Sleep-Wake and Temperature Rhythms in Preterm Babies Maintained in a Neonatal Care Unit

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Twenty healthy preterm babies with gestational ages between 31\(\frac{1}{2}\) and 35\(\frac{1}{2}\) weeks were studied in a low-risk neonatal care unit. Sleep-wake cycle data were collected by the nursery staff through behavioral observation every 10 min as well as the spontaneous or induced nature of awakenings. The data were divided in 10-min epochs, grouped in a series of seven consecutive days, and submitted to spectral analysis. Awakenings were analyzed through a method which calculates the duration of the intervals between the spontaneous or induced awakenings. Oral temperature data, collected every four hours (three consecutive days) were analyzed with the Cosinor technique. An average of 26% of the sleep behavior can be explained by rhythmicity, which is composed by several ultradian frequencies. Three-hour oscillation was the most potent component of the spectrum. Six children expressed a 24-h rhythm. Spontaneous awakenings showed several ultradian rhythms of low potency, whereas induced awakenings expressed a more potent overall rhythmicity. Only one baby expressed a temperature rhythm in the circadian range during the second week of life. These results support the idea that at least part of the sleep-wake rhythmicity identified in babies maintained in a neonatal care unit is generated by external influences.

CURRENT CLAIM: The development of sleep-wake rhythmicity was investigated in healthy preterm babies in the first two weeks of life, showing a potent 3-h rhythm exogenously generated by the feeding patterns of the nursery in all babies and a significant circadian rhythmicity in some of them.

Evidence about the functionality of the human circadian timing system in intrauterine life have been detected, representing the expression of this system under the synchronizer effect of maternal rhythmic signals (Reppert and Schwartz, 1983; Reppert and Rivkees, 1992). In the first months of post-natal life the child will express a cyclical pattern of sleep-wake behavior, composed of several ultradian frequencies, which will be progressively replaced by a 24-h rhythm, whose consolidation follows the maturation process of the central nervous system (Hellbrugge, 1960; Kleitman and Engelman, 1953; Hoppenbrows, 1987; Freudigman and Thoman, 1994).

The rhythmicity of other variables (oral temperature and heart rate) were also studied in newborns, demonstrating the presence of ultradian (Tenreiro et al., 1991; Glotzbach et al., 1995; Thomas, 1991) and circadian (Tenreiro et al., 1991; Updike et al., 1985; Mirmiran and Kok, 1991) rhythms; some studies show an earlier emergence of the circadian component for these variables when compared to the sleep-wake cycle (Glotzbach et al., 1994, 1995; Lodemore et al., 1991).

The presence of a weak circadian rhythm with periods above 24 h in sleep-wake, temperature, and heart rate cycles during the first weeks of life could suggest that, initially, these babies were free-running, and only afterwards would the synchronization of these rhythms occur (Hoppenbrows, 1987; Tenreiro et al., 1991).

Several authors have compared groups of term and preterm babies with still inconclusive results; some authors found early circadian rhythms in temperature, heart rate, and other variables (Updike et al., 1985; Mirmiran and Kok, 1991); others found a predominance of ultradian frequencies (Glotzbach et al., 1995).

Some authors suggest that the emergence of a synchronized sleep-wake circadian rhythm occurs in the same post-conceptional age in term and preterm babies, allowing for the necessary time for the maturation of the central nervous system (Anders and Keener, 1985; Shimada et al., 1993). On the other hand, other authors demonstrate that term and preterm babies develop a synchronized circadian rhythm after the same period of exposition to environmental cycles, arguing that the nursery environment, with poor rhythms, could be responsible by the apparent postnatal delay in the emergence of the synchronized circadian rhythm (McMillen et al., 1991). In favor of this environmental influence is also the fact that babies maintained in nurseries with light-dark cycles gain weight more quickly (Mann et al., 1986).

Preterm babies are out of the maternal environment before the expected date, becoming exposed to external influences earlier than term babies. These influences may involve constant conditions such as those found in neonatal care units, incubators with constant light and temperature.

