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### **Are parents' working patterns associated with their child's sleep? An analysis of dual-parent families in Australia**

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## Are parents' working patterns associated with their child's sleep? An analysis of dual-parent families in Australia

### Abstract

Insufficient sleep in children predicts emotional and behavioral problems, poorer school performance, and health problems. Child sleep durations have declined in recent decades, suggesting a need to identify and understand predictors of short sleep. The present study investigated whether aspects of parental employment (i.e. parental work hours, and non-standard work hours) were associated with sleep in children. Data collected from 2477 children aged 6–7 years as part of the Longitudinal Study of Australian Children were used in this paper. Child sleep duration, bedtimes, and wake times were determined from parent self-report using time-use diaries. Parents completed a survey assessing their work patterns as well as a range of other demographic and social factors. The results indicated that long mother work hours were associated with later bedtimes and increased odds of

### Keywords

analysis, sleep, child, their, associated, patterns, working, australia, parents, families, parent, dual

### Disciplines

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**Article Title:** Are parents' working patterns associated with their child's sleep? An analysis of dual-parent families in Australia

**Short Title:** Parent work and child sleep

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## ABSTRACT

Insufficient sleep in children predicts emotional and behavioral problems, poorer school performance, and health problems. Child sleep durations have declined in recent decades, suggesting a need to identify and understand predictors of short sleep. The present study investigated whether aspects of parental employment (i.e. parental work hours, and non-standard work hours) were associated with sleep in children. Data collected from 2477 children aged 6–7 years as part of the Longitudinal Study of Australian Children were used in this paper. Child sleep duration, bedtimes, and wake times were determined from parent self-report using time-use diaries. Parents completed a survey assessing their work patterns as well as a range of other demographic and social factors. The results indicated that long mother work hours were associated with later bedtimes and increased odds of <9.5 h sleep in children. Long father work hours were associated with earlier waketimes, earlier bedtimes, and reduced odds of long sleep. Non-standard work hours were associated with longer sleep and earlier bedtimes. The present results indicate the need to develop strategies to limit any adverse effects of parental work on child sleep, perhaps by promoting earlier and regular bedtimes. These findings warrant further investigation given the importance of sleep in healthy child development.

Key words: child sleep, parent work hours, non-standard work hours, bedtimes, waketimes.

## INTRODUCTION

Sufficient night-time sleep is important for the healthy development of children. Children who regularly get insufficient sleep and/or experience sleep problems are more likely to exhibit behavioral and emotional problems,<sup>1</sup> perform more poorly at school,<sup>2</sup> and have an increased risk of health conditions such as obesity and diabetes.<sup>3</sup> It is concerning, then, that average nightly sleep durations in children appear to have declined in recent decades.<sup>4-6</sup> A recent review of studies examining sleep duration in 690 747 children from 20 countries indicated that average nightly sleep durations declined by approximately one hour between 1905 and 2008.<sup>6</sup> These trends suggest a need to develop and implement strategies to promote healthier sleep in children.

Sleep is influenced and regulated by a combination of genetic, biological, environmental, and behavioral factors. Potential environmental and behavioral determinants of child sleep problems include late bedtimes,<sup>7</sup> early school start-times,<sup>8</sup> irregular sleep/wake patterns,<sup>9</sup> and use of electronic media such as television and video games.<sup>10,11</sup> These factors have the potential to be modified through interventions as a way to improve sleep in children.

It is plausible that aspects of parental employment also affect child sleep patterns. This factor is particularly relevant given that the proportion of employed parents has increased in recent decades in many developed countries.<sup>12,13</sup> Several researchers have raised the possibility that parental employment is associated with child sleep,<sup>14-16</sup> but this has been investigated by few studies. Recently, Radosevic-Vidacek and Koscec<sup>16</sup> found that child sleep duration was shorter in families where one or both parents worked non-standard hours (e.g. night shifts). This relationship was observed in

older (15–18 years) but not younger (11–14 years) children. This finding suggests that parental work may be associated with child sleep, but this requires further investigation.

