart of the social week as a near-week in physics [8–10], we were led to the postulation of a reciprocity among various terrestrial vs. solar environmental and vs. biomedical cyclicities, including the signatures of presumably wobbly magnetic periodisms, complementing the astronomical day and year [11–21. cf. 22–25]. We follow up on two abstracts submitted from Bratislava earlier to a meeting in Upice, Slovakia [26,27] with linear–nonlinear analyses in Minnesota. One of the two abstracts [27], pertinent to this investigation, is reproduced in the Appendix.

2. Materials and methods

Daily birth numbers in Davao, Philippines (7°N, 126°E) from 1993 to 2003 were analyzed. The data consist of 3418 spontaneous births from one private obstetrical clinic. Daily numbers varied between 0 and 6. Florida and Mikulecky [26] reported the presence of a statistically significant annual and semiannual periodicity, with peaks in October and April. In the same data, Mikulecky and Florida [27] reported the presence of trans- and cis-annual components with periods of 475 and 329 days, respectively, also noting the prominence of the transannual over the annual variation, with an amplitude ratio of 1.62 (see Appendix).

These data are re-analyzed herein by linear–nonlinear rhythmometry [28,29].

3. Results

The least squares spectrum of these data reveal with the presence of a long-term increasing trend, anticipated spectral peaks around 1.3, 1.0, and 0.5 year, whether the original daily data or the computed monthly means are considered, Fig. 1A. In order to obtain an estimate of uncertainty for the period, we considered a nonlinear model consisting of a linear trend, and cosine curves with initial (guess) periods of 1.3 and 1.0 year. In view of the unambiguous environmental synchronization of the 1.0-year component, this period was either fixed or estimated as a parameter in its own right in the nonlinear analyses. The latter were carried out on monthly means to reduce any serial correlation and/or over-estimation of the number of degrees of freedom, given the small numbers of births on any given day.

Whether the 1.0-year period was fixed or estimated, it could not be validated as statistically significant by nonlinear least squares, the 95% confidence interval of the amplitude overlapping zero. Both the linear trend and the transyearly component were validated nonlinearly. Including the about 1.0-year period as a parameter to be estimated in the model, the transyearly period is estimated to average 473.9 days or 1.297 years (95% CI: 1.212, 1.383), with an amplitude of 21% of the MESOR (95% CI: 0, 41). Somewhat tighter 95% CIs are obtained when fixing the 1.0-year period: the transyear period is estimated as 1.300 years (95% CI: 1.226, 1.375) and the amplitude is estimated as 21% of the MESOR (95% CI: 2, 39). A multiple-component cosinor model fitted to residuals from a linear trend detects with statistical significance both the transyear ($P < 0.001$) and the calendar year ($P = 0.008$), the transyear-to-calendar year amplitude ratio being larger than one (1.34), and the model accounting for 17% of the overall variance, Fig. 1B.

4. Discussion and conclusion

These results add further weight for an influence of non-photic environmental effects on human physiology and pathology. At the other extreme of life, sudden human cardiac death (ICD10 I46.1), transyears have also been documented in several geographic locations, notably in Arkansas, USA, and the Czech Republic, where they match the amplitude of the annual variation. In Minnesota, USA, during 1999–2003, a transyear predominates over the calendar year, being the sole spectral peak in that region of the spectrum. The calendar year is not

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detected, the alternation of cold winters and warm summers notwithstanding [30, cf. 31]. In many other health statistics data, however, such as mortality from myocardial infarction in Minnesota, USA, during 1968–1996, the calendar year is a major spectral component [19], even though a transyear can also be detected and validated by nonlinear least squares [32].

Of the three approaches used for the analysis of natality data in the Philippines, in the neighborhood of the equator in Mindanao, the calendar year was not validated by combined linear–nonlinear rhythmometry. It is noted that the signal reconstruction in Fig. 1B considers only the relative contribution of the transyear and the calendar year, illustrating their beat, but ignoring other major components seen in the least squares spectrum of Fig. 1A, a task awaiting the availability of longer series from larger populations in the same (or other) near-equatorial location. Before the prominence of a transyear in human natality can be generalized, similar statistics from other geographic locations for the same 11- year span or preferably for a longer span are needed.

Monthly natality data available from Italy and Japan were examined to that effect, notably since a circannual variation had been reported earlier [33–35]. In Milan and Rome, Italy, 23 years of data reveal a prominent annual component but no transyear after removal of a fourth-order polynomial trend, Fig. 2. In Japan as well, the annual component prevails in a monthly record covering over 100 years, as apparent from the least squares spectrum of detrended data, Fig. 3. Spectral peaks at one cycle per year and harmonics thereof are clearly seen, whereas any signal in the transyear range seems to be buried in the noise.

