A Model for Predicting Behavioural Sleep Problems in a Random Sample of Australian Pre-schoolers

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Behavioural sleep problems (childhood insomnias) can cause distress for both parents and children. This paper reports a model describing predictors of high sleep problem scores in a representative population-based random sample survey of non-Aboriginal singleton children born in 1995 and 1996 (1085 girls and 1129 boys) in Western Australia. Longitudinal repeated data were collected up to age 4 years by caregiver report. Children’s sleep rhythmicity levels in their first year, as well as conflicted and lax parenting in their second year, predicted higher scores on the sleep problem scale from the Child Behaviour Checklist/2–3 in the children’s third year. Higher scores on the sleep problem scale in the children’s third year predicted higher scores on the aggressive behaviour subscale of the Child Behaviour Checklist/4–16. The results support a model in which sleep problems mediated the relationship between parental conflict and aggressive behaviour, even when controlling for maternal depression, which has been associated with children’s aggressive behaviour. Copyright © 2007 John Wiley & Sons, Ltd.

Key words: behavioural sleep problems; pre-schoolers; random sample; Australian

The most common sleep disorders among pre-school children are childhood insomnias or behavioural sleep problems, characterized by inability to settle to sleep, repeated waking with demands for parental attention, and waking early in the morning (Stores, 1996). Behavioural sleep problems can have a profound effect on children and their families. When Lam, Hiscock, and Wake (2003) compared children with and without current sleep problems they found that children with sleep problems had significantly higher mean scores on the...
internalizing and externalizing scales, particularly the aggressive behaviour and somatic problems subscales of the Child Behaviour Checklist (CBCL). These effects can persist after early childhood, as was illustrated by Gregory and O’Connor (2002) who found that, after accounting for child sex, adoptive status, and stability of emotional/behavioural problems, children’s sleep problems at age 4 predicted behavioural/emotional problems in mid-adolescence.

Effects on parents can also be very serious. In a group of Swedish parents who had 6- to 12-month-olds with severe and chronic sleep problems, significantly more of the mothers whose children had a sleep problem met the criteria for a severe depressive episode compared with mothers whose children had no sleep problems (Thunström, 1999a). In Australia, children’s sleep problems reported at 6–19 months were associated with significantly higher levels of maternal depression (Armstrong, O’Donnell, McCallum, & Dadds, 1998). Mothers of children with sleep problems at 3–4 years of age reported significantly higher maternal depression scores and more limitations of daily functioning as a result of physical health problems (Lam et al., 2003).

Despite evidence about the effects of childhood sleep problems, there are limited longitudinal data sets on randomly sampled children that permit models of predictors of sleep problems to be examined. The model developed for this study was based on self-regulation theory. Self-regulation theory suggests, by the end of the first year of life, infants can control their affective arousal and, by their second year of life, they have active approaches to self-regulation behaviours (Calkins, 2004). Problems with self-regulation in infancy, including sleep, have been linked to sleep problems and aggression in children at 36 months (Degangi, Breinbauer, Roosevelt, Porges, & Greenspan, 2000).

Minde et al. (1993) suggested that pre-school children with sleep problems had difficulties in state and arousal regulation. Richman (1981) found an association between poor rhythmicity in children and more night waking. Sleep rhythmicity in infants between 6 and 13 months of age improved significantly following an intervention for behavioural sleep problems (Hall, Saunders, Clauson, Carty, & Janssen, 2006). These findings suggest that lower levels of sleep rhythmicity in late infancy could indicate difficulties self-regulating which would predict pre-schoolers’ sleep problems. For children in later infancy, breastfeeding has been associated with fragmented sleep at night (<6 consecutive hours) at 5 months (Touchette et al., 2005) and with extended waking at night or frequent waking at night (3 or more times) at 8 months of age (Zuckerman, Stevenson, & Bailey, 1987). Thus, continuing to breastfeed at age 1 could predict fragmented sleep and signalling at night in pre-school children.

