

LONG ABSTRACT

Background

A large body of literature has documented the important role of sleep duration and quality on health outcomes among adults, adolescents and children (Luyster, Strollo, Zee, & Walsh, 2012). Evidence suggests that poor quality and short duration of sleep can contribute to a number of negative physical, behavioral and emotional health outcomes (Ford and Cooper-Patrick, 2001; Grandner, Hale, Moore, & Patel, 2010; Newman, Enright, Manolio, Haponik, & Wahl, 1997; Wolk Gami, Garcia-Touchard, & Somers, 2005; Wong et al., 2004; Wong, Brower, Nigg, & Zucker, 2010). Additionally, sleep is of particular importance for young children's physical and cognitive development due to their stage in the life course (Beebe, 2011; Lam, Mahone, Mason, & Scharf, 2011; Vaughn, Elmore-Staton, Shin, & El-Sheikh, 2015). Prior research has documented that disparities in sleep health exist among racially and ethnically minority children, for example, non-Hispanic black and Hispanic children sleep less during the night than their non-Hispanic white peers (McLaughlin Crabtree et al., 2005; Hale, Berger, LeBourgeois, & Brooks-Gunn, 2009). Prior research has also found that socioeconomically disadvantaged children are disproportionately affected by lower-quality sleep (Hale, Berger, LeBourgeois, & Brooks-Gunn, 2009; McLaughlin Crabtree et al., 2005; El-Sheikh et al., 2013; Bagley, Kelly, Buckhalt, & El-Sheikh, 2015). However, less is known about the direct and indirect effects of neighborhood characteristics on children's sleep hygiene. Addressing the gap in existing literature is important given that poorer sleep quality among disadvantaged children may be one of the mechanisms leading to poorer health and quality of life in adulthood. Therefore, the main goal of the proposed research here is to better understand the influence of neighborhood effects on kindergarteners' sleep hygiene, and the mechanisms that may potentially explain this association. Given the increasing evidence of decline in sleep duration and quality among children in the United States, as well as the well-established association between poor sleep hygiene and negative health outcomes, this research is timely and has important public health implications (Luyster, Strollo, Zee, & Walsh, 2012; Matricciani, Olds, & Petkov, 2012).

Background Information about the Area of Research

A robust association between poor sleep hygiene and negative health outcomes among adults and adolescents has been well documented, and growing evidence points to the detrimental effects of poor quality and duration of sleep on health among children. Specifically, scholars have found that poor sleep hygiene may hinder cognitive growth and negatively affects daytime functioning among children, which ultimately affects their learning progress (Beebe, 2011; Lam et al., 2011; Vaughn et al., 2015). Poorer sleep quality may also contribute to children's irritability and difficulty concentrating (Dahl, 1996). Additionally, shorter sleep duration has been linked to behavioral issues and substance abuse later in life (Must and Strauss, 1999; Scharf, Demmer, Silver, & Stein, 2013; Lavigne et al., 1999; Wong et al., 2004, Wong et al., 2010). Finally, researchers have increasingly demonstrated that shorter sleep time is

associated with increased BMI and overweight/obesity (Bell & Zimmerman, 2010; Snell, Adam, & Duncan, 2007). Given the ample evidence of the importance of sleep quality and duration during childhood, determining mechanisms contributing to sleep outcomes is of high importance. As previously mentioned a number of social factors have been identified as important determinants of sleep outcomes among children. Indeed, lower socioeconomic status has been associated with later bedtimes, earlier wake times and shorter sleep duration among children (McLaughlin Crabtree et al., 2005; El-Sheikh et al., 2013; Bagley et al., 2015). In addition, scholars have noted that race/ethnicity has an independent effect on children's sleep above and beyond socioeconomic status. Specifically, non-Hispanic Black and Hispanic children tend to have later bedtimes, nap more during the day and sleep less during the night relative to their non-Hispanic White peers (Hale et al., 2009; Crosby, LeBourgeois, & Harsh, 2005). In addition to individual- and family-level characteristics, neighborhood-level characteristics have been recognized as a potential mechanism contributing to individual and household sleep habits and outcomes (Singh & Kenney, 2013).

