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Sleep Disturbance as a Potential Pathway Linking Childhood Poverty and Subsequent Mental Health

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multisite, longitudinal study designed to recruit more than 10,000 children aged 9–10 years and follow them over 10 years into early adulthood. A listing of participating sites and a complete listing of the study investigators can be found at https://abcdstudy.org/consortium_members/. ABCD consortium investigators designed and implemented this study and/or provided data but did not necessarily participate in the analysis or writing of this report. This manuscript reflects the views of the authors and may not reflect the opinions or views of the NIH or ABCD consortium investigators. Additional support for this work was made possible from NIEHS R01-ES032295 and R01-ES031074.

Data, code, and materials availability: Data from the Rural Upstate New York sample are available at https://doi.org/10.5281/zenodo.18828483.
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Abstract

Health inequalities originate in childhood and often persist throughout life. An important and only partially answered question is why: what is it about poverty and other forms of disadvantage early in life that leads to compromised health and wellbeing? Herein we test a relatively novel and under- researched pathway, sleep disturbance, which might also contribute to health inequalities. Lower income at wave 1 in each sample predicts sleep quality at wave 2 and mental health at wave 3. Sleep quality mediates the prospective associations between income and mental health in both samples. We show in two different, longitudinal samples with variable indicators of sleep and mental health that sleep disturbance may represent one pathway linking childhood poverty with subsequent mental health difficulties.

Thinking about childhood poverty has largely focused on three strands of inquiry: i. strengthening the quality of evidence regarding the developmental consequences of early in life disadvantage; ii. designing and evaluating interventions to ameliorate the adverse consequences of childhood poverty; and iii. identifying mechanisms linking poverty to child development. This study focuses on the third strand of scholarship by testing an under-studied pathway linking childhood poverty to health inequalities: sleep disturbance. Three underlying pathways linking childhood socioeconomic disadvantage with adverse developmental outcomes are harsh and unresponsive parenting (Grant et al., 2003; Wadsworth et al., 2016; Conger & Donnellan, 2007), diminished cognitive stimulation (Bradley & Corwyn, 2002; Hoff, Laursen & Tardif, 2002), and stress (Evans, 2004; Evans & Kim, 2013; Miller & Chen, 2013). Sleep disturbance may represent an additional pathway, but it has received little empirical attention.

A large literature documents the importance of healthy sleep for physical and mental health (Hale, Troxel & Buysse, 2020). This literature coupled with growing evidence of associations between socioeconomic status (SES) and sleep health (Hale et al., 2020) has generated interest in sleep disturbance as a potential contributor to health inequalities (El-Sheikh et al., 2022). Using temporally ordered data, we examine whether sleep disturbance may partially account for the well-documented associations between childhood poverty and elevated psychological distress (Grant et al., 2003; Wadsworth et al., 2016).We examine this proposed indirect pathway using two distinct samples of children. . One is a longitudinal study of rural poverty and child development with 50% of the sample born at or below the poverty line. The second is a large national study

containing measures of household income, sleep disturbance, and mental health.

Tithe environment of childhood poverty contains a plethora of psychosocial and physical risk factors inimical for healthy sleep. Children in low-income households are more likely to experience substandard housing, noise and crowding along with consistent daily structure and routines in their daily lives (Bradley & Corwyn, 2002; Conger & Donnellan, 2007; Evans, 2004; Evans, Eckenrode & Marcynyszyn, 2010). Children growing up in poverty also experience greater family conflict and turmoil (Grant et al., 2003; Wadsworth et al., 2016; Conger & Donnellan, 2007). Each of these features of childhood poverty, let alone in combination, is a potent disruptor of sleep.

To date only three studies have examined sleep disturbance as a potential pathway linking childhood socioeconomic disadvantage with developmental outcomes. Philbrook et al. (2018) and Hoyniak et al. (2019) found that lower household income or a composite SES index, respectively predicted reduced cognitive performance in children that was partially mediated by lower quality sleep. We have identified only one prior study examining childhood socioeconomic disadvantage, sleep, and mental health. Among youth ages 11 to 13, greater perceived financial difficulties was associated with poorer mental health through compromised sleep (Boe et al., 2012).