### **The present study**

The present paper investigated whether aspects of parental employment were associated with sleep patterns (bedtimes, wake times, and sleep duration) in school-aged children from dual-parent families. Parental employment was examined in relation to work hours and frequency of non-standard work schedules (i.e. evening/night shifts). We hypothesized that long parental work hours would be associated with later bedtimes, earlier wake times, and shorter sleep durations. In addition, we hypothesized that child sleep patterns may be disrupted where one or both parents work non-standard hours (i.e. evening or night shifts). We also investigated whether use of electronic media (i.e. television viewing, computer games etc) mediated the association between parent work and child sleep. This proposition is based on research indicating that (i) aspects of parental employment such as work hours and shift-work are associated with increased television viewing;<sup>17</sup> and (ii) increased use of electronic media such as television viewing predicts later bedtimes and short sleep in children.<sup>10</sup>

## **METHODS**

### **Participants**

We utilized data from the Longitudinal Study of Australian Children (LSAC). LSAC consists of an infant cohort (aged 0–1 at baseline) and a child cohort (aged 4–5 years at baseline). Participants in the LSAC were randomly selected from the Medicare Australia database. Medicare Australia is the publicly funded healthcare system in Australia, and the database (which includes all Australian residents, with very

few exceptions) provides the most comprehensive database of the Australian population.<sup>18</sup> The LSAC sample is intended to be broadly representative of all Australian children, with stratification used to ensure proportional geographic representation. Each LSAC cohort represents 1–2% of Australian children in that age range; thus the LSAC provides data that are extremely useful in assessing a range of developmental outcomes in Australian children.<sup>18</sup>

In this paper, data from the 4–5 year old cohort at the second wave of data collection (2006) were analyzed (these children were aged 6–7 years and attending school). We restricted the sample to dual-parent/guardian families who provided complete data on all variables of interest. Informed consent was obtained from all participants by LSAC, and ethics approval to use the data for the present research was obtained from the University of Wollongong's Human Research Ethics Committee.

## **Measures**

The LSAC involves structured interviews and parental completion of a questionnaire and a time use diary of the child's activities during two 24-h periods.

### **Time use diaries**

Child sleep and electronic media use were assessed using time-use diaries completed by one of the child's parents. Objective measures such as actigraphy and polysomnography are generally preferred over self-report measures. However, sleep diaries are considered to provide valid estimates of child sleep<sup>19</sup> and show agreement with actigraphy in relation to bedtimes, wake times, and sleep duration.<sup>19,20</sup>

In the present study, the time use diaries assessed the child's activities over two 24-h periods, one designated as a weekday and the other as a weekend day. Each diary



was split into 15-min intervals, consistent with previous research,<sup>19</sup> starting at 04.00 and finishing at 04.00 the following day. Parents were provided with detailed written instructions (including example diary entries) on how to complete the time-use diary. For each 15-min interval, parents were instructed to indicate the type of activity the child engaged in from a list of 26 activities (e.g. sleeping/napping, watching television, and using the computer).

Three sleep parameters were calculated for each weekday and weekend period using the sleep diary data. These included child bedtime, wake time, and sleep duration (calculated separately by summing each 15-min period the child slept over the 24-h period). Categories of sleep duration were created, consistent with existing research.<sup>21,22</sup> At present, there is no consensus on what constitutes short, healthy, and long sleep in children. This is partly because developmental changes in sleep duration make it difficult to create unified cut-offs, and also because studies use a variety of methods to assess sleep duration (e.g. actigraphy vs parent report). In this paper, we created four categories of sleep duration: <9.5 h sleep, 10 h sleep (9.5–10.4 h), 11 h sleep (10.5–11.4 h) and  $\geq 11.5$  h. The <9.5 h and  $\geq 11.5$  h categories provide an indication of short and long sleep; the 11 h sleep category corresponds with average sleep duration for this age group<sup>5</sup> and provides an appropriate reference category.