Neighborhoods can influence sleep directly through factors such as noise and indirectly through factors such as higher crime rates, higher population density, air pollution, availability of parks and other spaces to be physically active that may in turn affect activities that promote healthy sleep (Buxton et al., 2015; Evans & Saegert, 2000; Sheehan et al., 2017; Stretesky, Schuck, & Hogan, 2004). Scholars have found that neighborhood socioeconomic status was associated with shorter sleep duration as well as day-time sleepiness, controlling for individual socioeconomic status and sociodemographic characteristics (DeSantis et al., 2013; Fang et al., 2015; Hale, Emanuele, & James, 2015). Additionally, research demonstrates that physical neighborhood disorder is associated with greater sleep problems, including pediatric obstructive sleep apnea among older children and adolescents, controlling for individual socio-demographic and behavioral characteristics (Troxel et al., 2017; Singh & Kenney, 2013; Umlauf, Bollandm & Lian, 2011). However, very little is known about the neighborhood effects on young children's sleep hygiene, particularly children under the age of 6, who may be particularly vulnerable to lower quality sleep and sleep duration (Sheehan et al., 2018). Therefore, addressing this gap in scholarship and gaining a better understanding of direct and indirect effects of neighborhood disadvantage on children's sleep remains an important task. Using a restricted-access, geocoded dataset from the Early Childhood Longitudinal Study, Kindergarten class of 1998-1999 (ECLS-K), this study addresses some of the shortcomings of existing literature by examining the association between objective socioeconomic and parent-perceived neighborhood characteristics and young children's regular and latest bed times, a proxy for sleep quality and duration.

Methods

Data

Sponsored by the National Center for Education Statistics (NCES) in the U.S. Department of Education, the Early Childhood Longitudinal Study Kindergarten Class of

1998-1999 (ECLS-K) study combines data from the baseline (kindergarten) and first grade years. The child-level data were collected through parent, teacher and school administrator interviews, school information and direct child assessments (National Center for Education Statistics, 1998).

The ECLS-K collected data from a nationally representative sample; the primary sampling units were areas of counties or groups of counties which also housed the schools and, subsequently, individual students (National Center for Education Statistics, 1998). One-hundred primary sampling units were selected which resulted in a sample size of 21,260 individuals and 1,280 schools (National Center for Education Statistics, 1998). The base-year survey includes information on the children's and school's geographic locations, which was geocoded using Geographic Information System (GIS) software (National Center for Education Statistics, 1998). Individual children are attached to both a census tract code and a ZIP Code Tabulation Area (ZCTA). For this cross-sectional study, we used data from round two (survey data from the spring of 1999) because, unlike round one, it included questions involving bedtimes. Tract code information was available for 18,500 individuals. However, 987 of the individuals did not have parent interview information, so for this study the sample size was 17,513 before running the analyses. In order to run the analyses, I decided to use listwise deletion to eliminate the missing data. While using listwise deletion is contentious in nature, for the purpose of this study, listwise deletion eliminated a modest number of cases (1,716).

Round two includes 6,392 census tracts with the average number of children per tract at 2.8, with a minimum of 1 and a maximum of 23. Roughly half of the census tracts (3,680) contain only one child (ECLS-K Geocode User's Guide, 1998). While seemingly problematic for multilevel analyses, the inclusion of tracts with one individual at level-1 does not bias level-2 estimates when the level-2 sample size is at least 500 (Bell et al., 2010). Census data were obtained for each census tract, which have over 600 variables attached to them.

Analyses

To determine whether regular and latest weekday bedtimes vary across neighborhoods after accounting for variability among individuals, we first created empty mixed multilevel models with children nested within census tracts and ran the models using the mixed procedure in STATA 13.1. We then estimated an Intraclass Correlation Coefficient (ICC) for the outcomes to determine how much of the variance in the outcome variables is due to clustering at the neighborhood level. After estimating these baseline models, we developed and estimated a series of five mixed multilevel models incorporating individual-level demographic, socioeconomic status and perceived neighborhood disorder variables, and neighborhood-level demographic, socioeconomic status and disorder variables.

Major Findings

Across all ten models, race and sex are salient contributors to regular and latest weekday bedtimes. Significant discrepancies in regular and latest bedtimes exist for racial minorities compared to non-Hispanic white children, most strikingly for Asian or Pacific Islander children. While not as large as race differences, sex also plays a role in determining sleep time of children; females go to bed and have latest weekday bedtimes earlier than males, implying a parental perception that females need more sleep. Family type and income, generally, do not impact children's regular and latest bedtimes.

