Parental work and children's sleep patterns

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Abstract

Sleep is important for children's cognitive ability, socioemotional behaviors, and health; however, determinants of sleep patterns have been little studied. Our study uses nationally representative data from the PSID Child Development Supplement (n=2,554) to examine whether parental work schedules are associated with children's sleep patterns. Using parent reports of the hours they work in a normal week, we find that primary caregivers' (PCGs') work hours are predictive of children's sleep durations and wake-up times, even after controlling for a battery of background characteristics. Compared with children of non-working PCGs, children whose PCGs work part-time get significantly more sleep and have significantly later wake-up times; children whose PCGs work over-time get less sleep and have significantly earlier wake-up times. Timing of parental work is also predictive of children's sleep patterns. Potential mediators and moderators—including child age and the presence or absence of a secondary caregiver—are tested.

Recent research has found that children's sleep patterns are associated with a host of important cognitive, socioemotional, and health outcomes. However, determinants of children's sleep patterns have received relatively little attention from researchers. This paper examines parental work schedules as a potential determinant of children's sleep patterns. It specifically examines both parental work hours (part-time, full-time, and over-time work) and the timing of parental work (start times and end times) to determine whether parental work affects child sleep.

Relationship between sleep and child outcomes

Sleep has been linked to a variety of important outcomes. Cognitive decrements associated with sleep deprivation are well-established. For instance, in studies of adults, shorter sleep duration and sleep deprivation have been linked to delays and decrements in cognitive processing (Harrison & Horne, 1998; Pilcher & Huffcutt, 1996) and difficulty in conducting multiple tasks simultaneously (Schlesinger, Redfern, Dahl, & Jennings, 1998). Cognitive decrements as a result of sleep loss have been found in children as well (Carskadon, Harvey, & Dement, 1981; Randazzo, Muehlbach, Schweitzer, & Walsh, 1998; Sadeh, Gruber, & Raviv, 2003; Steenari et al., 2003). Studies have found that children's neurobehavioral functioning, including performance on memory tasks, can be affected by as little as 35 minutes of change in normal bedtime (Sadeh et al., 2003).

This decrement in cognitive performance seems to translate into poorer academic performance as well (Wolfson & Carskadon, 2003). Chronic sleep reduction (Meijer & van den Wittenboer, 2004) and shorter-term sleep restriction (Fallone, Acebo, Seifer, & Carskadon, 2005; Fredriksen, Rhodes, Reddy, & Way, 2004; Randazzo et al., 1998; Wolfson & Carskadon, 1998) are associated with worse performance in school in samples of elementary and middle school-aged children. While some evidence suggests that sleep quality may be even more important than sleep duration for academic outcomes (Meijer, Habekothe, & van den Wittenboer, 2000), experimental as well as correlational evidence indicates that sleep duration plays an important role as well.

Furthermore, children who get too little sleep may experience increased difficulty in regulating their emotions and behaviors (Dahl, 1999; Dahl & Lewin, 2002). Adolescents who are sleep deprived may have more difficulty in inhibiting or moderating their moods and emotional responses to various types of events—whether humorous, frustrating, or sad—than they do when they get more sleep (Dahl, 1996; Dahl,1999; Dahl & Lewin, 2002). This suggests that children's emotional functioning is negatively affected by sleep deprivation (Dahl, 1999). Indeed, internalizing and externalizing behaviors at school have been linked to fewer hours of objectively measured sleep in children (Aronen, Paavonen, Fjallberg, Soininen, & Torronen, 2000), and relationships between less sleep and internalizing behavior problems have been found using time diary reports of sleep as well (Hofferth & Sandberg, 2001). Sleep problems including insomnia and hypersomnia are common symptoms in children and adolescents diagnosed with major depressive disorder (Dahl & Lewin, 2002), and sleep duration is related to depressive symptomatology and lower self-esteem in non-clinical samples as well (Fredriksen et al., 2004; Wolfson & Carskadon, 1998). The association between disordered sleep and mood disorders is posited to be bi-directional; sleep deprivation may exacerbate mood disorders and depression, while depression may promote negative thought patterns or anxiety that make it difficult to fall asleep (Dahl & Lewin, 2002)

Related to this is the association between sleep deprivation and attention problems in children. Shorter sleep duration has been found to predict difficulties with attention in non-clinical samples (Epstein, Chillag, & Lavie, 1998; Fallone, Acebo, Arnedt, Seifer, & Carskadon, 2001; Fallone et al., 2005). The effects of sleep deprivation have also been linked by some researchers with symptoms that resemble ADHD (Dahl, 1996; Dahl & Lewin, 2002)

Finally, short sleep duration can affect children's physical health. In particular, researchers have recently begun to focus on the link between children's sleep and body mass index and overweight (Agras, Hammer, McNicholas, & Kraemer, 2004; Chaput, Brunet, & Tremblay, 2006; Lumeng et al., 2007; Reilly et al., 2005; Sekine et al., 2002; Snell, Adam, & Duncan, 2007). The importance of sleep is evident even when potentially confounding factors such as television watching, activity, parental socioeconomic status (Snell et al., 2007), parenting style, and home environment quality (Lumeng et al., 2007) are controlled. The weight of younger children (age 3-7.9) is particularly sensitive to sleep duration (Snell et al., 2007).