Electronic media use was determined by summing the amount of time spent watching television and using a computer. This was calculated separately for weekday and weekend electronic media use, and the data were coded as <1 h, 1–1.9 h, 2–2.9 h, and  $\geq 3$  h.

### **Self-completion questionnaire**

In addition to the sleep diary, parents also completed a questionnaire assessing a wide variety of factors including socio-demographic factors such as the child's gender and country of birth. In regards to employment, parents indicated the number of hours they usually worked each week. Responses were coded as not working, 1–34 h, 35–44 h and  $\geq 45$  h to reflect part-time work, full-time work and long work hours.<sup>23</sup> The frequency of non-standard work schedules (i.e. working after 18.00) was assessed and responses were coded as not working, never/rarely,  $\leq 1$  day a week, or  $\geq 2$  days a week.

Geographic area of residence was determined according to the Accessibility/Remoteness Index of Australia (ARIA), which is the standard index of remoteness in Australia.<sup>24</sup> This was used to determine whether each family lived in a highly accessible, accessible, moderately accessible, or rural/remote area. Socio-economic status was assessed using the Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socio-economic Advantage and Disadvantage.<sup>25</sup> This index provides a measure of socio-economic status that incorporates qualifications, income, and skilled occupation of individuals living within a given geographic region. In the present study, we split SEIFA scores into quartiles to provide an indication of the socio-economic status for each child.

### **Statistical analysis**

All data analyses were performed using SPSS version 17. The association between parent work and child bedtimes/wake times was examined using general linear modelling (separate analyses were performed for bedtimes and wake times). In the first step of the analyses, mother work hours, father work hours, and frequency of non-standard shifts for mothers and fathers were entered as independent variables; child gender, country of birth, socio-economic status, and geographic area of residence were

included as covariates. Second, interaction terms were added separately to examine whether the association between parent work and child bedtimes/wake times depended on child gender, and whether there were interactions between the different parental work variables. Third, these interaction terms were removed and electronic media use was added to examine whether it mediated the associations between parental work and bedtimes. Separate models examined these sleep parameters on a weekday night and a weekend night.

The associations between the parent work variables and child sleep duration were analyzed using multinomial logistic regression modeling. These analyses involved four steps. First, mother work hours, father work hours, and frequency of non-standard shifts for mothers and fathers were entered as independent variables with weekday sleep duration the dependent variable. Child gender, country of birth, socio-economic status, and geographic area of residence were included in the models as covariates. Second, interaction terms were added separately to examine whether the association between parent work and child sleep duration differed between males and females, and whether there were interactions between the different parental work variables. Third, the interaction terms were removed and electronic media use was added to the model to test whether it mediated the associations between any of the parental employment variables and child sleep. Finally, bedtimes and wake times were added to the model to examine whether these mediated the relationship between parent work and child sleep duration. These steps were performed separately for weekend sleep duration. The results are reported as adjusted odds ratios (OR) with 95% confidence intervals. Because three comparisons were performed in each model (11 h sleep vs <9.5 h sleep, 11 h sleep vs

10 h sleep, and 11 h vs  $\geq 11.5$  h), statistical significance was determined by a P-value of  $<0.017$ .

## RESULTS

The demographic characteristics of the sample are shown in Table 1. The sample consisted of 2477 children aged 6–7 years old ( $M = 6.27$ ;  $SD = 0.45$ ), with slightly more males (51.3%) than females; this is representative of the Australian population for this age group where 51.3% are male.<sup>26</sup> The majority of children were born in Australia (95.5%) and more than half (54.3%) lived in a highly accessible region (e.g. a major city), which is also consistent with the general population (61.4%).<sup>26</sup>