Few longitudinal studies were carried out comparing the evolution of sleep-wake and temperature circadian rhythms in preterm babies during the first weeks of life (Tenreiro et al., 1991; Anders and Keener, 1985). Also, we rarely see the concern with the influence exerted by nursery routine over the rhythmicity in these children (McMillen et al., 1991). In order to help clarify those points we describe in this study, sleep-wake and temperature rhythms were observed in 20 healthy preterm babies maintained in a low-risk neonatal care unit.

METHODS

Twenty preterm babies, recruited in the low risk neonatal care unit of the hospital of the University of São Paulo from...
July, 1997, to August, 1998, had their sleep-wake and oral temperature data collected during the first days of life (Table 1). Sleep-wake state was recorded by the nursery staff every 10 min in a spreadsheet provided by the researchers; the nature of the awakenings, spontaneous or induced, was also registered. Oral temperature data was also collected by the nursery staff every 4 h, with an electronic digital thermometer built into a pacifier (WeeCareTM).

To be included in the study these children had to fill the following criteria: 1) no evident neurological pathology, with a normal neurological exam at birth; 2) no other serious organic disturbance; 3) gestational age (GA) <36 weeks; and 4) first-minute Apgar >6.

These 20 infants, 11 girls and 9 boys, presented a gestational age varying from 31\(\frac{3}{7}\) to 35\(\frac{5}{7}\) weeks, with an average of 34\(\frac{2}{7}\)±2.82 weeks; average Apgar of 8, and average weight of 1885.15±174.5 g.

Nine babies were maintained in common cradles (Cc), six in incubators (Ic) and later in Cc, two in Ic and then in warm cradles (Wc), two in Wc/Cc, and one in Cc/Ic. Luminosity during daytime ranged from 240 to 350 lux, and during nighttime from 120 to 200 lux, with the lights on. Children remained in this unit around 12.3±3.79 days.

Mothers were allowed to enter the nursery every 3 h for breast feeding, being allowed to arrive 30 min before and leave 30 min after the 3-h limit. During the mother’s absence, children were bottle fed every 3 h.

Data collection obtained with the mother’s informed consent began when children were transferred to the low risk neonatal care unit and was continued until discharge.

Three infants stayed in the semi-intensive care unit at first, being transferred to the low risk unit afterwards; the others came directly from the obstetric center. For 10 children, data collection started during the first week of life, and for the other 10, in the second week. In Table 1 we summarize the data collected and analyzed.

**Analysis**

Sleep-wake data were analyzed in a series of seven consecutive days, divided into 10-min bins. For each bin the value of 1 was attributed to sleep and –1 to wakefulness, according to a method described elsewhere (Menna-Barreto et al., 1993). Time series longer than 5\(\frac{1}{2}\) days and shorter than seven days were completed with zero in order to produce seven consecutive days of data for all series. The resulting time series were then submitted to spectral analysis (Fast Fourier Transform) method, which adjusts sine and cosine curves of different periods to each series. This technique offers results in terms of spectral power (amplitude) of the several harmonics of the time series. With this method we were able to detect periodicities ranging from 20 min up to 84 h. The resulting amplitude values were then submitted to Siegel’s significance test \((p<0.05)\), which allows for the identification of significant components (Siegel, 1980). This test produces, as a result, a list of harmonics with their respective amplitude which have reached a criterion of less than 5% probability of being the result of random oscillations. One of the Siegel’s test results is the statistic \(y\), which can be interpreted as the relative contribution of each harmonic to overall rhythmicity, which in turn may be represented by the sum of all values of \(y\) shown to be statistically significant. This overall rhythmicity may be taken as the percentage of variability in a time series that can be explained by periodical changes.