Parental characteristics that have been associated with sleep problems are inter-parental conflict about parenting (lack of agreement between parents about parenting) and lax parenting style (permissive parenting). Richman (1981) found that mothers of pre-schoolers with sleep problems were less likely to confide in their husbands. In cases where mothers did not change their approaches to pre-schoolers with sleep problems, fathers have been requested to take over sleep management of pre-schoolers to improve their skills to help children sleep (Minde, Faucon, & Falkner, 1994). Parents who are in conflict may have difficulty equally supporting strategies to promote infant self-regulation; therefore, parental conflict could be an important predictor of pre-schoolers’ behavioural sleep problems. Zuckerman et al. (1987) argued that sleep problems that persist to 3 years of age result from pervasive difficulties with parents setting limits and boundaries. In a sample of pre-schoolers, lax parenting has been associated with sleep disturbance in a general paediatric group, but not in a sleep clinic group.
Lax parenting would be associated with unclear boundaries which would have the potential to undermine pre-schoolers’ efforts to develop self-regulation and therefore could serve as a predictor for infant sleep problems.

Although sleep problems have been associated with aggressive behaviour and tantrums in pre-schoolers (Lam et al., 2003; Zuckerman et al., 1987), externalizing behavioural disorders in pre-schoolers have also been associated with inter-parental conflict (Jouriles, Pfiffner, & O’Leary, 1988; Miller, Cowan, Cowan, Hetherington, & Clingempeel, 1993). Moreover, depressed mothers have been more likely to perceive their children as having more behavioural problems than non-depressed mothers, even when there were no significant differences in children’s behaviour between the groups (Webster-Stratton & Hammond, 1988). Because depression can be central to mothers’ perceptions of children’s behavioural problems, it is important to control for maternal depression when examining predictors of aggressive behaviour. Cummings and Davies (2002) have argued that much more work is needed towards establishing classes of psychological processes, beyond children’s sense of emotional security that can be linked to the effects of marital functioning on children’s adjustment.

The first aim of the analysis reported in this paper was to test a model of predictors from ages 1 to 2 for higher reported sleep problem scores at age 3 in a large, representative, population-based sample of children born in Western Australia. The second aim was to examine the relations between higher sleep problem scores in children’s third year of life and aggressive behaviours in their fourth year, controlling for maternal depression.

**METHOD**

Data for this analysis came from the RASCALS (Randomly Ascertained Sample of Children born in Australia’s Largest State) study in Western Australia. RASCALS is a longitudinal postal study of a sample of children born in Western Australia in 1995 and 1996. The study was designed to survey health-related behaviours (Kurinczuk, Parsons, Dawes, & Burton, 1999), to identify and evaluate health promotion opportunities from before birth to eight years and to investigate early causal pathways of mental health problems in childhood. There were 4007 mothers who responded at three months post-partum to the first postal questionnaire. A comparison with data available about all births in Western Australia (Stanley, Read, Kurinczuk, Croft, & Bower, 1997) showed that the 4007 mothers who responded were representatives of all women with live births in that period, with the exception of a slight under-representation of mothers with low birth weight babies (5.3% overall versus 4.7% in the sample) and mothers aged less than 20 years (6% overall versus 3.6% in the sample). Because metropolitan Aboriginal mothers were participating in a similar but more culturally appropriate study, they were not recruited into the RASCALS study.

For resource reasons, just less than a 70% random sample of mothers of singletons was drawn from the initial 4007 respondents. To ensure that potentially vulnerable and poor responders remained in the RASCALS study in informative proportions, we additionally retained all mothers who were single parents, mothers from households with an annual income of $A16 000 or less, and mothers whose partner was absent from the household. On this basis, 100 mothers and their infants were added to the random sample. Although we had
planned to weight the responses of the over-sampled groups, the response rates of those groups showed that they were not over-represented in the final participating population (Table 1); thus weighting was not necessary.

A total of 2837 mothers and their singleton infants were selected for follow-up of whom 2224 (78%) agreed, when their infant was one year old, to participate in the longitudinal RASCALS follow-up. Of that group, 1880 (85%) returned a self-completion questionnaire when their child was two years old; 1757 (80%) completed a questionnaire at three years; and 1656 (74%) completed a questionnaire when their child was four years old.