Table 1. Demographic characteristics of the 2477 children aged 6–7 years

	<i>n</i>	%
<b>Gender</b>		
Male	1271	51.3
Female	1206	48.7
<b>Born in Australia</b>	2366	95.5
<b>Area of residence</b>		
Highly accessible	1345	54.3
Accessible	596	24.1
Moderately accessible	406	16.4
Rural/remote	130	5.2
<b>Weekday sleep duration</b>		
<9.5 h	384	15.5
10 h	1044	42.1
11 h	856	34.6
$\geq 11.5$ h	193	7.8
<b>Weekend sleep duration</b>		
<9.5 h	469	18.9
10 h	743	30.0
11 h	816	32.9
$\geq 11.5$ h	449	18.1

	<i>n</i>	%
<b>Weekday electronic media use</b>		
<1 h	873	35.2
1–1.9 h	860	34.7
2–2.9 h	406	16.4
≥3 h	338	13.6
<b>Weekend electronic media use</b>		
<1 h	386	15.6
1–1.9 h	613	24.7
2–2.9 h	607	24.5
≥3 h	871	35.2
<b>Mother work hours</b>		
Not working	684	27.6
1–34 h	1315	53.1
35–44 h	339	13.7
≥45 h	139	5.6
<b>Father work hours</b>		
Not working	56	2.3
1–34 h	141	5.7
35–44 h	935	37.7
≥45 h	1345	54.3
<b>Regular non-standard work hours<sup>†</sup></b>		
Mother	423	17.1
Father	963	38.9

<sup>†</sup> works after 18.00 ≥ 2 days a week.

The average amount of sleep was 10.64 h (SD = 1.13) on a weekday night and 10.76 h (SD = 1.46) on a weekend night. Approximately one-third of the sample engaged in 2 h or more of electronic media use on a weekday, which increased to 59.7% on the weekend. Mothers were more likely to work part-time (53.1%), whereas most fathers worked full-time or more than full-time (92.0%). The majority of mothers (82.9%) and

fathers (61.1%) worked standard hours. Furthermore, most mothers (86.8%) and fathers (77.2%) did not regularly work on weekends.

### Parent work and child weekday bedtimes and wake times

Mother work hours were significantly associated with child bedtimes ( $F_{2,2458} = 3.994$ ,  $P = 0.019$ ), with bedtimes being later where mothers worked  $\geq 45$  h a week ( $M = 20.45$  h,  $SD = 0.53$ ) compared to those working 1–34 h a week ( $M = 20.33$  h,  $SD = 0.48$ ) (see Table 2). Father work hours were also associated with child bedtimes ( $F_{2,2458} = 7.264$ ,  $P < 0.001$ ), but  $\geq 45$  h work a week was associated with earlier bedtimes ( $M = 20.33$  h,  $SD = 0.46$ ) compared to those working 1–34 h a week ( $M = 20.46$  h,  $SD = 0.50$ ). Non-standard work hours of fathers was also associated with child bedtimes ( $F_{2,2458} = 5.547$ ,  $P = 0.004$ ), with later bedtimes observed where father frequently worked non-standard work hours.

Table 2. The relationships of parental work and electronic media use to child sleep (bedtimes, wake times, and sleep duration)

	Wake time, mean (SD)	Bedtime, mean (SD)	Sleep duration			
			<9.5 h (%)	10 h (%)	11 h (%)	≥11.5 h (%)
Mother hours						
Not working	07.17 (0.48)	20.34 (0.48)	15.6	38.7	36.5	9.1
1–34 h	07.16 (0.45)	20.33 (0.48)	14.1	42.1	35.8	7.9
35–44 h	07.12 (0.41)	20.37 (0.44)	17.1	47.2	31.3	4.4
≥45 h	07.14 (0.46)	20.45 (0.53)	23.7	46.8	20.9	8.6
Mother non-standard work hours						
Not working	07.17 (0.48)	20.34 (0.48)	15.6	38.7	36.5	9.1
≥2/week	07.15 (0.46)	20.34 (0.48)	15.4	42.3	32.4	9.9