An obvious initial objection is that these various negative outcomes may cause sleep problems rather than sleep problems causing these outcomes. However, several studies have shown, either through longitudinal methods (Reilly et al., 2005; Snell et al., 2007) or through experimentally manipulating sleep and examining the subsequent effect on outcomes (Allen, 2003; Fallone et al., 2005; Randazzo et al., 1998; Sadeh et al., 2003), holding all else constant, that sleep problems are, at least in some cases, temporally prior to other outcomes. This has been shown for cognitive/academic (Allen, 2003; Fallone et al., 2005; Randazzo et al., 1998; Sadeh et al., 2003); behavioral/attention (Fallone et al., 2001; Fallone et al., 2005); and physical health (Reilly et al., 2005; Snell et al., 2007) outcomes.

Sleep and Work

Although outcomes of sleep disruptions have been widely studied, determinants of variations in sleep duration and timing in children have received less attention. A few predictors of sleep patterns have been identified. Children who are exposed to marital conflict (El-Sheikh, Buckhalt, Mize, & Acebo, 2006), or less favorable parenting styles (lax rule-setting for adolescents; less parental warmth for younger children) (Adam, Snell, & Pendry, 2007) are more likely than other children to experience sleep disruptions or deprivation. Children from low socio-economic status or minority families get less sleep on average than their more advantaged peers (Adam et al., 2007; Fredriksen et al., 2004; Spilsbury et al., 2004). Finally, children's school schedules and activity choices (hours spent doing homework, watching TV, etc.) were found to predict their sleep durations (Adam et al., 2007). Another aspect of the family environment that may be expected to substantially affect children's sleep schedules is parental work schedules.

The number of mothers of young children working outside of the home has risen steadily in the last quarter century (Hofferth & Phillips, 1987). In 1970, only 29% of women with children age 6 or younger worked outside the home (Hofferth & Phillips, 1987). By 2004, by contrast, about 62% of women with children in this age group were employed outside of the home ("Women in the labor force: A databook," 2005). These trends hold for mothers of infants as well. Fifty-five percent of mothers of infants younger than one year worked outside the home in 2004, compared with 31% in 1976 (Dye, 2005). At the same time, many men are also working more; the percentage of employed men who work 48 or more hours per week on their main job rose has risen over the last 25 years (Kuhn & Lozano, December 2005).

While there has been significant research done on how maternal employment affects the time that women spend with their children (Bianchi, 2000; Sayer, Bianchi, & Robinson, 2004), there has been less research on how maternal employment affects the way that children's time is structured. Initial research in this area suggests that parental employment patterns may indeed affect how children spend their time, including their hours spent sleeping (Hofferth & Sandberg, 2001). Specifically, compared with children in families where the father was the sole breadwinner, children in two-earner families and families headed by working single mothers were found to get less sleep, while children in no-breadwinner families (i.e., families in which neither parent is employed) got more sleep (Hofferth & Sandberg, 2001).

A potential explanation for this is that children may have to adjust their bedtimes, and especially their waketimes, to account for parents' work schedules. For instance, pre-elementary school-aged children who receive care out of their homes must rise early enough to accommodate both their parents' start times at work, and the length of time spent in commute to both the child's care provider and the parent's workplace. Children whose parents work early shifts may have to rise earlier, even if they attend school rather than receive care from other caregivers. Children and adolescents whose parents engage in shift work may be more likely to have late bedtimes and an attendant abbreviation in total sleep duration; a Croatian study found support for this hypothesis in adolescents, though not for elementary-aged children (Radosevic-Vidacek & Koscec, 2004).

Thus, there is reason to hypothesize that parental employment and work schedules may affect the amount of sleep that children receive, and the timing of their sleep. This paper seeks to gain a deeper understanding of how parents' employment affects children's sleep. While past research using 1997 data from the Panel Study of Income Dynamics (PSID) has shown that parental work tends to translate into less hours of sleep for children (Hofferth & Sandberg, 2001), this paper seeks to build on this literature in several ways. First, it uses new data from the PSID to determine whether the same pattern holds in 2002-2003, when the second wave of child development supplement data was collected (Manieri, 2006). The economy was considerably cooler during this period—the unemployment rate in 1997 was 4.9% versus 5.8% in 2002 and 6.0% in 2003 (Bureau of Labor Statistics, 2007)—and the pool of employed parents may have been different. In addition, the children are five to six years older in the 2002-2003 round of PSID data collection, which allows us to examine how parental work is associated with older children's sleep.

Second, it seeks to gain a more nuanced picture of how various aspects of parental employment affect children's sleep duration and schedules. We go beyond examining parent breadwinner status to look at the *number of hours worked* by both the primary and the secondary caregiver (if present), and the *work timing* of children's caregivers.

Third, this paper examines several new aspects of children's sleep schedules. While previous work looked only at the effect of parent work on sleep duration, this paper will also consider the impact on children's sleep timing. For instance, it will examine whether any effects of parental work on child sleep duration seem to be driven by differences in bedtimes, wake-up times, or both. Furthermore, it will look at new moderating variables, including child age and the presence or absence of secondary caregivers.