The three prior studies on childhood poverty, sleep, and child development relied on relatively small samples with limited variation in household income, and none was specifically designed to examine the theoretical consequences of childhood poverty. Moreover, because sleep quality and developmental outcomes were assessed concurrently, these prior studies could not establish temporal ordering within the

proposed indirect pathway. The present study uses two longitudinal samples in which childhood poverty was assessed before sleep disturbance, which, in turn, was subsequently assessed prior to psychological mental health. This temporally ordered research design permits a stronger test of the proposed indirect pathway. Moreover, the rural upstate New York sample was designed to study poverty, oversampling families at or below the federal poverty line, whereas the second study recruited a national sample of American children.

Although much is known about developmental sequelae of childhood disadvantage, considerably less is known about the underlying mechanisms and much of the association remains unexplained. Herein we introduce and test with longitudinal data from two distinct data sets a relatively new, potential underlying pathway that may also contribute to our understanding of why poverty is bad for children. Such knowledge can ultimately also provide insights into the design of more effective policies to build resilience to childhood disadvantage.

Method

Sample 1 Rural Upstate New York

***Participants*.** Three hundred and forty-one children (*M* = 9.2 years, 49% male; 97% white) were recruited from rural areas in upstate New York from public schools, Co-operative extension, and various antipoverty programs (e.g., Headstart families, Section 8 housing). Because these data are part of a longitudinal study on childhood poverty, families at or below the US poverty line (income-to-needs ratio of 1.0) were oversampled consisting of

about half of the sample with remaining families between two and four times the poverty line, the composition of the majority of American families with children. Income-to-needs is a per capita index of income. At baseline, the mean income-to-needs of the upstate NY sample was 1.67. This study was approved by the Cornell University Institutional Review Board. Both informed parental consent and child assent were obtained for all of the data contained herein from this sample.

Procedure. Data were collected in the home at ages 9, 13, 17, and 24 with only data from the first three waves included to examine the hypothesized indirect pathway from childhood poverty to later mental health through sleep disturbance. . Mental health was assessed at age 17 with the Youth Self Report Scale (Achenbach, 2021) a widely used self-report assessment of overall psychological adjustment. Children report on a three-point scale (0 = sort of true, 1 = true, 2 = very true) whether various behavioral symptoms of anxiety, depression, and behavioral conduct problems apply to them. This scale has undergone extensive psychometric evaluation, including validation against clinical interviews and multi-informant (mother, father, teachers) convergence (Achenbach, 2021). At Wave 2, sleep disturbance was assessed with one item wherein the child reported trouble sleeping on a three-point scale. Wong et al. (2022) provide convergent validity evidence for this “trouble sleeping” single item with parent report associated with related actigraphy variables and with a standardized, well validated parent sleep questionnaire (Pediatric Sleep Questionnaire) (Chervin et al., 2000), and parental reports of trouble sleeping predicted the parallel child-reported sleep item. In particular, the estimated odds of child-reported “trouble sleeping” were 3.58 times as high among participants whose

parents endorsed “trouble sleeping” compared with those whose parents did not. In addition, the “trouble sleeping” item has shown expected associations with sleep latency measured by both sleep diary and actigraphy in children (Gregory et al., 2011).

Sample 2 National

Participants. The Adolescent Brain Cognitive Development (ABCD) study is a national data set of American children (*n* = 10,644) (*M* = 8.9 years, 52% male; 52% white) collected across 21 sites with a mean income-to-needs ratio of 3.87 at baseline. Data herein are for the first three waves of annually collected data. Ethical review and approval for all data collected within the scope of the ABCD Study came from a central Institutional Review Board (IRB) located at the University of California, San Diego or in some cases from local IRBs. Parental consent and child assent were provided at each wave of data collection covered in the present analyses.