Differences in the time structure of natality in the Philippines versus Italy and Japan, notably in the spectral region around the year, may stem from actual geographic/geomagnetic differences in the influence of physical environmental factors on birth. Equatorial ring currents, formed by the injection of ions originating in the solar wind (characterized by an about 1.3-year oscillation [5]) and the terrestrial ionosphere [36], and a lesser seasonal variation in temperature and/or sunshine duration may have favored non-photic over photic influences not seen at mid-continental latitudes. Uncertainties related to the small numbers of births recorded in Davao, Philippines, should also be kept in mind, however. In the case of sudden cardiac deaths as well, geographic/geomagnetic differences seen in terms of the relative prominence of a transyear versus annual variation have to be qualified by the finding of a sole annual variation of small amplitude, in the absence of any detectable transyear, when sudden cardiac death data are normalized and averaged from all 10 available sources using the same ICD10 I46.1 classification code. That overall summary included four sites with a predominant circannual variation, four sites with a predominant transyear, one site where both components were about equal in prominence, and one site where neither component was detected. Whereas the circannual variation was synchronized among all 10 sites, as evidenced by a phase test ($P = 0.018$), with an acrophase of −28 ° (95% confidence interval: −349 ° to −57°; referenced to January 1), the transyears were not, as apparent from their disparate period lengths ($P = 0.979$ from phase test). There is no other way but to continue the mapping of chronomes, systematically rather than opportunistically if at all possible, and to start charting the results in an atlas, the aim of an ongoing project of the BIOsphere and the COSmos (BIOCOS).

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Appendix

Original abstract submitted to meeting on "man in his terrestrial and cosmic environment"

Upice, Czech Republic, May 17–19, 2005.

Daily birth numbers in Davao, Philippines, 1993–2003: Halberg's transyear stronger than year

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Background. One of the last progressive findings in the chronocosmobiomedical research was made by Franz Halberg et al. and concerns deviations from circaannual and circasemiannual periodicities towards the periods of the “trans-year”, i.e. approximately for example 1.3 calendar year (Halberg F et al. Blood pressure self-surveillance for health also reflects 1.3 year Richardson solar wind variation: spin-off from chronomics. Biomed Pharmacother 2003, vol. 57, Suppl 1, p. 58–76), and “cis-year”, i.e. 0.9 year. These and other periods between 1 and 2 years and under 1 year in biomedical data are derived from their presence in the solar wind and in the rotation speed of the solar dynamo itself (Richardson et al. Solar wind oscillations with a 1.3-year period. Geophys Res Lett 1994, vol. 21, p. 1559–1560). **Aim** is to test their presence in the excellent time series of the natural birth daily numbers from Philippines. **Subjects** are 3418 neonates born spontaneously at one private obstetrician clinic during 4017 days within January 1st, 1993 to December 31st, 2003. The daily numbers of births fluctuated from 0 to 6. **Methods**. The data were processed by Halberg cosinor regression, testing 10 period lengths. There were the circatransannual (period length of 475 days) and circacisannual (period length of 329 days) rhythm as well as the synodic, anomalistic, tropic lunar and Bartels solar rotation cycle with their 2nd harmonics tested. **Results**. The unequivocal, highly significant presence of the circatransannual and circacisannual rhythm is the most prominent finding. The amplitude of the circatransannual periodicity represents 26% of its mesor while that of the circaannual one only 16% of the corresponding mesor. Other “cosmic” periods are described in the contribution by Florida and Mikulecký at this meeting. **Discussion**. Our findings confirm —in agreement with Halberg’s pioneer contributions—the superiority of transyear over the common year also on the time sequence of spontaneous births, at least in Philippines. This superiority can be expressed by the ratio of relative amplitudes of transyear and year—in our case 1.62 in favor of the transyear. It appears as an intriguing idea that the events in the sun perhaps manage the time course of births. It could indicate more broad relations between sun and systems of the human body, perhaps those based on neuroendocrine modulation. Israeli authors (Stoupel et al.) documented fluctuation of growth hormone levels in newborns and of their birth length during solar cycle. There, of course, are many other possible interpretations, based, e.g. on a possible influence of sun on weather with resulting oscillations of atmospheric pressure. **Conclusion.** The search for transyear and associated periodicities should be extended on many other kinds of biomedical data. The underlying putative mechanisms should be studied more intensively, including their molecular level.