Hypotheses:

We hypothesized that children of primary caregivers who worked would sleep less than children whose primary caregivers did not work, and that sleep durations would decrease the more hours parents worked. We hypothesized that other caregiver presence and schedules might moderate these effects. Specifically, we thought that any sleep deficits associated with primary caregiver work hours would become more pronounced in the absence of another caregiver who could help to regulate the child's sleep patterns. Finally, we hypothesized that the timing of work would matter for children's sleep; both early and late hours might be expected to impinge on children's sleep duration.

DATA AND METHODS

This study uses data collected for the second wave of the Panel Study of Income Dynamics-Child Development Supplement (PSID-CDS). The PSID is a longitudinal survey primarily sponsored by the National Science Foundation, the National Institute of Aging, and the National Institute of Child Health and Human Development and conducted by the University of Michigan. The Child Development Supplement collects additional information on the children of PSID families in the targeted age brackets. The first wave of the CDS, collected in 1997, targeted children 0-12 years of age. The second wave of the CDS (2002) followed the same children approximately five years later, and therefore includes children 5 to 18 years of age. Although a few children had reported ages of 19 years in 2002, these children were dropped from our analysis. When PSID-provided weights are applied, the CDS is nationally representative of children in the target age range.

The CDS collects information on a wide range of developmental and time-use measures. Developmental measures include information on physical, cognitive, socioemotional development, as well as relationships with family and peers. It also measures time use using a time diary methodology. Time diaries provide information on two 24-hour periods: one on a weekday, and the other on a weekend day. The time diaries report the various activities that children spent time on during the time diary days. Older children filled out time diaries on their own, with the assistance of a parent if necessary; parents of younger children completed the time diaries on their behalf. Time diaries cover one calendar day; they therefore start at one second after midnight on the time diary day and then end at midnight on the same day. Time diary completion days were randomly assigned when families completed the rest of the CDS interview, and time diary days could not be switched after they were assigned.

The original CDS sample included data on 3,563 children from 2,394 families. The 2002 wave of the CDS included data on 91% of those families, generating a sample size of 2,907 children and an 81.6% reinterview rate. Our sample excludes children who did not complete time diary information, who had missing values for sleep outcomes, and who reported being 19 years of age. Therefore, our final sample size is 2,554 children.

Measures

Sleep variables: Sleep duration is given by a variable that estimates the number of hours a child spent in their longest period of sleep during a day. This is constructed synthetically by using the child's waketime on the morning of the time diary day and their bedtime on the time diary day; that is, the variable actually incorporates information from two different sleep events, assuming reasonable stability in waketimes and bedtimes from day to day. Bedtimes and waketimes are reported by the child or a parent, if the child is too young to complete a time diary. Our analysis focuses on the weekday measures of these variables.

Work schedule variables: We use several distinct conceptions of work schedules here. The first is a dummy variable indicating whether or not primary caregivers (PCGs) and other caregivers (OCGs) report working for pay. This gives a gross sense of whether parental employment status per sé matters for children's sleep.

In order to estimate the effect of parental hours of work, we also examine both parents' reports of their "usual" hours worked in a week. Specifically, we use each caregiver's answer to the question: "Thinking about all the work you do for pay—either at home, the workplace, or any other location—how many hours per week do you typically work on (your job/all jobs)?" This definition does not explicitly prompt caregivers to include other time that they may spend that is related to work, such as commute time. Thus, this measure should include only the time parents spend at work (although some parents may have included all work-related time).

For the "usual" work schedule, we use dummy variables indicating whether parents report working a part-time (0.01-30 hours), full-time (30-42.5 hours) or overtime (42.5 hours plus) work schedule. No work is the omitted category. Our definition of part-time work is one used in past literature on maternal work and child outcomes (Brooks-Gunn, Han, & Waldfogel, 2002). Our definition of over-time work was created partly to induce variation in work hours among other caregivers. Using a 40 hour cut-off for over-time work, 78.3% of OCGs for whom we have work data would be categorized as over-time workers; using the 42.5 hour cut-off, the proportion of working OCGS categorized as over-time workers was reduced to 53.9%.

We also examine the timing of parental work. We look at the effect of both parents' work end times and parents' work start times. Parent end times are represented by dummy variables indicating whether parents end work before 3:00 PM, between 3 PM and 5:30 PM, between 5:30 PM and 7:30 PM, or after 7:30 PM (no work is omitted). Parent start times are represented by dummy variables indicating whether parents' work start times are before 7AM, between 7AM and 8AM, between 8AM and 9AM, between 9AM and 10AM, or after 10AM (again, no work is omitted).

Child controls: Child control variables include child age, gender, and a series of race dummy variables. Dummy variables indicate whether a child is black, Hispanic, Asian, or "other race"; non-Hispanic white is the omitted category in the multivariate analysis.

Family controls: Family control variables provide information on family structure and socioeconomic status. Family structure variables include the total number of children in the household, whether the head of the household is married, and whether an “other caregiver” is absent. The marital status variable and “other caregiver” variables are distinct because in some cases, an unmarried primary caregiver still reports a secondary caregiver (e.g., a live-in boyfriend, the child’s grandmother, etc.) being present. Socioeconomic status variables include total family income in 2002 (log transformed), and a variable representing parents’ education levels completed as of the 2001 PSID family level interview. The parental education variable averages the education levels of both parents if both education levels are available; if only one parent’s education level is available, that level is used.