To examine the potential effects of attrition, we compared a range of early life characteristics present at three months of age for the participants from the cohorts at one and four years of age with all of the respondents at three months (Table 1). From this we concluded that attrition was generally non-systematic and the

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**Table 1. Socio-demographic characteristics present at three months of age for the RASCALS study participants at three months, one year and four years of age**

<table>
<thead>
<tr>
<th>Characteristics present at 3 months</th>
<th>Participants at the age of 3 months</th>
<th>Participants at the age of 1 year</th>
<th>Participants at the age of 4 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n (4007)</td>
<td>n (2224)</td>
<td>n (1657)</td>
</tr>
<tr>
<td>Maternal country of birth:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>2806 (70.0)</td>
<td>1588 (71.4)</td>
<td>1193 (72.0)</td>
</tr>
<tr>
<td>Maternal education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High school</td>
<td>2102 (52.5)</td>
<td>1072 (48.2)</td>
<td>756 (45.6)</td>
</tr>
<tr>
<td>Some tertiary/other</td>
<td>949 (23.7)</td>
<td>551 (24.8)</td>
<td>424 (25.6)</td>
</tr>
<tr>
<td>Degree level</td>
<td>926 (23.1)</td>
<td>588 (26.4)</td>
<td>477 (28.8)</td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>3015 (75.2)</td>
<td>1725 (77.6)</td>
<td>1322 (79.8)</td>
</tr>
<tr>
<td>Cohabiting</td>
<td>710 (17.7)</td>
<td>354 (15.9)</td>
<td>24 (14.7)</td>
</tr>
<tr>
<td>Single/other</td>
<td>262 (6.5)</td>
<td>136 (6.2)</td>
<td>9 (5.7)</td>
</tr>
<tr>
<td>Number of children in household</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1550 (38.7)</td>
<td>900 (40.5)</td>
<td>686 (41.4)</td>
</tr>
<tr>
<td>2+</td>
<td>2423 (60.5)</td>
<td>1313 (59.1)</td>
<td>969 (58.5)</td>
</tr>
<tr>
<td>Number of adults in household</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>154 (3.8)</td>
<td>90 (4.0)</td>
<td>63 (3.8)</td>
</tr>
<tr>
<td>2+</td>
<td>3817 (95.3)</td>
<td>2123 (95.4)</td>
<td>1594 (96.2)</td>
</tr>
<tr>
<td>Fathers present in household:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>3711 (92.6)</td>
<td>2075 (93.3)</td>
<td>1563 (94.3)</td>
</tr>
<tr>
<td>Income: &lt;$A25,000 per annum</td>
<td>1175 (29.3)</td>
<td>613 (27.6)</td>
<td>416 (25.1)</td>
</tr>
<tr>
<td>Government benefits(^b): Yes</td>
<td>360 (18.3)</td>
<td>229 (20.4)</td>
<td>186 (21.7)</td>
</tr>
<tr>
<td>Family allowance(^b): Yes</td>
<td>1454 (73.7)</td>
<td>824 (73.4)</td>
<td>625 (72.9)</td>
</tr>
</tbody>
</table>

\(^a\)Percentages may not total 100% due to rounding errors or a small amount of missing data.

\(^b\)Data available only for children born in 1996 births as these data items were not collected from the 1995 births.
effects were not remarkable, given the length and method of follow-up. We are confident, therefore, that the four-year-olds used in this analysis are reasonably representative of four-year-old non-Aboriginal Western Australian singleton children. Only children who had data at all data collection points from ages 1 to 4 were retained for analysis of the model. The lowest number of respondents for any measure was 1317.

**Data Collection**

On, or within a month of, the study child’s first and subsequent birthdays, the parents were sent a postal questionnaire. Over the four years of interest, mothers provided comprehensive information about family demography and a range of other areas related to the child and family functioning including: infant temperament (Windle & Lerner, 1986); mental health (Achenbach, 1991; Achenbach, 1992); maternal depression (Beck & Steer, 1987); parenting practices (Arnold, O’Leary, Wolff, & Acker, 1993); and partner conflict around parenting practices (Dadds & Powell, 1991).