	Wake time, mean (SD)	Bedtime, mean (SD)	Sleep duration			
			<9.5 h (%)	10 h (%)	11 h (%)	≥11.5 h (%)
≤weekly	07.12 (0.44)	20.35 (0.46)	14.3	43.7	35.8	6.1
Never/rarely	07.16 (0.43)	20.36 (0.48)	17.4	44.0	31.5	7.1
<b>Father hours</b>						
Not working	07.19 (0.39)	20.37 (0.51)	16.1	42.9	32.1	8.9
1–34 h	07.23 (0.48)	20.46 (0.50)	17.0	43.3	31.9	7.8
35–44 h	07.18 (0.47)	20.36 (0.49)	15.5	42.8	32.7	9.0
≥45 h	07.13 (0.44)	20.33 (0.46)	15.3	41.6	36.2	6.9
<b>Father non-standard work hours</b>						
Not working	07.19 (0.39)	20.37 (0.51)	16.1	42.9	32.1	8.9
≥2/week	07.18 (0.44)	20.38 (0.49)	15.6	42.9	33.1	8.4
≤weekly	07.14 (0.45)	20.33 (0.44)	16.9	40.4	35.2	7.5
Never/rarely	07.14 (0.47)	20.32 (0.49)	14.0	42.8	36.0	7.2
<b>Electronic media use</b>						
<1 h	07.12 (0.42)	20.26 (0.46)	12.9	40.8	38.9	7.3
1–1.9 h	07.14 (0.42)	20.33 (0.42)	14.2	45.0	33.8	7.0
2–2.9 h	07.18 (0.45)	20.42 (0.49)	16.0	47.3	29.3	7.4
≥3 h	07.26 (0.58)	20.55 (0.54)	24.9	32.2	31.4	11.5

Father work hours were also associated with child wake times ( $F_{2,2458} = 5.561$ ,  $P < 0.001$ ), with wake times earliest with  $\geq 45$  h work (Table 2). Non-standard hours of fathers were also associated with child wake times ( $F_{2,2458} = 3.273$ ,  $P = 0.038$ ); more frequent non-standard work hours were associated with later wake times ( $M = 07.18$  h,  $SD = 0.44$ ) compared to never working non-standard hours ( $M = 07.14$  h,  $SD = 0.47$ ). None of the interaction terms were significant, indicating that the associations between parent work and bedtimes/wake times were similar in males and females. Furthermore, the effect of mother work (for example) on child bedtimes/wake times did not depend on father work.

As shown in Table 2, increased use of electronic media was associated with later bedtimes ( $F_{3,2455} = 36.532$ ,  $P < 0.001$ ) and earlier wake times ( $F_{3,2455} = 8.986$ ,  $P < 0.001$ ). Adding electronic media use to the models had little effect on the association between parent work hours and bedtimes/wake times.

### Parent work and weekday sleep duration

As shown in Table 3, children had an increased likelihood of  $<9.5$  h sleep on a weekday (OR = 2.11 [1.15–3.88]) where mothers worked  $\geq 45$  h a week. Children were more likely to have  $\geq 11.5$  h sleep on a weekday night in families where the mother did not work (OR = 2.49 [1.28–4.83]), or where the mother worked regular non-standard hours (OR = 1.78 [1.10–2.86]). There was also a trend for longer mother work hours to be associated with an increased likelihood of  $\geq 11.5$  h sleep, but this did not reach significance at the 0.017 level (OR = 2.65 [1.10–6.38]). Children were less likely to sleep  $\geq 11.5$  h in families where the father worked  $\geq 45$  h a week (OR = 0.61 [0.43–0.87]).