However, mother's educational attainment strongly influences children's regular and latest bedtimes, especially for the two highest attainment categories. Parent perceptions about neighborhood disorder affected regular bedtimes for the "some disorder" compared to the "no disorder" category, and children that live in somewhat disorderly neighborhoods have earlier regular bedtimes, on average. Similarly, for latest weekday bedtime, children from neighborhoods with parent perceived "some disorder" and "substantial disorder" have later latest weekday bedtimes, on average.

While, inevitably, individual characteristics have a greater effect on regular and latest bedtimes, neighborhood clustering also impacts regular and latest weekday bedtimes. Individuals from neighborhoods with higher compositions of non-Hispanic black residents have later bedtimes. Moreover, with the addition of a variable for the percent of non-Hispanic blacks at the neighborhood-level, the disparity between regular and latest weekday bedtimes between individual non-Hispanic black and non-Hispanic white children is cut nearly in half; this indicates that the relationship between race and sleep is to some extent explained by living in a predominantly non-Hispanic black neighborhood. Children from neighborhoods with high levels of residents aged 25 or older without a high school degree have later regular and latest weekday bedtimes, however, contrary to prediction, economic stress inversely contributes to bedtimes. This outcome, coupled with lack of significance for individual income, implies that social environment and educational attainment rather than economic insecurity may explain variability in bedtimes among children.

References

- Bagley, E. J., Kelly, R. J., Buckhalt, J. A., & El-Sheikh, M. (2015). What keeps low-SES children from sleeping well: the role of presleep worries and sleep environment. *Sleep Medicine, 16*(4), 496-502.
- Beebe, D. W. (2011). Cognitive, behavioral, and functional consequences of inadequate sleep in children and adolescents. *Pediatric Clinics, 58*(3), 649-665.
- Bell, J. F., & Zimmerman, F. J. (2010). Shortened nighttime sleep duration in early life and subsequent childhood obesity. *Archives of Pediatrics & Adolescent Medicine, 164*(9), 840-845.
- Buxton, O. M., Chang, A. M., Spilsbury, J. C., Bos, T., Emsellem, H., & Knutson, K. L. (2015). Sleep in the modern family: protective family routines for child and adolescent sleep. *Sleep Health: Journal of the National Sleep Foundation, 1*(1), 15-27.
- Crosby, B., LeBourgeois, M. K., & Harsh, J. (2005). Racial differences in reported napping and nocturnal sleep in 2-to 8-year-old children. *Pediatrics, 115*(1 Suppl), 225.
- Dahl, R.E. 1996. "The impact of inadequate sleep on children's daytime cognitive function." *Seminars in Pediatric Neurology, 3*(1), 44-50.
- DeSantis, A. S., Diez Roux, A. V., Moore, K., Baron, K. G., Mujahid, M. S., & Nieto, F. J. (2013). Associations of neighborhood characteristics with sleep timing and quality: the Multi-Ethnic Study of Atherosclerosis. *Sleep, 36*(10), 1543-1551.
- El-Sheikh, M., Bagley, E. J., Keiley, M., Elmore-Staton, L., Chen, E., & Buckhalt, J. A. (2013). Economic adversity and children's sleep problems: Multiple indicators and moderation of effects. *Health Psychology, 32*(8), 849-859.
- Evans, G. W., & Saegert, S. (2000). Residential crowding in the context of inner city poverty. In *Theoretical Perspectives in Environment-Behavior Research* (pp. 247-267). Springer, Boston, MA.
- Fang, S. C., Subramanian, S. V., Piccolo, R., Yang, M., Yaggi, H. K., Bliwise, D. L., & Araujo, A. B. (2015). Geographic variations in sleep duration: a multilevel analysis from the Boston Area Community Health (BACH) Survey. *Journal of Epidemiology and Community Health, 69*, 63-69.