Procedure. Mental health was assessed from both the primary caregiver using the caregiver version of the same YSR scale as used in the upstate NY study, the Childhood Behavior Checklist (CBCL) (Achenbach, 2021) as well as from a child self-report scale. The ABCD protocol child-report mental health is from a similar but abbreviated YSR scale, the ASEBA Brief Problem Monitor. The ASEBA is highly correlated with the YSR child and parent report scales, and has undergone extensive psychometric evaluation, including convergence with clinical, diagnostic interviews (Achenbach et al., 2011). One important advantage of the Brief Problem scale herein is it enables an indirect effects analysis in which sleep disturbance and mental health are reported by different informants. In the study of rural poverty, both sleep disturbance and mental health are dependent on child

reports. Indirect effects analyses are reported for both parent-and child-reported mental health in the ABCD sample. Sleep disturbance in the ABCD data set was measured with a well validated and reliable index of sleep, the Sleep Disturbance Scale for Children (SDSC) (Bruni et al., 1969). Parents report for the past 6 months (1 = never to 5 = always) how often various behaviors occur (e.g., “The child has difficulty getting to sleep at night”). Means, variance and internal consistency for the SDSC herein align well with the original scale development.

Results

Indirect-effects l models were tested in which baseline (Wave 1) income-to-needs predicted sleep disturbance at Wave 2, which in turn predicted Wave 3 r mental health3. Predictors were standardized and outcomes were modeled on their original scales. Missing data were handled with full-information maximum likelihood. The national sample was clustered by site (21 sites across the US). Each model controlled for age and sex and for the national sample, data site. Indirect effects were tested using the product-of-coefficients approach and are reported alongside direct and total effects.

Sample 1: Rural Upstate New York

In the rural cohort, Wave 1 income-to-needs significantly predicted lower sleep problems at Wave 2 ($a = -0.230$, $SE = 0.060$, $p < .001$). Elevated sleep problems at Wave 2 predicted mental health symptoms at Wave 3 ($b = 0.053$, $SE = 0.015$, $p = .001$). There was a significant indirect association between Wave income-to-needs and Wave 3 mental health through Wave 2 sleep disturbance (indirect effect = −0.012, SE = 0.005, p = .012) (Figure 1). The direct effect of Wave 1 income-to-needs on Wave 3 mental health, controlling for sleep

problems, remained significant (c' = −0.045, SE = 0.014, p = .001), and the total effect of Wave 1 income-to-needs on Wave 3 mental health was also significant (c = −0.057, SE = 0.013, p < .001). The model explained 17.9% of the variance in mental health (R^2 = .179) and 5.8% of the variance in sleep problems (R^2 = .058).