Approval to conduct the study was obtained from the Princess Margaret Hospital for Children Institutional Ethics Committee and the Confidentiality of Health Information Committee of Western Australia. Participation in the study was voluntary and consent was implied by the completion and return of questionnaires.

**Measures**

The demographic measures reported here include: infant gender; gestational age; birth weight; maternal age; marital status; family income; and maternal education. The measures used and times of administration are summarized in Table 2.

**Sleep rhythmicity**

The Revised Dimensions of Temperament Survey (DOTS-R) Child Version (Windle & Lerner, 1986) was used in the RASCALS study for one- and two-year-olds. It comprises 54 items to assess nine dimensions including: general activity level; sleep activity; approach/withdrawal; flexibility/rigidity; mood; sleep rhythmicity; eating rhythmicity; daily rhythmicity; and task orientation (Windle & Lerner, 1986). The caregiver rates each statement on a scale of 1–4 from how false to how true (1 [usually false] through 4 [usually true]).

Table 2. Measures administered in the study

<table>
<thead>
<tr>
<th>Measures</th>
<th>Age 1</th>
<th>Age 2</th>
<th>Age 3</th>
<th>Age 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Still breastfeeding</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions of temperament—revised (sleep rhythmicity)</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child behaviour checklist/2-3</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent problem checklist</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Parenting scale</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Child behaviour checklist/4-18</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Beck Depression Inventory</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Rhythmicity Scale includes six items, such as, my child usually gets the same amount of sleep each night and my child seems to get sleep at about the same time every night.

The DOTS-R has demonstrated sound psychometric characteristics across age groups, including pre-school children (Windle & Lerner, 1986). Although not tested for reliability and validity in Australia, testing in several countries provides evidence of cross-cultural validity (Ezpeleta, Granero, de la Osa, & Guillamon, 2000; Koot, 1991; Mednick, Hocevar, Schulsinger, & Baker, 1996).

**Sleep problems**

The CBCL for two- to three-year-olds (CBCL/2–3) was included in the RASCAL questionnaires for two- and three-year-olds. This is a 99-item instrument wherein parents are asked to rate whether each item was not true (0) to very true or often true (2). The scale captures behaviours including anxious/depressed, withdrawn, sleep problems, somatic problems, aggression, and destruction. The sleep problems scale includes items such as does not want to sleep alone, resists going to bed at night, and wakes up often at night (Achenbach, 1992). Higher scores on this scale indicate increased risk for behavioural sleep problems. After cumulative frequency distributions of the raw scores were formed for the scale, the percentiles of the cumulative frequency distributions were used to assign normalized T scores. A T score of 55 was assigned to all raw scores up to the 69th percentile and then T scores were assigned to raw scores between the 69th and the 98th percentile, according to a standard procedure (Achenbach, Edelbrock, & Howell, 1987).

Achenbach (1992) reported acceptable test–retest correlations; correlations between parents’ ratings on the CBCL/2–3; and support for construct validity. Koot, Van Den Oord, Verhulst, and Boomsma (1997) identified a sleep problem factor on the CBCL/2–3 in a large sample of Dutch pre-school children, with a Cronbach’s alpha in a community sample of 0.77, supporting the notion of cross-cultural validity.

**Parent problem checklist**

The parent problem checklist was incorporated in the study for two, three, and four-year-olds and served as a measure of inter-parental conflict, specifically, parents’ abilities to cooperate and operate as a team when parenting (Dadds & Powell, 1991). The checklist contains 16 items which parents rate on a 5-point Likert scale. Six items refer to parental disagreement over responding to child misbehaviour, six items refer to open conflict over parenting issues, and four items refer to whether a parent undermines the other parent’s relationship with the child. Parents indicate the level of the problem in each area, for example, disagreeing over who disciplines the children. The summed scale scores range from 16 to 80. With a sample of 282 mothers with pre-school and school-aged children, the measure had high internal consistency 0.70, a unidimensional factor on factor analysis and test–retest reliability of 0.9 at 8 weeks (Dadds & Powell, 1991).