Table 3. Relationship between parental work factors and child weekday sleep (results presented as odds ratios with 95% confidence intervals)

	<b>&lt;9.5 h</b>	<b>10 h</b>	<b><math>\geq 11.5</math> h</b>
<b>Mother hours</b>			
Not working	0.85 (0.55–1.31)	0.74 (0.53–1.02)	2.49* (1.28–4.83)
1–34 h	0.74 (0.51–1.07)	0.79 (0.60–1.05)	1.78 (0.99–3.21)
35–44 h	Ref	Ref	Ref
$\geq 45$ h	2.11* (1.15–3.88)	1.54 (0.92–2.57)	2.65 (1.10–6.38)
<b>Mother non-standard work hours</b>			



	<9.5 h	10 h	≥11.5 h
≥2/week	0.95 (0.65–1.40)	0.96 (0.72–1.27)	1.78* (1.10–2.86)
≤weekly	1.31 (0.94–1.84)	1.12 (0.86–1.44)	1.32 (0.83–2.12)
Never/rarely	Ref	Ref	Ref
<b>Father hours</b>			
Not working	0.84 (0.36–1.98)	0.97 (0.50–1.86)	1.24 (0.43–3.60)
1–34 h	1.03 (0.60–1.76)	0.99 (0.65–1.50)	0.82 (0.40–1.67)
35–44 h	Ref	Ref	Ref
≥45 h	0.88 (0.67–1.16)	0.85 (0.69–1.04)	0.61* (0.43–0.87)
<b>Father non-standard work hours</b>			
≥2/week	1.01 (0.74–1.38)	1.20 (0.95–1.52)	1.46 (0.97–2.20)
≤weekly	0.82 (0.60–1.13)	1.07 (0.84–1.36)	1.03 (0.67–1.58)
Never/rarely	Ref	Ref	Ref

\*  $P < 0.017$ . The following covariates were controlled for in the analyses: child gender, place of residence, country of birth, socio-economic status. Ref, referent category.

The associations between parent work and child sleep did not vary significantly by child gender, nor were there any significant interactions between mother and father work hours. This indicates that the associations between parent work and child sleep were similar in boys and girls, and that the effect of mother work hours (for example) on

child sleep did not vary by mother work schedules, father work hours, or father work schedules.

In step 3, use of electronic media for  $\geq 2$  h a day was associated with increased odds of short (OR = 2.06 [1.53–2.78]) and long sleep (OR = 1.74 [1.18–2.56]). The inclusion of this variable had little effect on the association between parental work and child sleep.

The only notable change was the slight attenuation in the association between mothers working  $\geq 45$  h a week and  $< 9.5$  h sleep in the initial model (OR = 2.11 [1.15–3.88]) and in the model where electronic media use was added (OR = 2.07 [1.13–3.82]). The magnitude of the reduction was small, but may indicate that electronic media use partially mediates the association between mother work hours and  $< 9.5$  h sleep in children.

In step 4, bedtimes and wake times were added to the model and were significantly associated with sleep duration. In the presence of bedtimes and wake times, the association between mothers working  $\geq 45$  h a week and  $< 9.5$  h sleep in the previous model (OR = 2.07 [1.13–3.82]) attenuated and was no longer significant (OR = 1.42 [0.47–4.32]). Similarly, the association between frequency of mother non-standard work schedules and long sleep was no longer significant in this model (OR = 1.84 [0.97–3.51]), nor was the association between long father work hours and long sleep (OR = 0.68 [0.43–1.09]). These findings suggest that bedtimes and wake times may underlie the association between parental work and child sleep duration.

### **Parent work and weekend child sleep**

Unlike the association between parental work and child sleep on a weekday night, there was very little evidence that parent work was associated with child sleep on a weekend

night. Non-standard work hours for mothers ( $F_{2,2458} = 3.794, P = 0.023$ ) and fathers ( $F_{2,2458} = 3.206, P = 0.041$ ) were significantly associated with child bedtimes. In particular, child bedtimes were later where mothers worked non-standard hours ( $M = 20.46$  h,  $SD = 0.51$ ) compared to mothers who never/rarely worked non-standard hours ( $M = 20.42$  h,  $SD = 0.56$ ). Child bedtimes were earliest where the father worked non-standard hours  $\leq$  weekly ( $M = 20.42$  h,  $SD = 0.54$ ) and latest when the father never/rarely worked non-standard hours ( $M = 20.50$  h,  $SD = 0.56$ ). Longer time spent using electronic media on the weekend was also associated with later bedtimes ( $F_{3,2455} = 11.878, P < 0.001$ ), but did not affect the relationship between non-standard work schedules and child bedtimes.