**Table 1**

<table>
<thead>
<tr>
<th>ID</th>
<th>Gestational Age (weeks)</th>
<th>Apgar Score</th>
<th>Cradle Type</th>
<th>Sleep Analyzed (postnatal age in days)</th>
<th>Temperature Analyzed (postnatal age in days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deb</td>
<td>31(\frac{3}{7})</td>
<td>7</td>
<td>Ic/Wc</td>
<td>6(\frac{1}{2})–12(\frac{1}{2})</td>
<td>11(\frac{1}{2})–13(\frac{1}{2})</td>
</tr>
<tr>
<td>Mat</td>
<td>32(\frac{2}{7})</td>
<td>7</td>
<td>Cc</td>
<td>11(\frac{1}{2})–16(\frac{1}{2})</td>
<td>16(\frac{1}{2})–18(\frac{1}{2})</td>
</tr>
<tr>
<td>Lil</td>
<td>33(\frac{3}{7})</td>
<td>7</td>
<td>Cc</td>
<td>3(\frac{1}{2})–9(\frac{1}{2})</td>
<td>7(\frac{1}{2})–9(\frac{1}{2})</td>
</tr>
<tr>
<td>Kev</td>
<td>33(\frac{3}{7})</td>
<td>8</td>
<td>Ic/Cc</td>
<td>6(\frac{1}{2})–11(\frac{1}{2})</td>
<td>7(\frac{1}{2})–9(\frac{1}{2})</td>
</tr>
<tr>
<td>Igr</td>
<td>34</td>
<td>9</td>
<td>Cc/Ic</td>
<td>6(\frac{1}{2})–12(\frac{1}{2})</td>
<td>9(\frac{1}{2})–11(\frac{1}{2})</td>
</tr>
<tr>
<td>Gio</td>
<td>34(\frac{3}{7})</td>
<td>7</td>
<td>Ic/Cc</td>
<td>6(\frac{1}{2})–12(\frac{1}{2})</td>
<td>6(\frac{1}{2})–8(\frac{1}{2})</td>
</tr>
<tr>
<td>Nat</td>
<td>34(\frac{2}{7})</td>
<td>7</td>
<td>Ic/Cc</td>
<td>6(\frac{1}{2})–12(\frac{1}{2})</td>
<td>6(\frac{1}{2})–8(\frac{1}{2})</td>
</tr>
<tr>
<td>Jan</td>
<td>34(\frac{2}{7})</td>
<td>9</td>
<td>Cc/Wc</td>
<td>3(\frac{1}{2})–11(\frac{1}{2})</td>
<td>7(\frac{1}{2})–9(\frac{1}{2})</td>
</tr>
<tr>
<td>Lav</td>
<td>34(\frac{2}{7})</td>
<td>8</td>
<td>Wc/Cc</td>
<td>3(\frac{1}{2})–11(\frac{1}{2})</td>
<td>9(\frac{1}{2})–11(\frac{1}{2})</td>
</tr>
<tr>
<td>Lfe</td>
<td>34(\frac{3}{7})</td>
<td>9</td>
<td>Cc</td>
<td>5(\frac{1}{2})–11(\frac{1}{2})</td>
<td>-- --</td>
</tr>
<tr>
<td>Ren</td>
<td>34(\frac{2}{7})</td>
<td>8</td>
<td>Ic/Cc</td>
<td>1(\frac{1}{2})–7(\frac{1}{2})</td>
<td>-- --</td>
</tr>
<tr>
<td>Sam</td>
<td>35</td>
<td>8</td>
<td>Ic/Wc</td>
<td>10(\frac{1}{2})–16(\frac{1}{2})</td>
<td>6(\frac{1}{2})–8(\frac{1}{2})</td>
</tr>
<tr>
<td>Ver</td>
<td>35</td>
<td>7</td>
<td>Ic/Wc</td>
<td>3(\frac{1}{2})–9(\frac{1}{2})</td>
<td>7(\frac{1}{2})–9(\frac{1}{2})</td>
</tr>
<tr>
<td>Rob</td>
<td>35(\frac{3}{7})</td>
<td>7</td>
<td>Cc</td>
<td>1(\frac{1}{2})–7(\frac{1}{2})</td>
<td>-- --</td>
</tr>
<tr>
<td>Fer</td>
<td>35(\frac{2}{7})</td>
<td>9</td>
<td>Cc</td>
<td>2(\frac{1}{2})–8(\frac{1}{2})</td>
<td>3(\frac{1}{2})–5(\frac{1}{2})</td>
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<tr>
<td>Rnt</td>
<td>35(\frac{2}{7})</td>
<td>9</td>
<td>Cc</td>
<td>4(\frac{1}{2})–11(\frac{1}{2})</td>
<td>5(\frac{1}{2})–7(\frac{1}{2})</td>
</tr>
<tr>
<td>Hil</td>
<td>35(\frac{3}{7})</td>
<td>8</td>
<td>Ic/Cc</td>
<td>3(\frac{1}{2})–9(\frac{1}{2})</td>
<td>6(\frac{1}{2})–8(\frac{1}{2})</td>
</tr>
<tr>
<td>Crl</td>
<td>35(\frac{2}{7})</td>
<td>9</td>
<td>Cc</td>
<td>6(\frac{1}{2})–12(\frac{1}{2})</td>
<td>7(\frac{1}{2})–9(\frac{1}{2})</td>
</tr>
<tr>
<td>Cam</td>
<td>35(\frac{2}{7})</td>
<td>9</td>
<td>Cc</td>
<td>6(\frac{1}{2})–12(\frac{1}{2})</td>
<td>7(\frac{1}{2})–9(\frac{1}{2})</td>
</tr>
<tr>
<td>Mcn</td>
<td>35(\frac{3}{7})</td>
<td>8</td>
<td>Ic/Cc</td>
<td>3(\frac{1}{2})–9(\frac{1}{2})</td>
<td>5(\frac{1}{2})–7(\frac{1}{2})</td>
</tr>
</tbody>
</table>