**Parenting scale**

The parenting scale was incorporated in the study for two-, three- and four-year-old children. The scale is a measure of dysfunctional parenting in discipline situations (Arnold et al., 1993). It has 30 items scored on 7-point scales with low scores indicating good parenting and high scores indicating dysfunctional...
parenting. Laxness represents one factor on the parenting scale. The laxness scale refers to permissive discipline or ‘giving in’ to children (Arnold et al., 1993). When factor analysis with data from 168 mothers and their pre-school children was undertaken, the scale demonstrated similar structure between clinical and non-clinical groups and it had an internal consistency and test–retest reliability of 0.83 (Arnold et al., 1993). Clinical and non-clinical groups of parents and children demonstrated significant differences in means on the laxness scale. There were significant correlations between laxness and externalizing behaviour problems (Arnold et al., 1993). In a study of pre-school children from a regular paediatric clinic, parental laxness was associated with sleep disturbance (Owens-Stively et al., 1997).

Aggressive behaviour

At age 4, the CBCL/4–18 replaced the CBCL/2–3 in the RASCALS questionnaire. The CBCL/4–18 is designed to record behavioural problems and competencies for children from age 4 to 18 years. It has 118 items which cluster to form two broad-band factors, internalizing and externalizing behaviours and nine narrow band factors including aggressive behaviour (Achenbach, 1991). Items for the aggressive narrow band include ‘physically attacks people’ and ‘gets in many fights’.

Hensley (1988) reported a normative study of the CBCL/4–18, which supported the reliability and content and construct validity of the measure in the Australian population. Bond, Nolan, Adler, and Robertson (1994) compared Melbourne school-aged children with data from the USA and Sydney and concluded that US normative problem data from the CBCL/4–18 were appropriate for use with Australian children.

Maternal depression measure

Data on maternal depression were collected with the revised version of the Beck Depression Inventory (Beck, Steer, & Garbin, 1988), a self-report measure for general depression that has been used extensively in clinical research. The measure was derived from clinical observations about the attitudes and symptoms displayed by depressed psychiatric patients. It comprises 21 symptoms and attitudes. Items reflect the intensity of depression and are rated from 1 (low) to 3 (high). Beck and colleagues report that the measure discriminates between normal and psychiatric patients and the psychometric properties have been consistently strong over 25 years of evaluation. Factor analysis with women who were outpatients with depression revealed four components: affective-cognitive symptomatology; somatic-performance difficulties; self-blame; and weight loss-related symptoms. Internal consistency in the same study was high at 0.88 (Steer, Beck, & Brown, 1989).

Analysis

Using SPSS 10.0 (SPSS, 1999), means and standard deviations were calculated for each of the four scales. For the sleep problem scales and the aggression scale, T scores were used in the analysis. Demographic data were summarized with proportions in each category. A correlation matrix of all of the main variables was constructed. Pearson’s product moment correlations were used to assess relationships among the measures (Table 3). All significant tests used in the analysis were two tailed.
Table 3. Inter-correlations among measures for children and mothers

<table>
<thead>
<tr>
<th>Measures</th>
<th>Babys' weight</th>
<th>Babys' gender</th>
<th>Still breastfeeding</th>
<th>Sleep rhythmicity</th>
<th>Sleep problems - T</th>
<th>Conflicted parenting</th>
<th>Lax parenting</th>
<th>Beck Depression Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Babys' weight in kg</td>
<td>—</td>
<td>—</td>
<td>n = 2208</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Babys' gender</td>
<td>-0.08**</td>
<td>—</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Still breastfeeding</td>
<td>0.03</td>
<td>0.05*</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep rhythmicity</td>
<td>0.07**</td>
<td>-0.03</td>
<td>-0.12**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleep problems - T</td>
<td>-0.04</td>
<td>0.04</td>
<td>0.07**</td>
<td>-0.17**</td>
<td>—</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflicted parenting</td>
<td>0.02</td>
<td>0.01</td>
<td>0.04</td>
<td>-0.14**</td>
<td>0.15**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lax parenting</td>
<td>-0.02</td>
<td>0.01</td>
<td>0.04</td>
<td>-0.2**</td>
<td>0.16**</td>
<td>0.30**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beck Depression Index</td>
<td>-0.02</td>
<td>-0.007</td>
<td>0.04</td>
<td>-0.12**</td>
<td>0.17**</td>
<td>0.26**</td>
<td>0.13**</td>
<td>—</td>
</tr>
<tr>
<td>Aggressive - T</td>
<td>-0.06*</td>
<td>0.03</td>
<td>-0.03</td>
<td>-0.15**</td>
<td>0.26**</td>
<td>0.21**</td>
<td>0.13**</td>
<td>0.23**</td>
</tr>
</tbody>
</table>

