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# FURTHER MAPPING OF THE NATALITY CHRONOME IN TODA CITY (JAPAN) MATERNITY HOSPITAL

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A b s t r a c t

In order to investigate any circannual and/or circaseptan variations in birth incidence and birth weight in Toda City (Japan), data on 4,411 consecutive births were obtained from the city's Maternity Hospital between 1 Jan 1999 and 31 Dec 2001. Data were analysed by cosinor separately for babies with birth weights in given ranges, and separately for boys and girls born at different gestational ages. A circannual rhythm was detected with statistical significance (P=0.047) for birth incidence of all vaginal deliveries, with an acrophase in the fall. A similar result for caesarean sections was of borderline statistical significance. A circaseptan component with a relatively consistent acrophase around midweek was of borderline statistical significance for birth incidence in some of the groups investigated. About-yearly and about-weekly variations were also found to characterize birth weight in some of the groups investigated.

K e y w o r d s

Natality, Japan, Circannual rhythm, Circaseptan rhythm

## INTRODUCTION

Circadian variations in birth incidence are well established (*1, 2*). By 1848, the distribution of 1,000 births recorded in Schmalkalden, Germany, was clearly non-random (P=0.004) (*3*). By 1933, Jenny had noted circadian population rhythms for natality in Switzerland (P<0.001) (4). By 1953 they were assessed by a periodogram (*5*). A review in 1962 (*1*) suggested that spontaneous normal births, in a 24–hour synchronized periodic environment, constitute a relatively simple temporal index, since the analysis of this population rhythm is not complicated by the many factors continuing to impinge on the organism after birth.

Birth incidence patterns have also been reported to be non-random along the scales of the week (*6, 7*) and the year (*7, 8*). This study examines whether about-