ID=identification code; CC=common cradle; WC=warm cradle; IC=incubator.
Spontaneous and induced awakenings were analyzed separately, according to an algorithm developed by one of the authors (LD). With this procedure we calculated the interval, in minutes, between consecutive induced awakenings and between consecutive spontaneous awakenings, calculating the frequency of intervals within arbitrary bins of one hour (1 h, 2 h, 3 h, etc.). The final result is a number of intervals in each bin presented as a fraction of the total number of intervals. Spontaneous and induced awakenings were also submitted to FFT and Siegel’s procedures described above.

Oral temperature data regularly collected for three consecutive days were analyzed by the minimum squares method of Cosinor to detect frequencies in the circadian range of 20 to 28 h (Nelson, 1979).

### RESULTS

During their stay in the nursery, preterm babies presented an average of 26% of their sleep-wake behavior explained by rhythmicity. This overall rhythmicity was composed of several ultradian, circadian and infradian frequencies. Among ultradian frequencies we distinguished a 3-h rhythm, which is the most conspicuous for the majority of children (n=17; see Table 2). Two babies presented a 2-h rhythm as the most robust, and one child did not show any significant rhythmicity. Six children presented a 24-h rhythm. The spectra of frequencies presented by individual children in the first and second weeks of life do not show marked differences and will not be discussed here.

Figure 1 shows graphics for three babies, corresponding to examples of the patterns of frequencies presented by the majority of children. The first graph corresponds to baby Mcn, born at 35 3/7 weeks of gestational age, observed during the first week of life in the neonatal care unit. This child showed around 31% of his sleep-wake behavior explained by a rhythmic pattern, which was composed of several low amplitude ultradian frequencies and a 3-h rhythm, with a relative amplitude around 13%. The second graphic corresponds to baby Nat, 34 2/7 weeks, observed during the second week of life. About 32% of her sleep behavior presented a regular expression. This rhythmicity was composed by some low intensity infradian and ultradian frequencies; a specific ultradian rhythm with a period of 3 h appeared as the most robust rhythm presented by this child. The third graphic shows the results of an infant, Igr, who showed a 24-h rhythm with a low relative amplitude (around 3%) value similar to those found for the other five children who presented circadian