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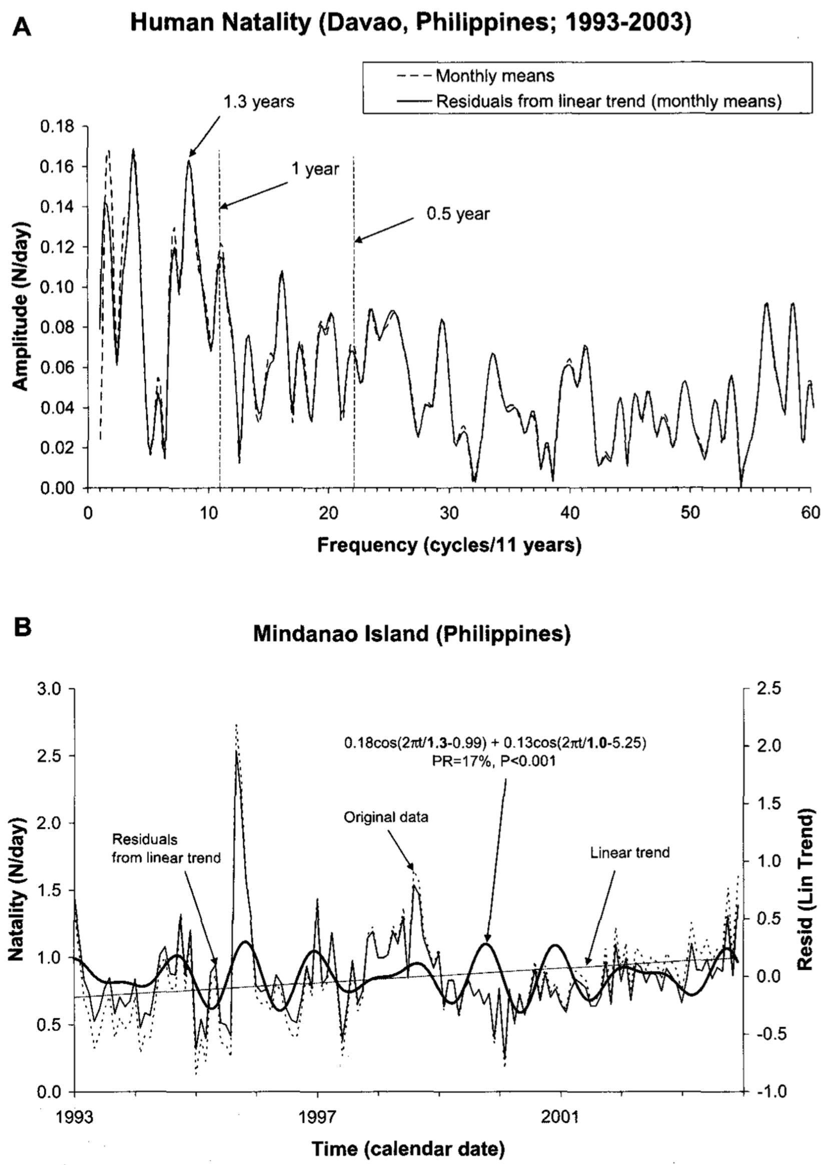

Fig. 1.

Fig. 1A Least Squares Spectrum. 1B Signal reconstruction.