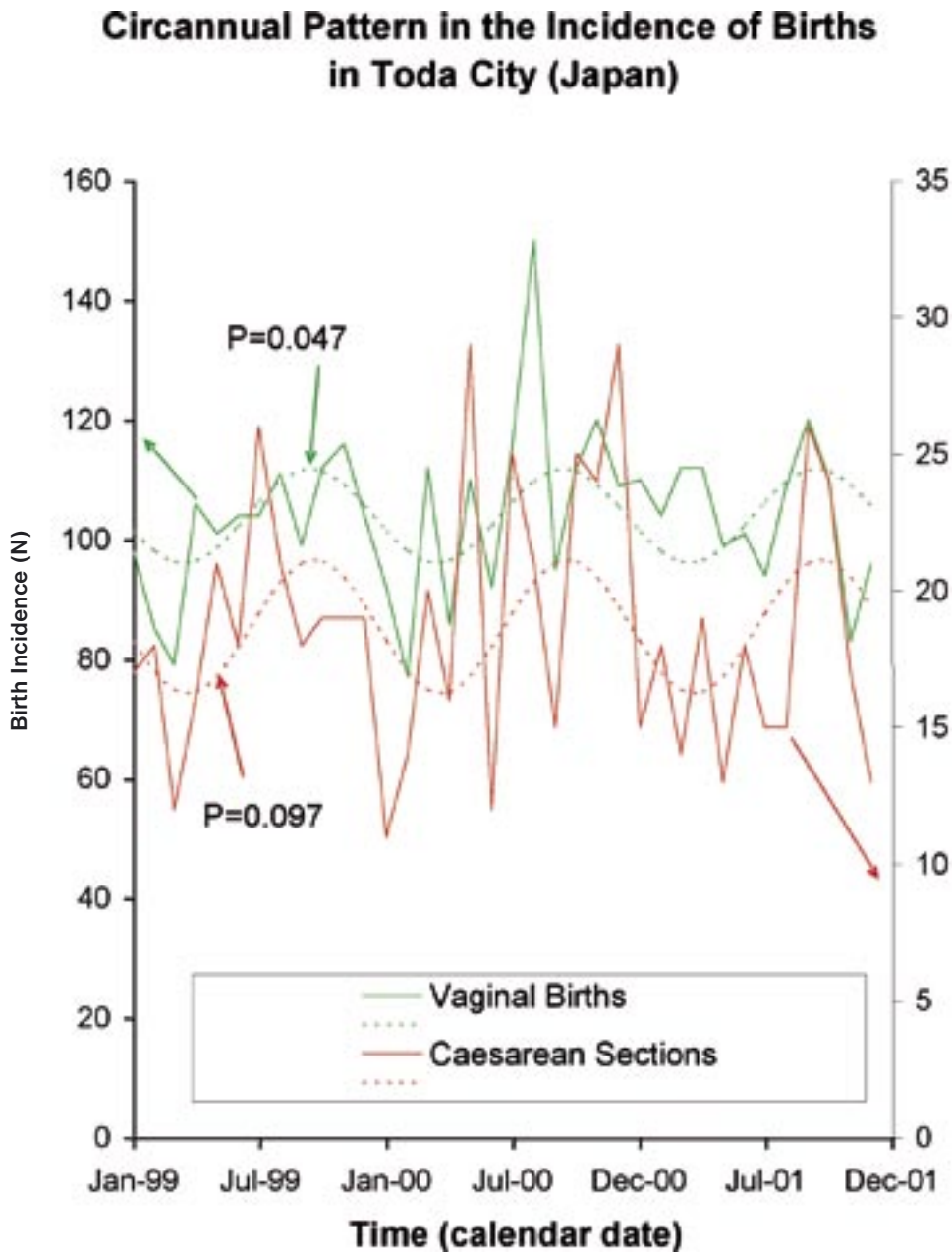


*Fig. 1*
Incidence of births illustrates the circannual rhythm

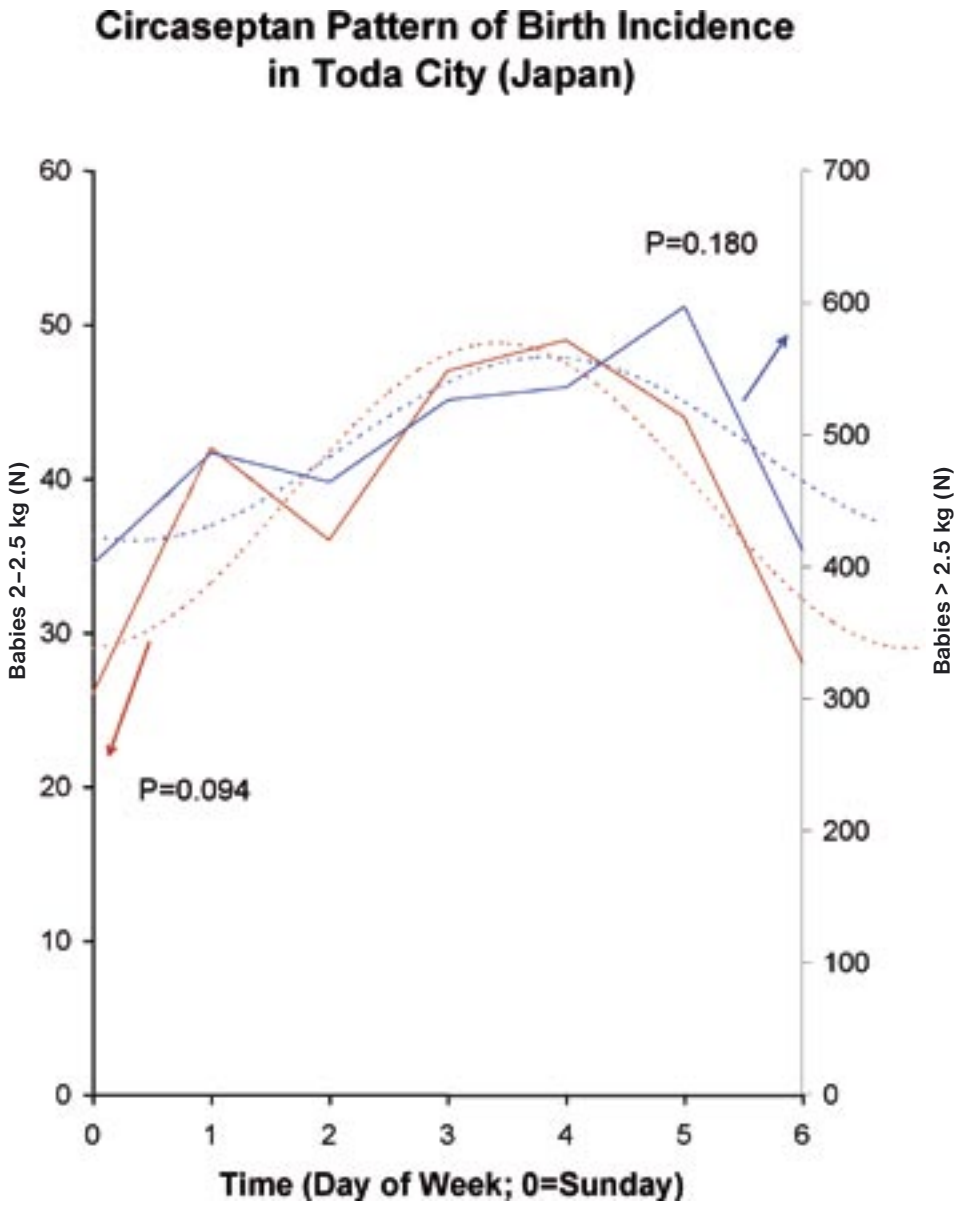


*Fig. 2*
An about 7-day (circaseptan) component of borderline statistical significance was obtained for 2–2.5 kg babies (P=0.094)