- Ford, D. E., & Cooper-Patrick, L. (2001). Sleep disturbances and mood disorders: an epidemiologic perspective. *Depression and Anxiety*, 14(1), 3-6.
- Grandner, M. A., Hale, L., Moore, M., & Patel, N. P. (2010). Mortality associated with short sleep duration: the evidence, the possible mechanisms, and the future. *Sleep Medicine Reviews*, 14(3), 191-203.
- Hale, L., Berger, L. M., LeBourgeois, M. K., & Brooks-Gunn, J. (2009). Social and demographic predictors of preschoolers' bedtime routines. *Journal of Developmental and Behavioral Pediatrics: JDBP*, 30(5), 394-402.
- Hale, L., Emanuele, E., & James, S. (2015). Recent updates in the social and environmental determinants of sleep health. *Current Sleep Medicine Reports*, 1(4), 212-217.
- Lam, J. C., Mahone, E. M., Mason, T. B., & Scharf, S. M. (2011). The effects of napping on cognitive function in preschoolers. *Journal of Developmental and Behavioral Pediatrics: JDBP*, 32(2), 90-97.
- Lavigne, J. V., Arend, R., Rosenbaum, D., Smith, A., Weissbluth, M., Binns, H. J., & Christoffel, K. K. (1999). Sleep and behavior problems among preschoolers. *Journal of Developmental & Behavioral Pediatrics*, 20(3), 164-169.
- Luyster, F. S., Strollo, P. J., Zee, P. C., & Walsh, J. K. (2012). Sleep: a health imperative. *Sleep*, 35(6), 727-734.
- Matricciani, L., Olds, T., & Petkov, J. (2012). In search of lost sleep: secular trends in the sleep time of school-aged children and adolescents. *Sleep Medicine Reviews*, 16(3), 203-211.
- McLaughlin Crabtree Crabtree, V. M., Korhonen, J. B., Montgomery-Downs, H. E., Jones, V. F., O'Brien, L. M., & Gozal, D. (2005). Cultural influences on the bedtime behaviors of young children. *Sleep Medicine*, 6(4), 319-324.
- Must, A., & Strauss, R. S. (1999). Risks and consequences of childhood and adolescent obesity. *International Journal of Obesity*, 23(S2), S2-S11.
- Newman, A. B., Enright, P. L., Manolio, T. A., Haponik, E. F., & Wahl, P. W. (1997). Sleep disturbance, psychosocial correlates, and cardiovascular disease in 5201 older adults: the Cardiovascular Health Study. *Journal of the American Geriatrics Society*, 45(1), 1-7.

- Scharf, R. J., Demmer, R. T., Silver, E. J., & Stein, R. E. (2013). Nighttime sleep duration and externalizing behaviors of preschool children. *Journal of Developmental & Behavioral Pediatrics*, 34(6), 384-391.
- Sheehan, C. M., Cantu, P. A., Powers, D. A., Margerison-Zilko, C. E., & Cubbin, C. (2017). Long-term neighborhood poverty trajectories and obesity in a sample of California mothers. *Health & Place*, 46, 49-57.
- Sheehan, C., Powers, D., Margerison-Zilko, C., McDevitt, T., & Cubbin, C. (2018). Historical neighborhood poverty trajectories and child sleep. *Sleep Health*, 4(2), 127-134.
- Singh, G. K., & Kenney, M. K. (2013). Rising prevalence and neighborhood, social, and behavioral determinants of sleep problems in US children and adolescents, 2003–2012. *Sleep Disorders*. doi:10.1155/2013/394320.
- Stretesky, P. B., Schuck, A. M., & Hogan, M. J. (2004). Space matters: An analysis of poverty, poverty clustering, and violent crime. *Justice Quarterly*, 21(4), 817-841.
- Troxel, W. M., Shih, R. A., Ewing, B., Tucker, J. S., Nugroho, A., & D'amico, E. J. (2017). Examination of neighborhood disadvantage and sleep in a multi-ethnic cohort of adolescents. *Health & Place*, 45, 39-45.
- Umlauf, M. G., Bolland, J. M., & Lian, B. E. (2011). Sleep disturbance and risk behaviors among inner-city African-American adolescents. *Journal of Urban Health*, 88(6), 1130-1142.
- Vaughn, B. E., Elmore-Staton, L., Shin, N., & El-Sheikh, M. (2015). Sleep as a support for social competence, peer relations, and cognitive functioning in preschool children. *Behavioral Sleep Medicine*, 13(2), 92-106.
- Wong, M. M., Brower, K. J., Fitzgerald, H. E., & Zucker, R. A. (2004). Sleep problems in early childhood and early onset of alcohol and other drug use in adolescence. *Alcoholism: Clinical and Experimental Research*, 28(4), 578-587.
- Wong, M. M., Brower, K. J., Nigg, J. T., & Zucker, R. A. (2010). Childhood sleep problems, response inhibition, and alcohol and drug outcomes in adolescence and young adulthood. *Alcoholism: Clinical and Experimental Research*, 34(6), 1033-1044.