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The development of the circadian heart rate rhythm (CHR) in Asian infants

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Objective: To test the hypothesis that term-born Asian infants, at reduced risk to die of Sudden Infant Death Syndrome (SIDS) exhibit a circadian heart rate rhythm (CHR) at a later age than non-Asian term infants.

Method: Repeated overnight heart rate (HR) traces obtained with a battery-operated Polar S810i heart-rate monitor at home in 17 Asian Torajan infants in Indonesia, were compared with those of 52 non-Asian infants monitored as part of the Collaborative Home Infant Monitoring Evaluation (CHIME). HR was determined using a moving window averaging technique. A comparison of median HR during quiet sleep (QS) episodes (identified by minimum HR variability), established the presence of CHR.

Results: Seventy-three percent of non-Asian CHIME infants ≤7 weeks exhibited CHR compared to 45% of Asian Torajan infants. Between 8 and 12 weeks, 94% of non-Asian CHIME infants exhibited CHR, compared to 33% of Asian Torajan infants (p<0.001). Forty seven and 56% of Asian Torajan infants exhibited the CHR at the age intervals of 16-20 weeks and 21-25 weeks respectively. Active wakefulness percentages as a function of the entire recording and median QS HR were not significantly different in the two groups.

Conclusion: Despite the fact that Asian Torajan infants were on average a week older than non-Asian CHIME infants, between two and three months of age only one in three exhibited the CHR, compared to virtually all non-Asian CHIME infants. We speculate that the cause of this difference rests in the infants’ environment rather than their genetic origin.

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identified variables that seemed to influence the appearance of the circadian temperature rhythm: being firstborn, supine sleeping, affluent families, breastfeeding and older mothers.

The primary objective of this study was to test the hypothesis that the appearance of the circadian heart rate rhythm (CHR) in Asian infants in Indonesia appeared later than that of a non-Asian control group. The protocol of the Collaborative Home Infant Monitorning Expedition (CHIME), carried out during the 1990s, a sizable number of infants were included in a nighttime polysomnogram (PSG) that derived HR values. The available tracings from non-Asian subjects in CHIME were used as controls.

### 2.2. Procedures

In Toraja, three trained research assistants visited mothers and infants at home between 5 and 7 PM for application of the transmitter bands around the chest, just under the arms. Mothers were instructed to follow their usual routines including changing clothes and breastfeeding as long as they kept the watch in the vicinity of the infant (at a distance of no more than one meter). These units were removed in the morning between 6:00 and 8:00 AM by one of the three research assistants who visited the home again for that purpose. This procedure was initiated in all infants between three and seven weeks of age and repeated either two or three times (Table 1). This was thus a longitudinal CHR study.

As part of a different study, a systematic in-home interview with mothers by two of the authors (TH, SS; 19) revealed that in Toraja most infants are wrapped in a sarong (long cotton cloth) or a blanket, including their heads. They are placed supine on a hard kapok mattress on the floor where they sleep with their mother and often the father and other siblings. These mothers do not smoke, and they tend to recline with their infants and report going to sleep before 9:00 PM. Feeding information was also obtained during this interview and classified as either exclusive breastfeeding or breastfeeding with some addition of solids. Formula feeding is rare in rural Toraja.

In the US, CHIME PSGs were gathered in a cross-sectional manner. In the five laboratories, personnel were trained in a standardized protocol for obtaining PSG data to ensure comparability of the results. Monitoring onset could be as early as 6:00 PM or as late as 9:00 PM and the monitoring would continue for at least eight hours. Throughout the night a demand-feeding schedule was followed with opportunity for breastfeeding. In some laboratories mothers were offered a recliner in the room with the instruction to be as quiet as possible; in others, the mother or caretaker was offered a separate room to rest.

The youngest infants were typically wrapped in a blanket while arm movements of older infants were limited with gauze bands secured with safety pins to the diaper. Infants were placed in a supine or side-lying position, and, in most laboratories they were observed with the help of a low-illumination or infrared video camera and

### Table 1

<table>
<thead>
<tr>
<th>Duration (wks)</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Range</th>
<th># (%) Exclusive Breastfeeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 weeks</td>
<td>17</td>
<td>39 (7.6)</td>
<td>27-49 weeks</td>
<td>13 (43%)</td>
</tr>
<tr>
<td>8-12 weeks†</td>
<td>15</td>
<td>5 (8.3)</td>
<td>5 weeks</td>
<td>3 (18%)</td>
</tr>
<tr>
<td>16-20 weeks</td>
<td>15</td>
<td>27 (11.4)</td>
<td>10 weeks</td>
<td>14 (93%)</td>
</tr>
<tr>
<td>21-25 weeks</td>
<td>9</td>
<td>9 (7.3)</td>
<td>16 weeks</td>
<td>8 (89%)</td>
</tr>
</tbody>
</table>

Notes: Formula feeding was exclusive breastfeeding, two formula-fed and two received both.

1. Asian Toraja infants were on average 1 week and 5 days older than non-Asian CHIME infants (*t* = 3.3 of 30, *P* < 0.0003). †: *P* < 0.02; ‡: *P* < 0.0001.