None of the parental employment variables were significantly, or near significantly, associated with child wake times or sleep duration on a weekend night.

## DISCUSSION

This cross-sectional study found associations between parental employment and child sleep in a sample of Australian dual-parent families. These associations were primarily observed for weekday sleep, although there was some evidence that non-standard work hours were associated with later child bedtimes on a weekend night. The limited results for weekend sleep are not surprising given that the majority of mothers (86.8%) and fathers (77.2%) in this sample did not regularly work on weekends. There is also evidence that other factors such as electronic media may have a greater influence on child sleep during the weekend,<sup>8</sup> which was partially supported by the present results.

The associations between parental employment and weekday child sleep need to be interpreted with some caution since the cross-sectional data do not indicate causation. Furthermore, it is important to acknowledge that the direction of the results discussed below does not imply that parents should work less or change their working patterns. This may not be possible for many parents and could have adverse consequences such as loss of income. Furthermore, balancing work and family commitments can benefit parents and children through increased resources (e.g. income, social support) and coping skills.<sup>27</sup> Rather than suggesting reducing the amount or timing of work, it is more important to lessen any negative effects of parental work on their child's sleep.

In regards to parental work hours, earlier child wake times were observed in families where the father worked long hours. This observation could reflect disturbances in child sleep caused by the father waking up and leaving early for work. Child bedtimes were significantly later when the mother worked long hours. This finding may be explained in terms of longer work hours interfering with aspects of the child's evening routine such as meal-times which may delay bedtimes.<sup>28</sup> However, long father work hours were associated with earlier bedtimes, which was an unexpected finding. The different findings for mother and father work hours may reflect traditional gender roles. For instance, although gender roles have changed considerably in recent decades, mothers may be more likely to assume the role of the primary caregiver. It is important to acknowledge that the majority of mothers in the present sample worked part-time whereas most fathers worked full-time or longer, which is consistent with other Australian data.<sup>23</sup> In families where the father works longer hours, the mother may have an opportunity to work fewer hours and ensure that children have regular and earlier bedtimes. Thus, the observed association between longer father work hours and earlier

child bedtimes could reflect the part-time work arrangement of the mother. This is a tentative conclusion, and requires further investigation.

Long parent work hours were also associated with child sleep duration. In particular, long mother work hours were associated with short sleep, while long father work hours were associated with a reduced likelihood of longer sleep. It is possible that parents who work longer hours underestimate the amount that their child sleeps. However, it is also feasible that longer work hours contribute to short sleep in children and there are a number of potential mechanisms underlying these associations. One possibility is that increased electronic media use by children mediates the relationship between parent work and child sleep. This is important because use of electronic media is associated with later bedtimes as observed here and in other studies<sup>11</sup> and shorter sleep durations.<sup>17</sup> Previous studies have indicated that children spend more time watching television if their mother works longer hours,<sup>17</sup> perhaps reflecting reduced parental supervision. It has also been suggested that increased electronic media use could lead to short sleep via later bedtimes, possibly by contributing to increased arousal and disruptions in the circadian regulation of sleep caused by artificial light.<sup>10</sup> We found only weak evidence that electronic media use mediated the relationship between parental work hours and child sleep duration, and suggest that more research is conducted in this area.