#### Table 2

<table>
<thead>
<tr>
<th>ID</th>
<th>Gestational Age (weeks)</th>
<th>3-h Spectral Power</th>
<th>24-h Spectral Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deb</td>
<td>31 3/7</td>
<td>7</td>
<td>---</td>
</tr>
<tr>
<td>Mat</td>
<td>32 3/7</td>
<td>8</td>
<td>---</td>
</tr>
<tr>
<td>Lil</td>
<td>32 6/7</td>
<td>8</td>
<td>---</td>
</tr>
<tr>
<td>Kev</td>
<td>33 2/7</td>
<td>8</td>
<td>1.5</td>
</tr>
<tr>
<td>Igr</td>
<td>34</td>
<td>9</td>
<td>---</td>
</tr>
<tr>
<td>Gio</td>
<td>34 1/1</td>
<td>7</td>
<td>---</td>
</tr>
<tr>
<td>Nat</td>
<td>34 2/7</td>
<td>7</td>
<td>---</td>
</tr>
<tr>
<td>Jan</td>
<td>34 2/7</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Lav</td>
<td>34 3/7</td>
<td>8</td>
<td>---</td>
</tr>
<tr>
<td>Lfe</td>
<td>34 4/7</td>
<td>9</td>
<td>---</td>
</tr>
<tr>
<td>Ren</td>
<td>34 4/7</td>
<td>8</td>
<td>---</td>
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<td>Sam</td>
<td>35</td>
<td>8</td>
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<td>7</td>
<td>---</td>
</tr>
<tr>
<td>Rob</td>
<td>35 1/7</td>
<td>7</td>
<td>---</td>
</tr>
<tr>
<td>Fer</td>
<td>35 2/7</td>
<td>9</td>
<td>---</td>
</tr>
<tr>
<td>Rnt</td>
<td>35 2/7</td>
<td>9</td>
<td>---</td>
</tr>
<tr>
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<td>8</td>
<td>2</td>
</tr>
<tr>
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<td>9</td>
<td>4</td>
</tr>
<tr>
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<td>Mcn</td>
<td>35 3/7</td>
<td>8</td>
<td>---</td>
</tr>
</tbody>
</table>

ID=identification code

Figure 1. Relative amplitude of the sleep-wake rhythms expressed by babies Mcn, Nat, and Igr during the 1st and 2nd weeks of postnatal life, respectively.
components in their sleep-wake cycle. This baby was one of the two who presented a predominant 2-h rhythm (16%), with a weak 3-h component.

In the neonatal care unit, these children were frequently awakened by the staff for general care and feeding. We calculated the percentage of induced awakenings (spontaneous + induced=100% of total awakenings) for each baby/day and found this percentage was extremely variable among children and for the same child in different days. There was no coherent tendency for increase or decrease in that percentage along the days (see Table 3).

The spectral analysis of spontaneous awakenings revealed a rhythmicity composed by several ultradian frequencies, without an evident predominance of any of them and more potent rhythms around 18-24 h. Therefore, rhythms in the range of 3 h show an intensity as low as other frequencies (see Figure 2). The analysis of induced awakenings revealed a stronger 3-h component for all babies in comparison to spontaneous awakenings. This rhythmicity was composed of several ultradian frequencies, but with significant differences among children in spite of the fact that they were maintained in the same environment. Thirteen of the 20 babies presented a 24-h rhythm in spontaneous awakenings; but only seven

<table>
<thead>
<tr>
<th>ID</th>
<th>% of Induced Awakenings First Day/Age in Days</th>
<th>% of Induced Awakenings Last Day/Age in Days</th>
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<tbody>
<tr>
<td>Lav</td>
<td>77%/3</td>
<td>41.6%/10</td>
</tr>
<tr>
<td>Jan</td>
<td>50%/4</td>
<td>66.6%/10</td>
</tr>
<tr>
<td>Mcn</td>
<td>23%/3</td>
<td>100%/10</td>
</tr>
<tr>
<td>Sam</td>
<td>64%/3</td>
<td>77.7%/17</td>
</tr>
<tr>
<td>Hil</td>
<td>46%/3</td>
<td>30%/14</td>
</tr>
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</table>

ID=Identification code.

<table>
<thead>
<tr>
<th>ID</th>
<th>24 h in IA</th>
<th>24 h in SA</th>
</tr>
</thead>
<tbody>
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<td>X</td>
</tr>
<tr>
<td>Mat</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Lil</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Kev</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Igr</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Gio</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Nat</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Jan</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Lav</td>
<td>X</td>
<td>--</td>
</tr>
<tr>
<td>Lfe</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Ren</td>
<td>--</td>
<td>X</td>
</tr>
<tr>
<td>Sam</td>
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<td>Hil</td>
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<td>X</td>
</tr>
<tr>
<td>Crl</td>
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<td>Cam</td>
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<td>X</td>
</tr>
<tr>
<td>Mcn</td>
<td>X</td>
<td>--</td>
</tr>
</tbody>
</table>

ID=Identification code; IA=Induced awakenings; SA=Spontaneous awakenings.