*Correlation significant at 0.05.
**Correlation significant at 0.01.
Each of the variables that was theoretically related to sleep problems (still breastfeeding in at age 1, sleep rhythmicity at age 1, inter-parental conflict at age 2, and lax parenting at age 2) was examined in individual models for their predictive ability for higher sleep problem scores. Effect sizes and confidence intervals were calculated for each model. The predictor variables for ages 1 and 2 were entered in a multiple regression model with higher sleep problem scores as the criterion variable. In a separate regression model, higher sleep problem scores at age 3 were entered to predict the criterion variable, aggression at age 4, while controlling for maternal depression when children were four years old.

A potential model in which sleep problems at 3 years of age mediated the relationship between inter-parental conflict at age 2 and aggressive behaviour at age 4 was tested using the procedure outlined by Baron and Kenny (1986). The four conditions that had to be met to establish a mediational relationship included: (1) the independent variable (inter-parental conflict) must predict the hypothesized mediator (sleep problems); (2) the independent variable must predict the dependent variable (aggression); (3) the mediator must predict the dependent variable, while controlling for the independent variable; and (4) the ability of the independent variable to predict the dependent variable must be significantly reduced when the effects of the mediator are removed. The significance of the indirect effect was tested using a procedure described by Baron and Kenny (1987) and Sobel (1982, 1987).

RESULTS

The demographic variables were similar in each year of the group retained for analysis to the figures in Table 1, except for slightly higher proportions of mothers with degree qualifications (29.3–31%), and slightly lower proportions of mothers with incomes per annum of < $25,000 (18–19%). Of the 2208 infants, few were low birth weight (4%). Only 5.2% of the 2214 infants were pre-term. Mean gestational age was 39.2 weeks (S.D. = 1.6) and mean birth weight was 3417 g (S.D. = 517.8).

There were significant correlations among a number of the measures (Table 3). In particular, sleep rhythmicity at age 1 was correlated significantly with all the measures in the table except baby’s gender. Still breastfeeding was only significantly correlated with baby’s gender, sleep rhythmicity, and sleep problems. Sleep problems at age 3 were positively correlated with conflicted and lax parenting at age 2, aggressive T scores at age 4 and Beck’s Depression Index scores. The Cronbach's alphas for the scales were: Sleep Rhythmicity Scale (0.77); Parenting Conflict Scale (0.89); and Lax Parenting Scale (0.82).

Testing the theoretical model

Each of the variables predicted higher sleep problem scores in the individual models. Whether the child was still breastfeeding versus weaned in the first year of life had a small effect size \((d = 0.17)\); however, children who were still breastfeeding at one year of age had significantly higher sleep problem scores at 3 years of age than children who were weaned. Having ever breastfed versus never been breastfed did not predict sleep problems at three years of age. Sleep rhythmicity at one year of age also had a small effect size; lower sleep rhythmicity at one year of age predicted significantly higher sleep problem scores.
at age 3 and accounted for 3% of the variance. Inter-parental conflict predicted higher sleep scores at three years of age, accounting for about 2.2% of the variance. More lax parenting at two years of age predicted higher sleep problem scores, accounting for 2.7% of the variance.

When all of the factors were examined in an additive model with sleep problems as the criterion variable, sleep rhythmicity at age 1, and more conflicted and lax parenting at age 2 predicted higher sleep problems at age 3, and together accounted for 6.4% of the variance. Each predictor predicted about 1.0% of the variance above and beyond the other predictors (see Table 4).

Sleep scores at age 3 were entered into a regression model with aggression at age 4 as the criterion variable, while controlling for maternal depression in year 4. Higher sleep problem scores at age 3 predicted more aggressive behaviour at age 4, after controlling for maternal depression. The effect size was moderate, with sleep problems accounting for 5.1% of the variance (see Table 5).