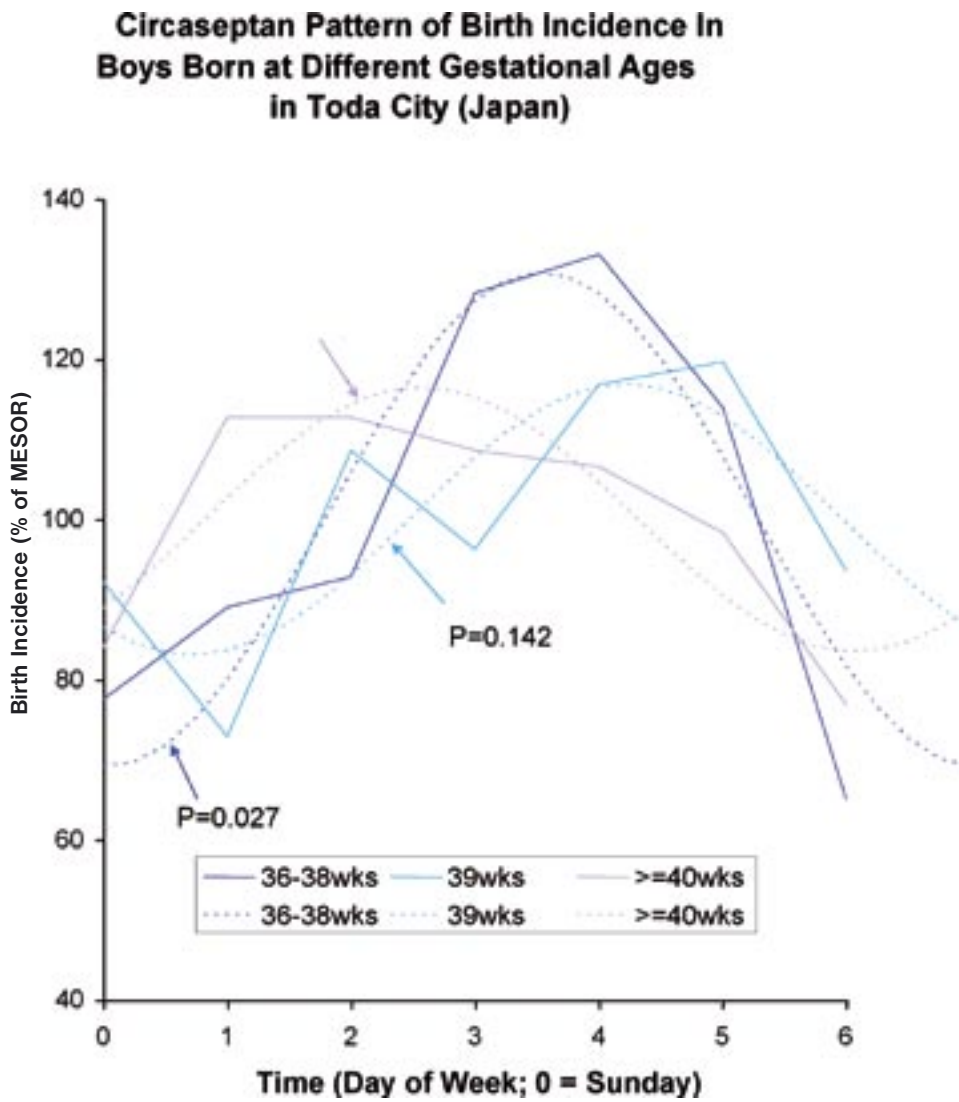


*Fig. 3*
The circaseptan rhythm of boys in Toda City (Japan)

weekly and about-yearly patterns characterize birth incidence and birth weight in Toda City, Japan.

## MATERIALS AND METHODS

Birth statistics were obtained from the Maternity Hospital in Toda City (Japan). Between 1 Jan 1999 and 31 Dec 2001, there were 4,411 births. Gender, birth weight, and gestational age at birth were recorded in each case, together with information about whether delivery was by caesarean section, whether the pregnancy ended with intrauterine fetal death, and other complications. The data were analysed as a whole in terms of birth incidence, separately for vaginal deliveries and caesarean sections. The data were also analysed separately for babies with a given birth weight (<1.5, 1.5–2, 2–2.5, and >2.5 kg), and separately for boys or girls born at gestational ages of 36–38, 39 or ³40 weeks. Anticipated components with periods of 1.0 and 0.5 year and 1.0 and 0.5 week were fitted by least squares to each data series by cosinor (*9, 10*).