Parental mental health scales measuring self-esteem, self-efficacy, and generalized distress are also included in some models. Generalized mental distress is measured using the K-6 scale (Kessler et al., 2002). The K-6 scale asks respondents to rate how often in the last 30 days they have experienced feelings of distress, including nervousness, restlessness, and hopelessness. The scale was re-coded so that high scores on the scale represent high levels of distress. Self-esteem is measured using the Rosenberg self-esteem scale, which asks respondents to rate how true a series of statement is for them. Sample statements include “On the whole, I am satisfied with myself” and “I feel I do not have much to be proud of” (Rosenberg, 1965). Statements that indicated negative emotions were reverse-coded, so that high scores on the scale represent high levels of self-esteem. Self-efficacy was measured using the Pearlin and Schooler mastery scale. Sample items include “I have little control over the things that happen to me” and “I often feel helpless dealing with the problems of life” (Pearlin & Schooler, 1978). Items were reverse coded, so that higher scores indicate higher levels of self-efficacy/mastery.

Summary statistics of outcome, work, and control variables are given in Table 1.

--Table 1 about here--

Model:

We use the following basic model to estimate the effect of parental work on child sleep outcomes:

$$SleepMeasure_i = \beta_0 + \beta_1 PCGWork_i + \beta_2 OCGWork_i + \beta_3 ChildControls_i + \beta_4 FamilyControls_i + \varepsilon_1$$

While this model represents primary and other caregiver work effects as independent of each other and of other factors, we include some interaction models as well.

As noted above, the sleep outcome measures included children's weekday sleep duration, as well as their wake-up times and bedtimes. The PCG and OCG work variables were each specified in several different ways, as detailed above. All analyses are run using child-level weights, to ensure that our sample is representative of all children living in the United States. Regression analyses use Huber-White standard errors to adjust for non-independence of error terms for children in the same family. Regressions also include dummy variables to flag missing data for independent variables. While controls are included in all models, we do not report the results on those coefficients in our tables for ease of presentation.

RESULTS

We ran several specifications of our models in order to determine whether parental work schedules are related to child sleep. Initially, we examined whether child sleep measures were associated with parental employment status, given by a dummy indicating whether or not caregivers were employed. When these very simple measures of employment status for primary and other caregivers are used, there is no statistically significant relationship between parental employment and child sleep (see Table 2). This is true despite the inclusion of an interaction term indicating when both parents are working. However, this is a very coarse-grained analysis; there may still exist variations in impact on child sleep based on parental work *hours* or work *timing*. The rest of the analyses in this section address those questions.

--Table 2 about here--

Parental work hours

Our initial hypothesis was that children of parents who worked would sleep less, with a linear relationship between parental hours worked and child sleep duration. We expected that children who lacked an "other caregiver" would be especially sensitive to their parents' work hours, and that this linear relationship would be heightened for them. Our analyses provided little evidence for these hypotheses; indeed, surprising results emerged that contradicted our original suppositions.

To examine the impact of work hours, we first regressed child weekday sleep duration, bedtimes, and wake-up times on parents' reports of the number of hours they work in a usual week (see Table 3). This analysis partially supported our initial hypotheses in that children whose primary caregivers reported working more than 42.5 hours per week did receive (marginally significantly) less sleep than did children of non-working primary caregivers. However, children whose PCGs worked full-time had sleep durations that were nearly the same as for children of non-workers, and children whose PCGs worked part-time received *more* sleep than did children of non-working PCGs.

--Table 3 about here--

Most of the effect of caregiver work hours seems to have been driven by differences in wake-up times associated with hours worked (Table 3). Children whose PCGs work part-time wake up significantly later, and children whose PCGs work over-time wake up significantly earlier, than do children of non-working PCGs. Likewise, children whose OCGs work overtime wake up significantly earlier than do children with non-working OCGs. By contrast, there is little effect of parental work hours on bedtimes. For child bedtimes, no parental work predictors are significant at the .05 significance level, and only one parental work predictor (PCG full-time work schedule) is even marginally significant. PCG full-time work hours were negatively associated with child's bedtime at the .10 significance level, indicating that children of full-time working PCGs went to bed marginally earlier than did children of non-working PCGs. Thus, to the extent that parental work hours are associated with child sleep duration, this association seems to be driven by associations between parental work hours and child wake-up times. These results suggest that children may be adjusting their wake-up times, but not their bed-times, in response to parent work schedules; this question is explored further in the section on parental work timing.

An obvious possibility is that the interaction of parent schedules may be more important than either parent's schedule individually. That is, it may be more detrimental for children that their primary caregiver works long hours if the other caregiver also works long hours, as compared to when the other caregiver works only part-time or not at all. To test whether the effects of primary caregiver hours were consistent across other caregiver work hour schedule, we ran two separate interaction models. The first model tested whether PCG work hour effects were moderated by the presence or absence of a second caregiver. The second model tested whether PCG work hour effects were moderated by OCG work hours, given that an OCG was present.