All of the conditions for mediation outlined above were met for the inter-parental conflict, sleep problems, and aggression model, even controlling for maternal depression. Specifically, conflicted parenting demonstrated a modest significant relationship with the aggression T score while controlling for maternal depression ($r = 0.17, p < 0.001$). The individual paths are discussed above and the test of the indirect effect was significant ($z = 3.28, p = 0.001$).

**DISCUSSION**

The study has a number of limitations. The most significant are parental reports of both sleep problems and aggressive behaviour, without any objective measures to support their reports. Nevertheless, parental reports have been viewed as valid when investigations are focused on perceptions of sleep problems (Atkinson, Table 4. Factors from ages one and two years predicting sleep problems at three

<table>
<thead>
<tr>
<th>Model</th>
<th>$R^2$</th>
<th>$B$</th>
<th>Std. error</th>
<th>Beta</th>
<th>$t$</th>
<th>$p &lt;$</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.60</td>
<td>1.47</td>
<td></td>
<td></td>
<td>50</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Still breastfeeding at year 1</td>
<td>0.56</td>
<td>0.41</td>
<td>0.04</td>
<td>1.36</td>
<td>0.17</td>
<td>0.002</td>
<td></td>
</tr>
<tr>
<td>Sleep rhythmicity</td>
<td>-0.19</td>
<td>0.46</td>
<td>-0.13</td>
<td>-4.22</td>
<td>0.000</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Conflicted parenting</td>
<td>0.23</td>
<td>0.06</td>
<td>0.11</td>
<td>3.73</td>
<td>0.000</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Lax parenting</td>
<td>0.8</td>
<td>0.22</td>
<td>0.11</td>
<td>3.7</td>
<td>0.000</td>
<td>0.01</td>
<td>0.06</td>
</tr>
</tbody>
</table>

*Note: The effect size is the squared semi-partial correlation between the individual predictors and the outcome criterion.*

Table 5. Sleep problems at age three predicting aggressive behaviour at age four

<table>
<thead>
<tr>
<th>Model</th>
<th>$R^2$</th>
<th>$B$</th>
<th>Std. error</th>
<th>Beta</th>
<th>$t$</th>
<th>$p &lt;$</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.41</td>
<td>1.18</td>
<td></td>
<td></td>
<td>35</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>$T$ score for Sleep Problems Scale</td>
<td>0.21</td>
<td>0.02</td>
<td>0.23</td>
<td>9.15</td>
<td>0.000</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>Becks Depression Score</td>
<td>0.16</td>
<td>0.02</td>
<td>0.178</td>
<td>7.11</td>
<td>0.000</td>
<td>0.03</td>
<td>0.05</td>
</tr>
</tbody>
</table>

*Note: The effect size is the squared semi-partial correlation between the individual predictors and the outcome criterion.*
Vetere, & Grayson, 1995; Morrell, 1999). Higher scores on the Sleep Problem subscale were equated with infant sleep problems; however, a cut-off score to delineate problem sleepers from non-problem sleepers was not used. The findings are relevant only to the general non-Aboriginal population of children in Western Australia. Although the data support the mediational model outlined above, it is not possible to conclusively establish the temporal sequence of variables implied in the model.

The effect sizes were rather small in the additive model; however, sleep problems are complex with multiple determinants, such as infant temperament, parental comfort measures, and maternal attachment. For example, when Morrell and Steele (2003) developed a logistic regression model to show the contribution of predictor variables to infant sleep problems with predictor and criterion variables one year of age, maternal attachment contributed 4% of the variance, difficult temperament contributed 10% of the variance, and active physical comforting contributed 3% of the variance. Thunström (1999a) reported associations between young children’s sleep problems and parental feelings of incompetence, parental feelings of role restriction, perceived health problems, problematic infant behaviours and family psychosocial problems. Our effect sizes are very meaningful given that they are predicting higher sleep problem scores one and two years distant from the variables.