We did, however, find evidence that the association between parent work and child sleep duration was mediated by child bedtimes and wake times. Thus, child sleep duration could feasibly be improved by targeting child bedtimes and wake times. This is important given that previous studies have shown that parent-set bedtimes are associated with earlier bedtimes, longer sleep durations, and improved daytime functioning in adolescents.<sup>29</sup> Furthermore, interventions aimed at promoting more

regular bedtimes and wake times in children have been successful in lengthening sleep duration in children.<sup>9</sup>

There are other mechanisms not explored in this study which may also link long parent work hours to short child sleep. For example, parents who work longer hours may themselves be at risk of later bedtimes and shorter sleep, which has the potential to contribute to poor sleep patterns in children.<sup>11,15,30</sup> Work stress may also contribute to sleep problems in children, since long work hours are associated with elevated stress levels.<sup>31</sup> These factors have the potential to spill over and contribute to family stress or marital tension, both of which predict short sleep in children.<sup>8,31</sup> Unfortunately, we did not have specific measures of work stress in this study; thus future research should examine these pathways.

There was also a non-significant trend for long mother work hours to be associated with longer sleep duration. This is an unexpected finding, but it is possible that in some families mothers choose to work longer hours. The increased access to income may allow for more formal childcare which could facilitate longer sleep in some children. However, this finding requires further clarification in future research.

It was hypothesized that non-standard work hours would be associated with later bedtimes, earlier wake times, and short sleep. Our results did not support this hypothesis, and instead we found that non-standard work hours of fathers were associated with later wake times and mother non-standard work hours associated with longer sleep. This is in contrast with the findings of Radosevic-Vidacek and Koscec<sup>16</sup> who found shorter child sleep where one or both parents worked non-standard hours. Furthermore, non-standard work hours of mothers in particular have been linked with a range of adverse outcomes in children.<sup>32</sup> However, the relationship between non-

standard work hours and child outcomes is likely to be complicated and influenced by a range of factors. For example, non-standard work hours may have a negative impact on the child when family income is low as this may limit, for instance, access to childcare services.<sup>33</sup> However, non-standard work hours may also reflect flexibility in work arrangements; this could have positive effects on the family and the child as the mother and father are then better able to share parenting responsibilities, and perhaps experience less work stress. This may explain the observed findings linking non-standard hours with later wake times and longer sleep duration in children.

In addition to the cross-sectional data, there are a number of limitations of this study. First, this study used data collected through the LSAC, which includes a representative sample of Australian children and families. However, the present results may potentially be biased since some parents in the original sample did not complete the sleep diary data and hence were excluded from this study. Therefore, although this study included a considerable sample of Australian children, it may not necessarily be representative of the population. Furthermore, the present study focused on dual-parent families and the findings cannot be generalized to single-parent families. This is an important consideration, because the nature of the associations observed in the present sample could differ in single-parent families. This study also relied on diaries completed by the parent to assess child sleep. These provide a subjective estimate of child sleep and could potentially have been biased by a range of factors including parental work hours (e.g. accuracy may decline with longer work hours). The time-use diary also assessed activities in 15-min blocks, which has the potential to overestimate child sleep duration. Despite this, previous research indicates good agreement between the sleep data obtained through sleep diaries and more objective measures such as actigraphy.<sup>19,20</sup>

Diary data can thus be considered to provide valid and inexpensive estimates of child sleep.<sup>19</sup>

## **CONCLUSIONS**

This study provides insight into the association between parental work and child sleep, and is relevant given recent increases in the proportion of employed parents. These findings may inform the promotion of healthy sleep in school-aged children by addressing long work hours and work schedules of parents. The present results do not imply that parents should avoid part-time or full-time employment. Rather, there is a need to understand and reduce any adverse impacts of mother and father employment on child sleep, which may be beneficial for child health and well-being. The present results indicate that bedtimes and wake times could underlie the association between parent work and child sleep, and could be targeted as a way to lengthen sleep duration in children with insufficient sleep. In addition, increased parental monitoring of electronic media use in children may be a further way of addressing short sleep in children from dual-parent families. Finally, governments and organizations need to continue to respond to the rise in employed parents by making the workplace more family friendly, and lessening unwanted overtime and long work hours. In combination, these strategies may be effective in improving the sleep of children, which in turn may promote healthy development and improved cognitive performance at school.



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