Figure 2. Histograms of periodicities of induced and spontaneous awakenings for babies Nat and Ren, presenting the relative amplitude of these rhythms in the ordinates. A and B=Baby Nat's spontaneous and induced awakenings, respectively; C and D=Baby Ren's spontaneous and induced awakenings, respectively.
infants presented this rhythm in induced awakenings. Four babies showed a 24-h rhythm in induced awakenings and not in the spontaneous ones.

In relation to oral temperature, only one infant showed a significant circadian rhythm in the second week of life. Infant Deb presented 33% of circadian rhythmicity in oral temperature, with \( p=0.05 \). This child was 31\( \frac{3}{7} \) weeks old (gestational age) and remained in the incubator during the entire the period of sleep-wake and temperature data collection. She did not show a 24-h rhythm in the analysis of the sleep-wake cycle. In order to check whether the temperature in the incubator could be masking the oral temperature oscillations, we analyzed the incubator temperature values and found no significant circadian rhythmicity. The graphics of oral and incubator temperature values are shown in Figure 3.

**DISCUSSION**

According to literature data, in the first weeks of life children express a rhythmicity of sleep-wake behavior composed mainly of ultradian frequencies. A few weeks later, these faster rhythms are progressively replaced by slower rhythms in the circadian range (Meier-Koll et al., 1978). Studies with preterm infants generally focus the development of a circadian sleep-wake rhythm, which would emerge at a gestational age comparable to term babies. Other periodicities, ultradian or infradian, are generally ignored in the literature, possibly because their genesis is poorly understood.

Our subjects showed, during their stay at a neonatal care unit in the first two weeks of life, a percentage of their sleep-wake behavior explained by rhythmicity composed mostly of ultradian rhythms, as would be expected in term babies with a similar postnatal age.

Among the ultradian frequencies we distinguished a 3-h rhythm with a great relative amplitude, being the most conspicuous periodicity expressed by the preterm babies. This is probably due to the fact that, in the nursery, our subjects were fed every 3 h and, if they were sleeping, awakened by the staff, which is demonstrated by the high number of induced awakenings. This is confirmed by the relatively larger amplitude of the 3-h component in induced rather than spontaneous awakenings. Since mothers were allowed to arrive 30 min before and leave 30 min after the scheduled time for feeding, we believe this could explain the presence of a predominant 2-h rhythm in two children.

Most studies performed with preterm babies recruited children maintained in the most arhythmic conditions as possible, that is, in incubators with parenteral nutrition and irregular nurse care, which makes it difficult to find a predominant specific rhythm (Tenreiro et al., 1991; Mirmiran and Kok, 1991). Nevertheless, Glotzbach et al. (1995) found
ultradian periodicities of 3 and 4 h in temperature, coincident with feeding and nurse interventions.

Therefore, while they were in a neonatal care unit, these preterm babies' sleep-wake cycle was dominated by an exogenously generated rhythm, rather a masking effect than a synchronization of the infant’s biological clock by an environmental zeitgeber. This interpretation is supported by the high index of induced awakenings, and their rhythmicity, that these children presented until their last day in the neonatal care unit.

On the other hand, it does not mean that these babies are unable to exhibit endogenous rhythms, as it is suggested by the presence of rhythmicity in spontaneous awakenings, although with low amplitudes. Other studies have already demonstrated the presence of circadian and ultradian rhythms in several variables in babies maintained in less regular conditions, younger than our subjects, and thus submitted to more intensive surveillance (Freudigman and Thoman, 1994; Tenreiro et al., 1991; Updike et al., 1985; Mirmiran and Kok, 1991).

In relation to temperature, only one infant exhibited circadian rhythmicity. We must observe that this particular infant remained in the incubator during all the data collection periods, where the ambient temperature did not oscillate in the circadian range. This child’s sleep-wake cycle did not show a circadian component, therefore the circadian temperature rhythm we found is probably an endogenously-generated rhythm.

The absence of rhythmicity in other babies’ temperatures was similar to what is reported in the literature (Tenreiro et al., 1991), where, if detected, ultradian and circadian temperature rhythms appear erratically in preterm babies observed during the first weeks of life. One must bear in mind that most of the studies reported in the literature were performed on subjects submitted to intensive care due to a variety of health conditions, whereas our subjects were all healthy.

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**REFERENCES**