The first model interacted the PCG work terms with a dummy variable that took a value of 1 when the OCG was absent. Thus, in addition to the main effects of PCG work hours on child sleep, we were able to find the marginal effects of PCG work hours given that the OCG was absent as well. The results did not support a significant interaction between PCG work hours and absence of an OCG (see Table 4).

--Table 4 about here--

As in the previous models, there continued to be a significant positive main effect of part-time PCG work on both sleep duration and child waketimes, and a significant negative main effect of over-time PCG work on child waketimes. Moreover, the negative association between over-time PCG work and child sleep duration, which previously was only marginally significant, became significant at the .05 significance level in this specification. However, the interaction terms are not significant. Thus, we do not find that the associations between child sleep and PCG work hours are moderated by the absence or presence of an OCG.

The second model included only those children for whom an OCG was present, and it tested whether the effects of PCG work hours are moderated by OCG work hours for this subsample. OCG work hours were collapsed into two groups: the first was the no work/part-time group (dummy variable=0) and the second was the full-time/over-time group (dummy variable=1). The OCG dummy variable was then interacted with PCG work hours. When this specification is used, both main effects and interaction effects are insignificant for all child sleep outcomes (analysis available upon request).

We also tested whether child age moderates the effect of parental work hours. We tested the moderating effects of age by interacting parental work variables with a dummy variable that takes a value of 1 for “younger” children (those less than 11 years old) and 0 for “older” children (11 years of age or older). The results indicate that the effects of the primary caregiver work hours are fairly similar for older and younger children (see table 5). None of the age-by-PCG work hour interaction terms are statistically significant. Thus, the pattern seems to hold for both younger and older children that part-time work for PCGs is associated with a boost in sleep duration (which drops to marginal significance in this specification) and over-time work is associated with marginally significantly shorter sleep duration.

--Table 5 about here--

However, the associations between other caregiver work hours and sleep do appear to be different for younger and older children. For older children, OCG over-time schedules are associated with significantly less sleep. There are, however, statistically significant positive interactions between the "younger" dummy and two of the three OCG work hour variables (part-time and over-time OCG work). These interactions mean that while OCG part-time work hours are associated with a (statistically insignificant) *decrease* in sleep duration for older children of .441 hours compared with older children with non-working OCGs, younger children with part-time working OCGs sleep .348 hours *longer* than younger children of non-working OCGs. Likewise, older children of over-time working OCGs sleep .494 hours *less* than the older children of non-working OCGs and wake up .383 hours *earlier*; both differences are statistically significant. Younger children of over-time working OCGs, however, actually sleep .16 hours *more* than the younger children of non-working OCGs, and they wake up .12 hours *later*.

Because the result that part-time work was associated with benefits for children's sleep was unexpected, we hypothesized that these results might be capturing some underlying difference between non-working and part-time working primary caregivers. For instance, full-time homemakers may be more depressed than their employed peers (Hoffman & Youngblade, 1998); these differences may influence the sleep routines that they develop for their children. Moreover, while non-working primary caregivers obviously may be non-working by choice, it is also plausible that this group may include those whose non-employment is less positive. For instance, non-working primary caregivers may be suffering a bout of unemployment, they may be on welfare, or they may be out of the labor force due to the recent birth of a new child. Each of these conditions may be associated with certain stressors that could affect mothers' mental health. Because parents help to regulate their children's sleep schedules, we speculate that disruptions to mothers' mental health could in turn affect children's sleep processes.

In order to test this theory, we included a series of mental health indicators in our models. The Child Development Supplement collected parent reports on their own self-esteem, self-efficacy, and depressive symptoms. Hours worked in a usual work week was significantly positively correlated with self-esteem for both primary ($r= 0.12$, $p<0.001$) and other caregivers ($r= 0.14$, $p<0.001$) (analysis available upon request). Also in line with predictions, hours worked in a usual week was significantly negatively correlated with mental distress for both PCGs ($r= -0.08$, $p=.0013$) and OCGs ($r= -0.11$, $p=.0038$). Self-efficacy was not significantly correlated with work hours for either the OCG or the PCG. Likewise, PCGs' work hours were not significantly correlated with OCGs' mental health measurements, and vice versa.

None of the mental health measures were significantly associated with child sleep in pairwise correlations. The lack of association between parental mental health and child sleep suggested that mental health neither mediated the relationship between work and sleep (as might occur if work status affects mental health, which in turn affects sleep), nor represented a variable that work was acting as a proxy for (as might occur if mental health drives both parental work status and child sleep patterns). Nonetheless, we included all three measures in a model with the parental work variables in case effects would appear once other covariates were controlled for. Including the mental health variables in the parental work models had little effect on the work coefficients, although the coefficient on overtime work for the PCG becomes significant at the .05 significance level (results not shown). However, we did find an independent effect of primary caregiver self-esteem on child sleep patterns; higher PCG self-esteem is significantly associated with longer child sleep duration and earlier bedtimes.