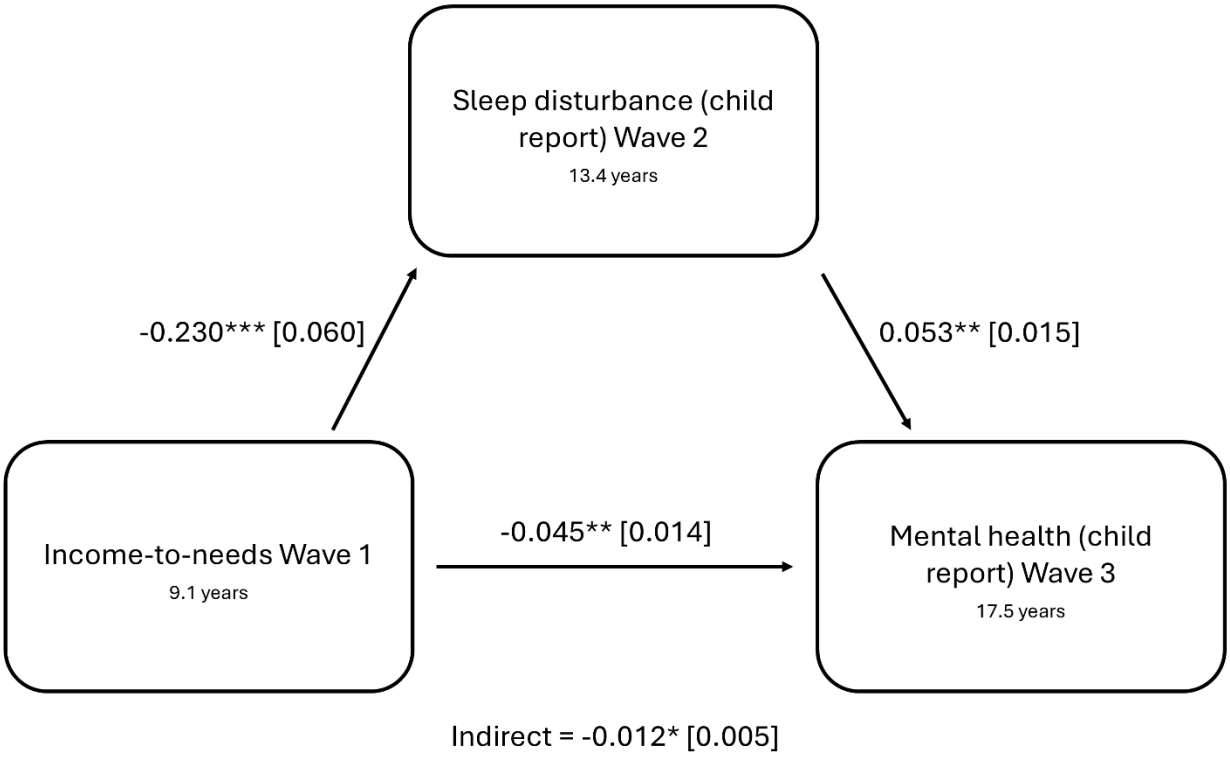


Figure 1. Mediation model for the rural upstate New York sample. Income-to-needs reflects total household income adjusted for family size relative to the federal poverty threshold. Sleep disturbance was assessed using a single child-reported item indicating difficulty sleeping, and mental health was measured using the Youth Self-Report Total Problems scale. Paths display standardized path coefficients with standard errors in brackets. Mean age is shown at each wave. The indirect effect represents the product of the income-to-

sleep and sleep-to-mental health paths. Missing data were handled using full-information maximum likelihood with robust standard errors. Age and sex were included as covariates.

Sample 2: National Sample

Parent-reported Child Mental Health

Baseline income-to-needs significantly predicted lower sleep disturbance at Wave 2 (a = −0.072, SE = 0.018, $p < .001$). In turn, greater sleep disturbance at Wave 2 predicted elevated parent-reported mental health at Wave 3 (b = 7.928, SE = 0.357, $p < .001$). There was a significant indirect association between baseline income-to-needs and Wave 3 parent-reported mental health through Wave 2 sleep disturbance (indirect effect = −0.574, SE = 0.150, $p < .001$) (Figure 2). The direct effect of baseline income-to-needs on mental health controlling for sleep disturbance, remained significant (c' = −1.315, SE = 0.228, $p < .001$), and the total effect of baseline income-to-needs on mental health was also significant (c = −1.890, SE = 0.323, $p < .001$). The model explained 24.4% of the variance in mental health ($R^2 = .244$) and 0.5% of the variance in sleep disturbance ($R^2 = .005$).

