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Timing and Scarring Effects of Early Childhood Sleep: Do They Matter for Later Human Capital Formation?

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Key Findings

- Childhood sleep problems are associated with a lower scores on all cognitive outcomes including IQ in later ages.
- A cumulative model gives the best fit indicating a dose-response relationship. Longer the exposure; larger the effect.
- Past sleep problems scar.
- Non cognitive outcomes including behavioral difficulties could mediate the relationship between sleep and cognition.

What Problem Was This Research Addressing?

The role of fetal and early childhood for shaping the outcomes over the life course has been long recognized [1]. Early literature suggests that disadvantaged childhood may have adverse effects on long term programming such as development of cognitive and non-cognitive skills, thereby affecting human capital formation in the long run. One potentially crucial determinant of human capital formation is the quality of sleep in early childhood. However, a big gap exists in the understanding of 'how human capital formation responds to early childhood adverse sleep shocks.

What This Research Adds

In our study, we adapt examples of life course research that investigates the relationship between early shocks particularly, poverty, maltreatment, stability of family structure and cognitive outcomes, health behaviors and subjective wellbeing to childhood sleep problems. We examine if timing of sleep problems (Table 1) across the various stages of childhood matter for cognition and study the mechanisms through which early childhood sleep affects later human capital formation (Figure 1).

Methods

We use Avon Longitudinal Study of Parents and Children (ALSPAC), a population based longitudinal study, based in South West of England [2]. A total of 14541 pregnant women, with expected dates of delivery between April 1991 and December 1992 were enrolled in the study, resulting in a final sample of 13978 children. Firstly, a structured life course analysis is used to select the best model (lowest Bayesian information Criteria/BIC) that fits the relationship between cognitive outcomes (verbal and performance IQ) measured at 8 years using Weschler Intelligence Scale for Children (WISC-III) and child sleep problems namely continuously waking up during sleep measured during infancy, early and mid-childhood [3]. Second, we use a check for scarring effects adapted from the unemployment and wellbeing literature whereby we see if past cumulative measure of sleep problem has an effect on cognition after controlling for current sleep problems. Third, we use Blinder-Oaxaca decomposition to decompose the 'treatment effect' of high dose sleep problems into observable mediators (non-cognitive outcomes) and unobservables to explain the cognition gap between children with low dose and high dose sleep problems.

Project Partner:

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Table 1. Sleep problem variable definition

Infancy sleep problem	1 = sleep problem at age 18 or 30 months 0 = no sleep problem at age 18 or 30 months
Early childhood sleep problem	1 = sleep problem at age 42 or 57 months 0 = no sleep problem at age 42 or 57 months
Mid-childhood sleep problem	1 = sleep problem at age 69 or 81 months 0 = no sleep problem at age 69 or 81 months
Cumulative sleep problem	Sum of infancy, early childhood and mid-childhood variables (range: 0-3)
Persistent sleep problem	1 = sleep problems in infancy, early childhood and mid-childhood 0 = all else
Any sleep problem	1 = sleep problem in infancy, early childhood or mid-childhood 0 = all else

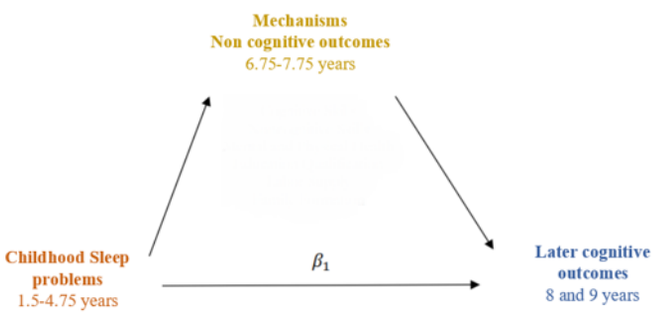
Research Findings

The prevalence of sleep problems varies over time, from infancy to mid-childhood. Almost 45% of the children has at least one sleep problem. Sleep problems are associated with a lower scores on all cognitive outcomes including that of verbal and performance IQ. Most importantly, we find that an accumulation model of sleep fits the data best compared to alternative variables encoding other sleep exposure patterns. This implies that longer the exposure to childhood sleep problems, larger is the adverse effects on cognition. Results from analysis of scarring effects of sleep shows that past cumulative measures of sleep are associated with cognition outcomes even after controlling for the current sleep problem. Therefore, past sleep problem 'scars. The decomposition analysis shows that behavioral difficulties could potentially mediate the relationship between sleep problems and cognition. In particular, behavioral difficulties and number of social fears widens or increases the cognition cap between children with and without sleep problems (Table 2).

Policy Relevance of Research

- Findings show that timing of sleep problem does not matter. This is important for timing of policy intervention indicating interventions to improve sleep can be implemented at any point in time (given the results) during childhood.
- Nevertheless, past sleep problems in infancy or childhood has a scarring effect on cognition implying intervention at earlier ages is still better. Better returns for cost of investment at earlier ages.
- Mediating effects of behavioral problems in addition to malleability of behaviors indicates the possibility of interventions aimed at improving behavioral problems to reduce the negative effects of sleep problems on cognition.

Figure 1. Channels through which early sleep problems may affect later cognition outcomes



Variance decomposition method proposed in Heckman & Pinto (2015) and applied in Heckman et al. (2013)

Table 2: Summary of results

	IQ	Short-term memory	Mathematical Reasoning
BIC	32046.9	19445.4	9837.3
Coefficient	-0.96	-0.13	-0.20
95% CI	(-1.38,-0.54)	(-0.22,-0.04)	(-0.32,-0.89)
Scarring effects	Yes	Yes	Yes
Mediation effects	Yes	Yes	Yes

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