## RESULTS

A circannual rhythm in birth incidence was detected with statistical significance (P=0.047) for all vaginal deliveries (acrophase = -253°, with 360° equated to 1 year; time reference = Dec 20, 1998). A similar result (acrophase =-259°) was of borderline statistical significance for caesarean sections (P=0.097). *Fig. 1* illustrates the similarity in phase of the yearly patterns.

An about 7-day (circaseptan) component of borderline statistical significance was obtained for 2–2.5 kg babies (P=0.094), *Fig. 2.* Whereas the circaseptan results were not statistically significant for girls, the 7-day component was of borderline statistical significance for boys born at gestational ages of ≥ 40 weeks (P=0.052), and it was statistically significant for boys born at gestational ages of 36–38 weeks (P=0.027). Moreover, the circaseptan acrophases of boys are very similar (GA: -182° at 36–38 weeks; -217° at 39 weeks; and –217° at ³40 weeks), *Fig. 3.*

For birth weight, a circannual component was only of borderline statistical significance for boys born at gestational ages of 36–38 (P=0.088) or 39 (P=0.058) weeks. The half-yearly component was detected with statistical significance for girls born at gestational ages of ³40 weeks (P=0.010), and it was of borderline statistical significance for girls born at gestational ages of 36–38 weeks (P=0.082). A summary by population-mean cosinor at 6 months also yields results of borderline statistical significance (P=0.085), with an acrophase of –120° (360° equated to 6 months; time reference = Dec 20, 1998). A weekly component was statistically significant for boys born at gestational ages of 36–38, 39 or ≥ 40 weeks. (P<0.001), and it was of borderline statistical significance for girls born at 39-week gestation (P=0.052). The circasemiseptan component was of borderline statistical significance only for boys born at gestational ages of ≥ 40 weeks (P=0.093).

## DISCUSSION

About-yearly and/or half-yearly variations have been reported to characterize birth incidence (*8*) as well as birth weight (*11, 12*). In data from Denmark, published by *Wohlfahrt et al.* (*13*), our re-analyses revealed a circannual component slightly more prominent than the half-yearly component for birth weight, whereas in the case of length at birth, the reverse held true. Moreover, the prominence of the half-year over the year was strengthened in analyses of data from babies born at the same gestational age of 40 weeks (*14*).

Both components have also been detected with statistical significance in data on birth weight from La Coru a, Spain (*11, 12*). For infants followed-up longitudinally at about monthly intervals for up to about 1.5 years, a circannual component was also found to persist after birth and to be more pronounced as a function of age than as a function of calendar month, suggesting that the circannual variation may in part be endogenous, while still amenable to synchronization by environmental cycles. The finding of near- (*15*) and far- (*16–19*) trans-years made recently could not be detected with statistical significance in this study, with data covering no more than 3 years. Longer records should be sought to assess the presence of any such spectral components that have environmental counterparts differing from the calendar year (*15–19*).

An about-weekly and/or half-weekly variation was also reported by *Marazzi et al.* (*6*) for birth incidence, as well as for stillbirths and for perinatal mortality. Similar about-weekly patterns were found for babies in 4 different birth weight categories (<1.5, 1.5–2, 2–2.5, and >2.5 kg), based on a statistic summarizing 220,540 births and 2,152 perinatal deaths. Whereas a 7-day synchronized circaseptan environmental component has recently been looked upon as a "statistical" variation (*20*), a near-weekly component characterizes the geomagnetic indices Kp and aa (*21–25*).

The sample available is very small, spanning no more than 3 years and stemming from only a single maternity hospital. Whereas more data are needed to validate the results presented herein, some anticipated features reproduce earlier results.

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## DALŠÍ MAPOVÁNÍ CHRONOMU NATALITY V PORODNICI VE MĚSTĚ TODA (JAPONSKO)

S o u h r n

Cílem práce bylo studium cirkaanuálního (roční) a /nebo circaseptánního (7denního) kolísání incidence porodů a porodní váhy na souboru dat celkem 4411 porodů v porodnici ve městě Toda (Japonsko) od 1. 1. 1999 do 31. 12. 2001 a studium těchto dat jako časové struktury (chronomu) populačního rytmu. Data byla analyzována kosinorovou analýzou odděleně pro děti s porodní váhou v určitém rozmezí, pro hochy a dívky, a dle různého gestačního stáří. Ve výskytu fyziologických porodů byl nalezen statisticky významný výskyt ročního rytmu. Podobné výsledky byly nalezeny u porodů ukončených císařským řezem na hranici statistické významnosti. Asi 7denní (circaseptánní) rytmus byl nalezen na hranici statistické významnosti v některých skupinách dětí. Asi roční a asi týdenní rytmy byly nalezeny v porodní váze v některých skupinách dětí.

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