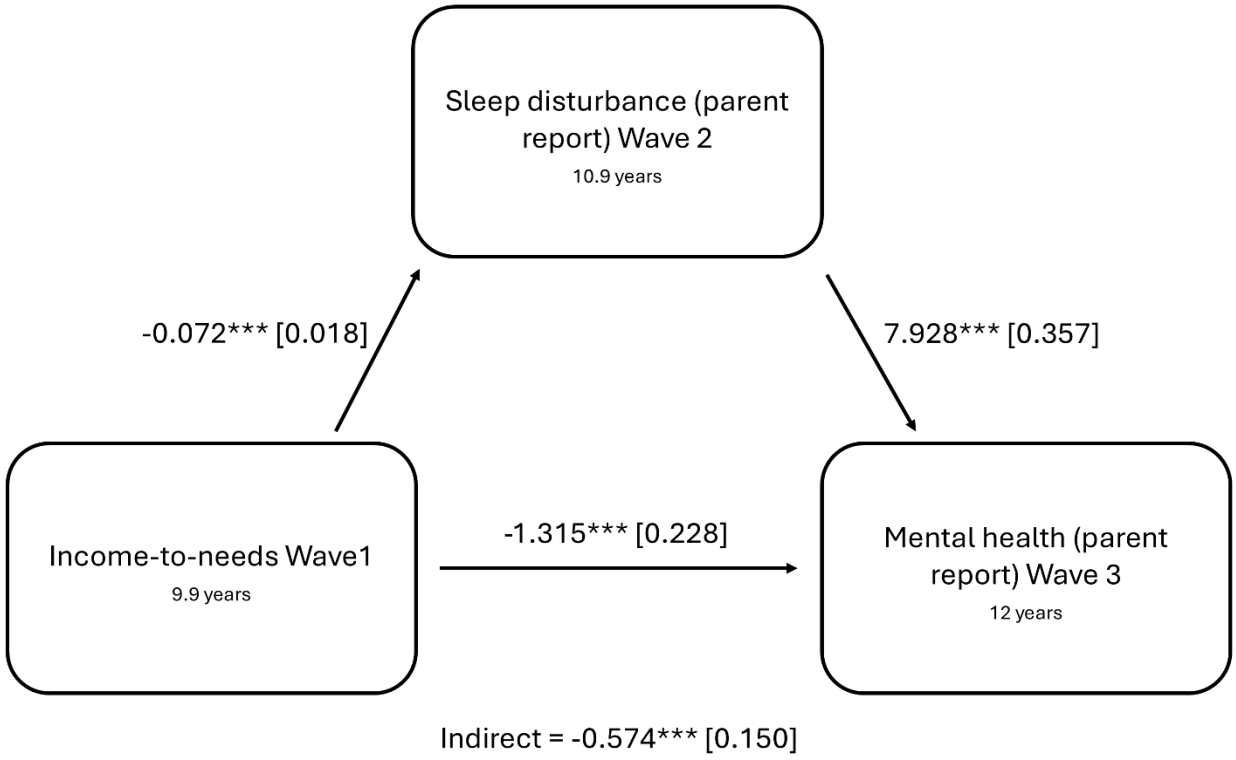


Figure 2*:* Mediation model for the nationally representative sample, parent-reported mental health. Income-to-needs reflects total household income adjusted for family size relative to the federal poverty threshold. Sleep disturbance was assessed using the parent-reported Sleep Disturbance Scale for Children (SDS), and mental health was measured using the Child Behavior Checklist (CBCL) Total Problems score. Paths display standardized path coefficients with standard errors in brackets. Mean age is shown at each wave. The indirect effect represents the product of the income-to-sleep and sleep-to-mental health paths. Missing data were handled using full-information maximum likelihood (MLR) with robust standard errors. Age and sex were included as covariates, and models accounted for clustering by study site.

Child-reported Mental Health

Baseline income-to-needs significantly predicted lower sleep disturbance at Wave 2 (a = −0.075, SE = 0.018, p < .001). Higher sleep disturbance at Wave 2 predicted more youth-reported mental health at Wave 3 (b = 1.071, SE = 0.065, p < .001). There was a significant indirect association between baseline income-to-needs and Wave 3 youth-reported mental health through Wave 2 sleep disturbance (indirect effect = −0.081, SE = 0.021, p < .001) (Figure 3). The direct effect of baseline income-to-needs on mental health, controlling for sleep disturbance, remained significant (c' = −0.615, SE = 0.081, p < .001), and the total effect of baseline income-to-needs on mental health was also significant (c = −0.696, SE = 0.083, p < .001). The model explained 5.8% of the variance in BPM-Y Total Problems (R^2 = .058) and 0.6% of the variance in sleep disturbance (R^2 = .006).