The participation rates for our study from one year to the next varied from 74% to 84% of the sample from the previous year. Other longitudinal studies with children in the United States, Australia, and Norway have reported participation rates from one year to the next of 79% (Sharek et al., 2002), 47% (Burke, Beilin, & Dunbar, 2001) and 73–80% (Astrom & Jakobsen, 1998). Our rates compare favourably with the studies cited.

The theoretical model used to predict sleep problems from the contributions of breastfeeding into the infant’s first year, inter-parental conflict, and lax parenting is a strength of the study. A number of authors have linked infant sleep problems to difficulties with self-regulation (Degangi et al., 2000; Goodlin-Jones, Burnham, Gaylor, & Anders, 2001; Minde et al., 1993).

It is not surprising that children who still breastfed in the first year of life had a small effect size for predicting sleep problems in the third year of life. Breastfeeding has been associated with night waking and fragmented sleep in mid to late infancy (Touchette et al., 2005; Zuckerman et al., 1987); however, it has not been associated with persistent sleep problems (Touchette et al., 2005; Zuckerman et al., 1987).

The significant negative contribution of sleep rhythmicity to sleep problems at three years of age was interesting theoretically, although it has not been previously demonstrated in the literature. Sleep rhythmicity captures an infant’s ability to organize sleep around predictable patterns which may indicate that difficulties with early organization predict later and more persistent sleep problems. Touchette et al. (2005) suggested that fragmented sleep beyond the first year of life was associated with longer term and more serious sleep problems.

The significant contributions of parental conflict and lax parenting to the prediction of higher sleep problem scores in the third year of life are supported by Touchette and colleagues’ comments that parental behaviours are important in terms of nocturnal awakening. Parental conflict as a predictor of sleep problems has not been previously studied, but a failure to agree on more general aspects of parenting would logically link to difficulties around consistently handling fragmented sleep, night waking, and difficulty settling by parents.
Lax parenting has been associated with sleep disturbance in a population of preschool children from a regular paediatric clinic (Owens-Stively et al., 1997).

Our study makes an important contribution to the literature which has linked inter-parental conflict to externalizing behavioural disorders in pre-schoolers (Jouriles et al., 1988; Miller et al., 1993). The design was particularly strong because we controlled for maternal depression in the child’s fourth year when aggressive behaviour was being measured; parental depression has been demonstrated to be important in terms of parent–child discord and conduct disorder in children (Fendrich, Warner, & Weissman, 1990). The mediational role of sleep problems between conflicted parenting and child aggression offers one explanation for the relationship between conflicted parenting and child aggression. There have been associations between sleep problems and tantrums (Zuckerman et al., 1987) in one study of pre-schoolers, and sleep problems in infancy and at five years predicting somatic complaints, tantrums, eating difficulties, and sleeping difficulties at 10 years (Pollock, 1994). Parents’ difficulties in agreeing about setting limits for children’s behaviour may contribute to persistent sleep problems, which may, in turn contribute to or exacerbate aggressive behaviour.

Questions have been raised about whether parents’ perceptions should be considered as the sole criterion for classifying childhood sleep disorders (Gaylor, Goodlin-Jones, & Anders, 2001). Sadeh (2004) argued that parental reports can be superior to objective measures of sleep interruptions. Quine (2001) and Armstrong, Quinn, and Dadds (1994) reported the tendency for tired parents to use shouting, smacking, and punishment to respond to children’s sleep problems. Those reports underscore the importance of attending to parents’ perceptions and the potential effects of behavioural sleep problems in children.

CONCLUSION

Findings from this large, longitudinal, population-based study support the importance of exploring behavioural sleep problems in non-clinical samples. The relationships between parental variables and sleep problems, as well as sleep problems and aggressive behaviour highlight the importance of managing sleep problems in the pre-school population by proposing interventions that involve both parents and attending to parenting approaches. In particular, from a clinical standpoint, attention should be directed to assist parents to resolve parental conflict over childrearing and to develop parenting strategies that emphasize clear, consistent and appropriate consequences (Arnold et al., 1993). Sleep problems could provide a venue for access to families. Further research should focus on the mechanisms by which interventions to diminish sleep problems affect both parents’ approaches to children, not only in relation to the sleep problem per se, but also more generally.

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