In summary, nonstandard parental work *hours* are associated with children's weekday sleep duration. PCG part-time work is associated with a boost in children's weekday sleep duration; this effect occurs (to varying degrees of statistical significance) among both younger and older children. Moreover, the pattern of a part-time work benefit for children's sleep is evident regardless of OCGs' presence. The effect persists even when we account for differences in mental health that are associated with hours worked. Finally, we note that the effects on sleep duration seem to come through effects on children's wake-up times, which are significantly correlated with sleep duration. Coefficients on bedtimes are rarely significant, while the patterns of coefficients on wake-up times closely mirrors those found for sleep duration.

Parental work timing

The duration of parental work hours is one obvious way through which parental work schedules may affect child sleep; the *timing* of parental work is another potential pathway. Initially, we expected that late shifts worked by parents—evening and night shifts—would be most disruptive of children's sleep schedules. However, our analysis of parental work hours suggests a competing hypothesis. Parental work hours were more strongly associated with differences in wake-up times than with differences in bed-times, this suggests that children's bedtimes may be less sensitive to parents' work schedules than are their wake-up times. If this is true, we might expect early start-times for parents' work to be more strongly associated with children's sleep outcomes than are late work times. We test these competing hypotheses in this section.

First, we tested whether parents' reports of working late or evening shifts as part of their usual work schedule were associated with child sleep measures. We found little evidence of effects of late parent work schedules on children's sleep schedules. Coefficients were small and results were not significant (analysis available upon request). However, because parents were asked to classify their schedules without uniform guidance as to what constituted a "night shift" or an "evening shift", we were concerned that the lack of results may be due to inconsistency in parents' definitions of late shifts. To address this problem, we looked at the work schedules parents reported actually working on the time diary day. This included the times that parents started and finished working, which enabled us to test the associations between child sleep and different start and stop times for parents' work. Again, we found little relationship between parental evening and night work and children's sleep duration (analysis available upon request).

However, clear relationships between parental work and child sleep did emerge when we examined parental start times. Parental reports of their normal schedules provided no way to distinguish early morning schedules from other schedules. Thus, we employ parent reports of their start-times on the time diary day to evaluate the relationship between parental start-times and child sleep. Parents' start times are categorized as either before 7:00, 7:00-8:00, 8:00-9:00, 9:00-10:00, or after 10:00.

We find fairly predictable relationships between PCG start-times and child sleep deficits relative to children of non-working parents (Table 6). Specifically, children whose PCGs start work before 9:00 seem to get less sleep relative to children of non-working PCGs. However, this effect is non-linear and not entirely consistent. Children whose PCGs start work before 7:00 get more sleep than do children whose PCGs start work from 7:00-8:00 or 8:00-9:00, and the difference between the children of these earliest working PCGs and non-working PCGs is insignificant. Interestingly, however, children whose PCGs start work between 7:00-9:00 get significantly less sleep compared with children whose PCGs do not work. Furthermore, the coefficients on these earlier start-times are fairly substantive; in particular, children whose PCGs start work from 7:00-8:00 AM get .42 hours (25 minutes) less sleep on average than do children of non-working PCGs, holding all else constant. Children of PCGs who start work later than 9:00 have sleep durations that are not significantly different than those of children of non-working PCGs.

--Table 6 about here--

We again ran interactions between child age (younger vs. older) and parental sleep schedules. The pattern for the main effects was the same as for the start time model without the age interaction. However, the interaction terms were generally not significant (analysis available upon request). Only the interaction between Younger and OCG start-times from 8-9:00 were significant; this interaction was positive and significant in both the sleep duration and the wake-up time models. However, given that only one interaction was significant, and that there were not consistent relationships between age and the parent work timing effects on sleep schedules, the robustness of this interaction seems questionable.

Thus, parental work timing appears to be related to child sleep. While late-night work was not associated with children's sleep, the timing of work start-times is associated with both child sleep duration and wake-up times. Early morning start-times predict less sleep for children, although this effect is not strictly linear, nor consistently significant for *all* early-morning starters.

DISCUSSION

While we do find statistically significant associations between parental work and sleep, an obvious question is whether the sleep gaps that we find are meaningful. We find that children of PCGs who work part-time sleep about .32 hours (19 minutes) more and children of overtime workers sleep almost .2 hours (about 12 minutes) less than children of non-working primary caregivers. It is worth asking whether such effects on sleep are associated with meaningful outcomes in terms of health, academic performance, etc. There are several ways we can evaluate the substantive significance of these results.

First, we can calculate an effect size of various work schedules compared with non-working, and determine how substantive effects are in standard deviation terms. For instance, children whose parents work part-time sleep .32 hours more per night on average compared with children of non-working PCGs (table 3). Since the standard deviation of weekday sleep duration is 1.55 hours, this translates to an effect size of d=0.203. According to Cohen's guidelines, this would be characterized as a small effect.

Alternatively, we can compare the size of these gaps in sleep duration by work schedules to others gaps that we care about. For instance, the gap in sleep duration between African-American students and whites has been observed in past research (Adam et al., 2007; Spilsbury et al., 2004). Adam and colleagues (2007) found that the size of the African-American sleep deficit, adjusted for covariates, ranged from .046 hours for younger children to .419 hours for older children. The larger figure is on par with the deficit associated with a PCG work start-time of 7:00-8:00.