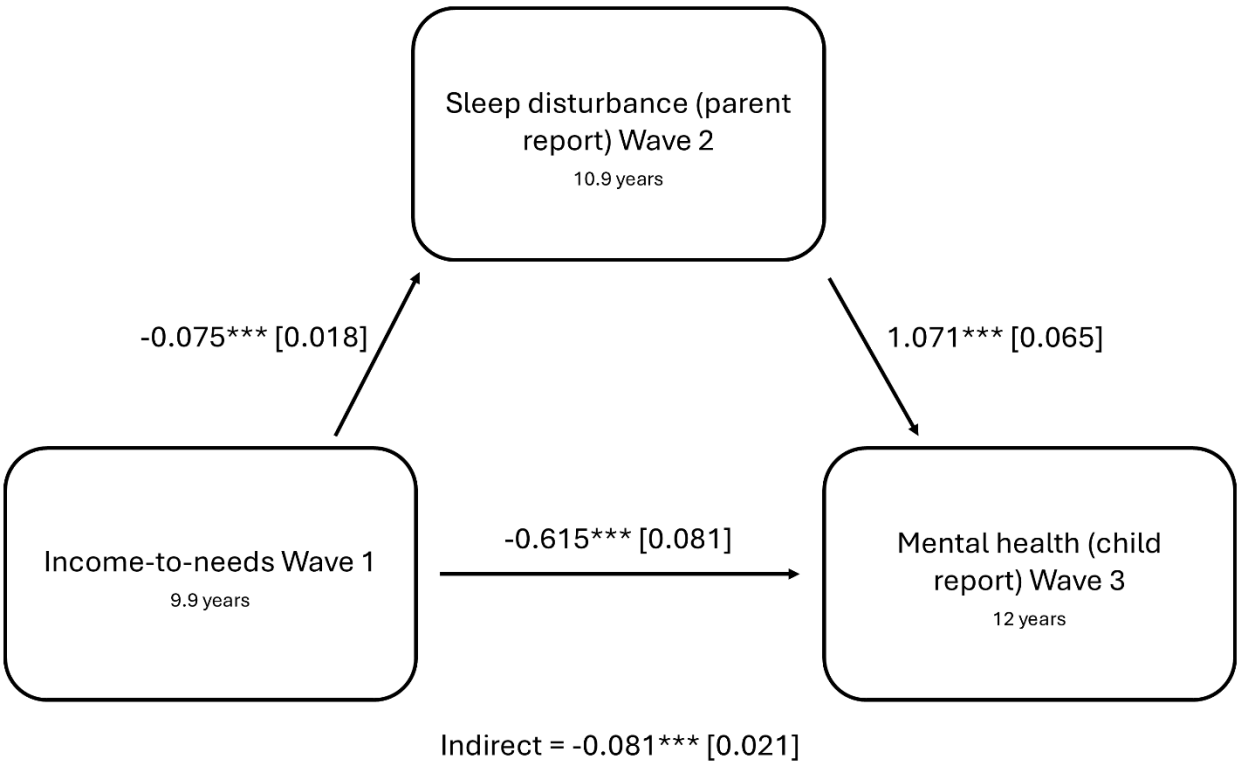


Figure *3*:Mediation model for the nationally representative sample, child reported mental health. Adolescent Brain Cognitive Development (ABCD) Study. Income-to-needs reflects total household income adjusted for family size relative to the federal poverty threshold. Sleep disturbance was assessed using the parent-reported Sleep Disturbance Scale for Children (SDS), and mental health was measured using the Brief Problem Monitor–Youth (BPM-Y) Total Problems score. Paths display standardized path coefficients with standard errors in brackets. Mean age is shown at each wave. The indirect effect represents the product of the income-to-sleep and sleep-to-mental health paths. Missing data were handled using full-information maximum likelihood (MLR) with robust standard errors. Age and sex were included as covariates, and models accounted for clustering by study site.

