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# **Factors Affecting the Sleep of One-Year-Olds: A Pilot Study using Objective Monitoring of New Zealand Infants**

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## **Abstract**

Sleep takes time to mature and in infancy the structure and cycle of sleep differs greatly to that of adults. Data concerning normative sleep of infants is lacking due to few studies using objective measures. Factors affecting infants' sleep are both intrinsic and extrinsic in nature. The causes of problematic sleep are not well understood. This study aimed to pilot a methodology involving 1 week of actigraphy monitoring of 1-year-olds, as well as collecting normative data concerning sleep and sleep ecology through questionnaires and diaries. Potential factors contributing to sleep quantity, quality and maturation were investigated. Sleeping problems were reported in 35% of the sample of 52 Wellington infants. Current breastfeeding, time awake at night, and poor evening mood were all associated with problem sleep. Short sleep duration and more instances of being put to bed were also significant predictors of reporting problem sleep. Infants were typically rated in a poorer mood and exhibited more bedtime problems at the weekend. Longer sleep onset latencies and poorer sleep efficiency were identified by actigraphy on weekend evenings. The timing of sleep did not differ between genders or between week days and weekends, or childcare and non-childcare days. Mixed model analysis of variance indicated that the maturation and quality of sleep were significantly correlated with age and stages of cognitive and motor development. Sleep duration did not correlate with ponderal index, possibly due to the young age group as well as underrepresentation of short sleeping or overweight infants. Results support previous studies in western societies and autonomous sleeping is common. Potential mechanisms behind relationships between sleep and feeding, temperament and development are

discussed. Strengths and limitations of methods and procedures are assessed. Actigraphic recording of 1-year-olds is demonstrated to be a useful and reliable tool for studying sleep of infants and the results contribute to normative data. Future studies in NZ should consider recruiting a more representative sample and incorporate a longitudinal design to further assess the relationships highlighted here and in previous research.

(331 words)

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## List of Terms and Abbreviations

<b>Active interval</b>	Used in actigraphy. The times spent out of bed in active wake, as defined by sleep diary data
<b>ANOVA</b>	Analysis of covariance
<b>ASQ</b>	Ages and Stages Questionnaire
<b>AW64</b>	Actiwatch™ MiniMitter 64, brand of actigraph
<b>BISQ</b>	Brief Infant Sleep Questionnaire
<b>BMI</b>	Body mass index (kg/m <sup>2</sup> )
<b>Brain Plasticity</b>	The capacity to adapt and learn in response to internal and external needs
<b>Circadian</b>	Latin for ' <i>about a day</i> '. Refers to the self sustaining rhythms that have a periodicity of approximately 24-hours
<b>CPHR</b>	Centre for Public Health Research
<b>EEG</b>	Electroencephalography
<b>EMG</b>	Electromyography
<b>EOG</b>	Electrooculography
<b>Excluded interval</b>	Used in actigraphy. The times when data is deemed invalid for analysis
<b>ICSD</b>	International Classification of Sleep Disorders
<b>K-complex</b>	EEG phenomena characteristic of stage two sleep
<b>Log10</b>	Log to the base 10
<b>NREM</b>	Non-rapid eye movement sleep
<b>OSA</b>	Obstructive sleep apnoea
<b>Pākehā</b>	Person of predominantly European descent; not Māori
<b>Plunket</b>	A NZ society set up to support parents of children from 0-5 years of age
<b>Process C</b>	The signal of alertness from the internal circadian clock
<b>Process S</b>	The homeostatic drive for sleep

<b>PSG</b>	Polysomnography, the gold standard measure of sleep using EEG, EMG and EOG channels
<b>Ponderal index</b>	Measurement of body status ( $\sqrt[3]{\text{weight/length}}$ )100
<b>REM</b>	Rapid eye movement sleep
<b>Rest interval</b>	Used in actigraphy. The time spent in bed, as defined by sleep diary data
<b>CSN</b>	Suprachiasmatic nuclei
<b>SES</b>	Socioeconomic status
<b>SIDS</b>	Sudden infant death syndrome
<b>Sleep cycle</b>	The cycle of NREM/REM sleep stages throughout the sleep period
<b>Sleep interval</b>	Used in actigraphy. The time spent asleep whilst in bed, defined by the Actiware <sup>®</sup> software
<b>Sleep spindle</b>	EEG phenomena characteristic of stage two sleep
<b>SQRT</b>	Square root transformation
<b>Sleep/wake cycle</b>	The cycle of sleep and wake throughout the 24 hour day
<b>SWRC</b>	Sleep/Wake Research Centre, Massey University, Wellington
<b>SWS</b>	Slow wave sleep (stages three and four)
<b>Threshold for wake</b>	The number of activity counts per minute of actigraphy required to define wakefulness