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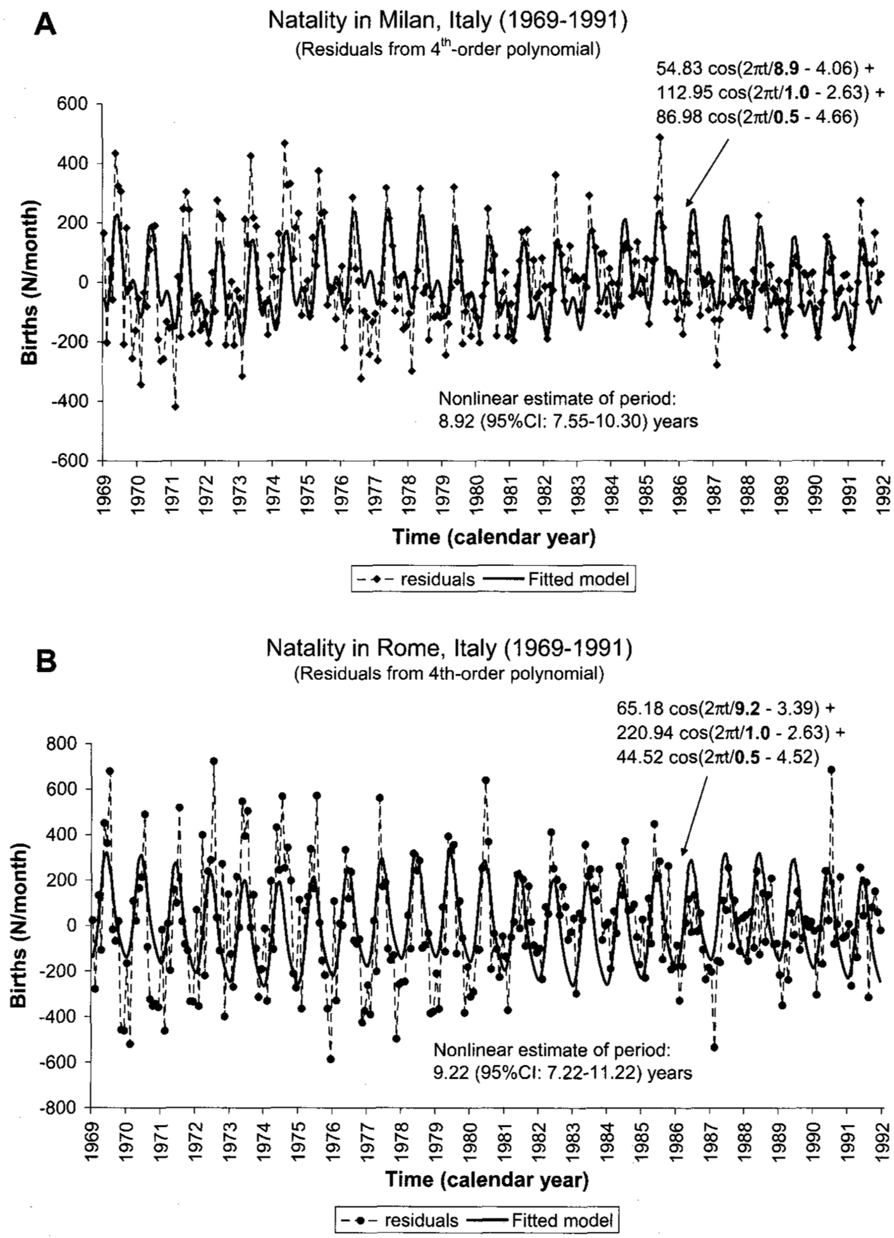

Fig. 2.

Fig. 2A Annual rather than transannual variation in natality in Milan, Italy (1969–1991). 2B Annual rather than transannual variation in natality in Rome, Italy (1969–1991).

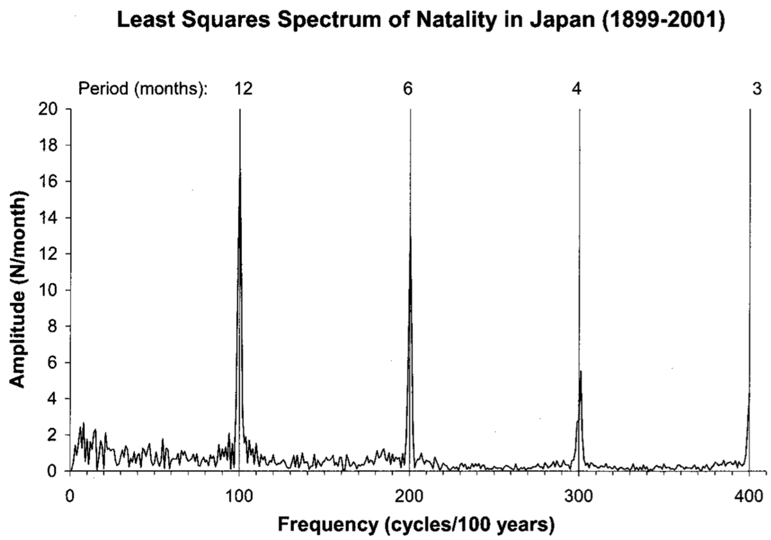

Fig. 3.

Prominent annual variation in natality data from Japan covering over 100 years (after detrending by second-order polynomials over four separate spans), seen by spectral peaks at frequencies of 1 cycle per year (100 cycles/100 years). Harmonic terms at two, three, and four cycles per year (vertical dashed lines) likely account for the circannual waveform. Note absence of spectral peak in the transyear region of the spectrum (around 75 cycles/100 years), by contrast to Fig. 1.

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