Finally, we can relate the differences in sleep hours that we find to the amount of sleep decrement that studies have shown make a difference for child outcomes. For instance, Sadeh (2003) found that difference in sleep duration of just 35 minutes (.58 hours) had a significant effect on children's performance on a series of cognitive and memory tasks. Because these data are experimental, they offer particularly persuasive evidence that even relatively short differences in sleep duration over a relatively short span of time (three days) can measurably affect cognitive performance.

Observational data also suggest that even small changes in sleep duration can make a difference in important outcomes. Wolfson and Carskadon (1998) found that on average, A and B students slept only about 25 minutes (.42 hours) more per night than did their peers who earned C's. Likewise, Lumeng and colleagues (2007) find that the difference in average sleep duration in 3rd grade between children who are later classified as overweight in 6th grade vs. those who are not is only .12 hours (7.2 minutes). The significant effects we find of parental work on child sleep are generally in excess of the .12 hour difference that predicted overweight longitudinally. Our largest coefficients are in the range of the .42 hour difference that distinguished A and B students from their peers. This suggests that although our effect sizes are relatively small, the relationship between parental work and child sleep may still be large enough to have some impact on important child outcomes.

There are several limitations to this study. First, the sleep measures rely on human reporting; precise sleep measurement methods like actigraphy would be preferable. Second, this analysis examines only children ages 5 and older. Parental work schedules may be associated with sleep differently for younger children. This would especially be true given that children ages 5 and older are likely to be in school, and therefore have external impositions on their sleep schedule besides their parents' work schedules.

While this analysis begins to look more closely at how parental work schedules may affect children's sleep, much work remains to be done. For instance, sleep regularity (comparability of weekday and weekend sleep) is important, but this study ignores the question of regularity of sleep schedules. Future work should incorporate measures of variability as well as single-day sleep duration and sleep timing measures.

In addition, more fine grained analysis of the time diary data to examine when children and parents are spending time together may reveal the extent to which PCGs are responsible for caring for children in the morning hours during which children's sleep seems to be most sensitive to parental work schedules. More information on how parents' and children's time together is associated with both parental work and child sleep may uncover pathways through which parental work and child sleep are related.

Finally, further exploration is needed to determine how caregivers' schedules jointly affect child sleep. While we conducted preliminary analyses on this topic in regards to PCG hours worked, it would be useful to expand the analysis to examine how PCG work timing is affected by OCGs' schedules as well. Studies such as these may help to shed light on how parental work schedules in general, and nonstandard parental work schedules in particular, affect children's sleep.

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Table 1: Weighted summary statistics:

	n	Mean	SD
Control variables			
Male	2554	.490	.50
White	2547	.637	.50
Black	2547	.152	.36
Hispanic	2547	.139	.35
Asian	2547	.029	.17
Other race	2547	.043	.20
Child age	2554	12.24	3.71
Head married	2554	.714	.45
OCG present	2554	.792	.41
Number of children in household	2416	2.51	1.09
Log 2002 family income	2505	10.82	.87
Parental education	2439	12.89	2.80
Sleep variables			
Hours of sleep-weekday	2554	9.21	1.55
Bedtime-weekday	2554	9:46	1:13
Waketime-weekday	2554	7:00	1:19
Parental work variables			
% PCG working for pay	2,554	.676	
% OCG working for pay	1332	.876	
Average PCG hours (if works for pay)	1745	37.76	13.48
Average OCG hours (if works for pay)	1138	47.10	12.40
% PCG part-time (<30 hours)	2554	.168	
% PCG full-time (30-42.5 hours)	2554	.320	
% PCG over-time (>42.5 hours)	2554	.185	
% OCG part-time (<30 hours)	1332	.045	
% OCG full-time (30-42.5 hours)	1332	.292	
% OCG over-time (>42.5 hours)	1332	.539	

Table 2: Child weekday sleep by parental employment status

	(1) Sleep duration	(2) Bedtime	(3) Waketime
PCG work for pay	0.036	-0.052	-0.009
	(0.119)	(0.079)	(0.111)
OCG work for pay	-0.119	0.065	-0.024
	(0.197)	(0.120)	(0.149)
Both work for pay	0.030	-0.019	-0.044
	(0.161)	(0.107)	(0.152)
No OCG present	-0.975+	1.096	0.096
	(0.562)	(0.704)	(0.584)
Controls	X	X	X
Observations	2554	2554	2554
R-squared	0.206	0.327	0.108

Robust standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
PCG signifies the primary caregiver; OCG signifies the other caregiver

Table 3: Weekday sleep by caregiver usual work hours

	(1) Sleep duration	(2) Bedtime	(3) Waketime
PCG usual: part-time	0.315*	0.003	0.314*
	(0.134)	(0.074)	(0.130)
PCG usual: full-time	0.057	-0.138+	-0.093
	(0.097)	(0.079)	(0.087)
PCG usual: over-time	-0.198+	-0.011	-0.257**
	(0.107)	(0.078)	(0.090)
OCG usual: part-time	-0.092	0.066	-0.144
	(0.217)	(0.124)	(0.220)
OCG usual: full-time	-0.018	-0.020	-0.069
	(0.136)	(0.081)	(0.128)
OCG usual: over-time	-0.175+	-0.037	-0.210*
	(0.098)	(0.075)	(0.105)
No OCG present	-0.550**	0.048	-0.545*
	(0.209)	(0.123)	(0.217)
Controls	X	X	X
Observations	2554	2554	2554
R-squared	0.217	0.328	0.123