Discussion

The large and robust literature on health inequalities generally (Marmot, 2015) and specifically for children (Spencer, 2000) has led to investigation of potential mechanisms underlying these inequalities (Duncan, 2012). At present likely pathways include harsh and unresponsive parenting (Grant et al., 2003; Wadsworth et al., 2016; Conger & Donnellan, 2007), diminished cognitive stimulation (Bradley & Corwyn, 2002; Hoff, Laursen & Tardif, 2002), and stress (Evans, 2004; Evans & Kim, 2013; Miller & Chen, 2013). Sleep disturbance may be an additional pathway linking childhood disadvantage with compromised developmental outcomes.

As documented earlier, only three studies have examined sleep disturbance as a possible intermediary process linking childhood disadvantage with children's

development. Two of these found evidence for indirect effects of lower SES on delayed cognitive development (Philbrook et al., 2018; Hoyniak et al., 2019), and one showed that children in families with more perceived financial difficulties had poorer mental health that was partially mediated by reduced sleep quality (Boe et al., 2012). None of these studies was designed to measure the developmental outcomes of childhood disadvantage and were unable to examine the proposed pathway using temporally ordered data. Furthermore the samples were small and not representative; and all lacked substantial variation in SES.

Across two distinct samples, lower family income was associated with greater subsequent sleep disturbance, which in turn, was associated with worse psychological adjustment. Similar temporally ordered pathways were evident in a sample designed to study childhood poverty by oversampling (~ 50%) at or below the poverty line at baseline. This sample, however, is all rural and predominantly Caucasian. In addition, sleep quality was assessed by child report using only one item and the same child four years later reported on their psychological health on a standard index. Therefore, the common source of data for sleep quality and for mental health in the rural poverty study may inflate covariation.

The second sample we have analyzed is a large, national data set of American children. This sample used a well-validated, multi-item measure of sleep disturbance. Both parent-reported mental health of their child as well as children's self-reported psychological distress each showed the same temporally ordered pattern linking lower income with greater sleep disturbance, and, in turn, later elevated mental health symptoms. Similar pathways are shown across two quite different samples strengthens the

evidence that sleep disturbance may be an additional pathway linking childhood poverty with later mental health difficulties. Concerns about common respondent sources in the rural poverty study are reduced by the replication in the national data set, regardless of whether child- or parent-reported mental health is assessed. Although sleep disturbance was assessed with a single item in the rural poverty sample, the similar pattern found in the national data set using a well-validated multi-item measure provides convergent evidence across different measurement approaches.

Because the analyses did not adjust for earlier levels of sleep disturbance or mental health, the findings should be interpreted as temporally ordered indirect associations rather than evidence that sleep disturbance mediates changes in mental health over time. The temporal ordering of the measures and replication across distinct samples nevertheless support continued investigation of sleep disturbance as a possible link between childhood poverty and later psychological adjustment.

Sleep disturbance is a plausible candidate pathway linking childhood poverty with later mental health because many features of the environments in which economically disadvantaged children live can interfere with sleep. These include noise, crowding, substandard housing, lack of family routines and structure, along with escalated levels of family conflict and turmoil (Evans, 2004). Another important extension of the present work would be to drill down to see if, for instance, childhood poverty → chaos → sleep disturbance → mental health. Use of a stronger research design such as fixed effects analyses would also be an important next step. There are at least three well-documented reasons why childhood poverty is bad for children, namely harsh and unresponsive

parenting, deficiencies in cognitive stimulation, and elevated stress. Interference with sleep may be an additional pathway linking childhood disadvantage with subsequent health and development and warrants further investigation.

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