Robust standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
Omitted categories are PCG does not work and OCG does not work
PCG signifies primary caregiver; OCG signifies other caregiver

Table 4: Weekday sleep by PCG hours with OCG absence interaction

	(1) Sleep duration	(2) Bedtime	(3) Waketime
PCG usual: part-time	0.355*	-0.027	0.299*
	(0.146)	(0.081)	(0.138)
PCG usual: full-time	0.035	-0.144+	-0.077
	(0.110)	(0.086)	(0.100)
PCG usual: over-time	-0.282*	-0.016	-0.303**
	(0.117)	(0.081)	(0.103)
OCG Absent	-0.397	-0.003	-0.582*
	(0.241)	(0.155)	(0.258)
PCG part time * OCG Absent	-0.486	0.183	0.068
	(0.410)	(0.200)	(0.443)
PCG full-time * OCG Absent	-0.178	0.038	-0.068
	(0.198)	(0.138)	(0.197)
PCG over-time * OCG Absent	-0.020	0.043	0.183
	(0.233)	(0.191)	(0.191)
Controls	X	X	X
Observations	2554	2554	2554
R-squared	0.209	0.328	0.121

Robust standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
Omitted main effect category is primary caregiver not working
PCG signifies primary caregiver; OCG signifies other caregiver

Table 5: Weekday sleep with interactions for age

	(1) Sleep duration	(2) Bedtime	(3) Waketime
PCG usual: part-time	0.357+	0.079	0.493*
	(0.213)	(0.113)	(0.234)
PCG usual: full-time	0.081	-0.105	0.027
	(0.144)	(0.115)	(0.146)
PCG usual: over-time	-0.258+	0.089	-0.157
	(0.143)	(0.105)	(0.135)
OCG usual: part-time	-0.441	0.260	-0.359
	(0.331)	(0.207)	(0.375)
OCG usual: full-time	-0.199	0.125	-0.072
	(0.210)	(0.128)	(0.215)
OCG usual: over-time	-0.494**	0.043	-0.383*
	(0.143)	(0.109)	(0.166)
No OCG present	-0.652**	0.081	-0.642*
	(0.232)	(0.150)	(0.259)
Younger	0.875**	-1.037**	-0.315+
	(0.166)	(0.123)	(0.170)
PCG part-time * Younger	-0.162	-0.121	-0.298
	(0.252)	(0.152)	(0.248)
PCG full-time * Younger	-0.230	0.046	-0.162
	(0.180)	(0.137)	(0.169)
PCG over-time * Younger	-0.079	-0.132	-0.101
	(0.194)	(0.158)	(0.158)
OCG part-time * Younger	0.789*	-0.181	0.541
	(0.381)	(0.265)	(0.428)
OCG full-time * Younger	0.319	-0.169	0.156
	(0.254)	(0.167)	(0.239)
OCG over-time * Younger	0.660**	-0.083	0.503**
	(0.176)	(0.140)	(0.176)
OCG Absent * Younger	0.352+	-0.058	0.286
	(0.204)	(0.152)	(0.196)
Controls	X	X	X
Observations	2554	2554	2554
R-squared	0.183	0.239	0.056

Robust standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
Omitted work categories are PCG-no work and OCG-no work. Younger children are those less than 11 years old.

Table 6: Weekday sleep by start-time

	(1) Sleep duration	(2) Bedtime	(3) Waketime
PCG start before 7	-0.127	-0.125	-0.192
	(0.135)	(0.093)	(0.192)
PCG start between 7 and 8	-0.422**	0.173	-0.351**
	(0.151)	(0.134)	(0.127)
PCG start between 8 and 9	-0.279**	0.058	-0.274**
	(0.089)	(0.064)	(0.094)
PCG start between 9 and 10	-0.146	0.131	-0.050
	(0.182)	(0.106)	(0.148)
PCG start after 10	0.052	-0.001	0.001
	(0.154)	(0.093)	(0.139)
OCG start before 7	0.017	-0.043	-0.060
	(0.155)	(0.082)	(0.154)
OCG start between 8 and 9	-0.160	-0.218*	-0.427**
	(0.133)	(0.096)	(0.118)
OCG start between 8 and 9	-0.083	-0.240*	-0.318**
	(0.110)	(0.103)	(0.103)
OCG start between 9 and 10	0.195	-0.243*	-0.093
	(0.205)	(0.112)	(0.189)
OCG start after 10	-0.029	-0.081	-0.190
	(0.161)	(0.097)	(0.170)
No OCG present	0.254	-0.303	-0.092
	(0.325)	(0.227)	(0.206)
Controls	X	X	X
Observations	2554	2554	2554
R-squared	0.217	0.334	0.123

Robust standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%
Omitted work categories are PCG-no work and OCG-no work.
PCG signifies primary caregiver; OCG signifies other caregiver