HHS Public Access

Author manuscript

*Infant Ment Health J.* Author manuscript; available in PMC 2020 July 01.

Published in final edited form as:

*Infant Ment Health J.* 2019 July ; 40(4): 479–495. doi:10.1002/imhj.21783.

# Parenting and Toddler Self-Regulation in Low-Income Families: What Does Sleep Have to do with it?

**Megan M. Julian, Ph.D.**[1,2], **Christy Y. Y. Leung, Ph.D.**[2,3], **Katherine L. Rosenblum, Ph.D.**[1,2], **Monique K. LeBourgeois, Ph.D.**[4], **Julie C. Lumeng, M.D.**[2,5,6], **Niko Kaciroti, Ph.D.**[2,7], **Alison L. Miller, Ph.D.**[2,8]

[1]Department of Psychiatry, Medical School, University of Michigan, Ann Arbor, MI

[2]Center for Human Growth and Development, University of Michigan, Ann Arbor, MI

[3]Department of Surgery, Division of Otolaryngology, University of Chicago Medicine, Chicago, IL

[4]Department of Integrative Physiology, University of Colorado Boulder, Boulder, CO

[5]Department of Pediatrics and Communicable Diseases, Medical School, University of Michigan, Ann Arbor, MI

[6]Department of Nutritional Sciences, School of Public Health, University of Michigan, Ann Arbor, MI

[7]Department of Biostatistics, School of Public Health, University of Michigan, Ann Arbor, MI

[8]Department of Health Behavior and Health Education, School of Public Health, University of Michigan, Ann Arbor, MI

## Abstract

Toddlerhood is a sensitive period in the development of self-regulation, a set of adaptive skills that are fundamental to mental health and partly shaped by parenting. Healthy sleep is known to be critical for self-regulation, yet, the degree to which child sleep alters interactive child-parent processes remains understudied. This study examines associations between observed parenting and toddler self-regulation, with toddler sleep as a moderator of this association. Toddlers in low-income families (*N*=171) and their mothers were videotaped during free play and a self-regulation challenge task; videos were coded for mothers' behavior and affect (free play) and toddlers' self-regulation (challenge task). Mothers reported their child's nighttime sleep duration via questionnaire. Results revealed significant sleep x maternal negative affect and sleep x maternal negative control interactions. Children who did not experience negative parenting had good self-regulation regardless of their nighttime sleep duration. For children who did experience negative parenting, self-regulation was intact among those who obtained more nighttime sleep, but significantly poorer among children who were getting less nighttime sleep. Thus, among children who were reported to obtain less nighttime sleep, there were more robust associations between negative parenting and poorer self-regulation than among toddlers who were reported to obtain more sleep.

**Keywords**

toddler; self-regulation; sleep duration; parenting; low-income families

Self-regulation refers to the ability to regulate one's own emotions, responses, and behaviors when coping with internal and environmental stimuli and suppressing a dominant response to engage in goal-directed behaviors (reviewed in Bridgett, Burt, Edwards, & Deater-Deckard, 2015). Effective self-regulation in early childhood develops in the context of the parent-child relationship (Bernier, Carlson, & Whipple, 2010) and is fundamental for early childhood mental health (reviewed in Masten & Coatsworth, 1998). As well, such self-regulation capacities are concurrently and longitudinally linked to numerous positive child outcomes, including social competence (reviewed in Blair & Raver, 2015), school readiness (reviewed in Blair & Raver, 2015; Eisenberg, Valiente, & Eggum, 2010), and positive adjustment (Blair & Diamond, 2008). Importantly, the ability to self-regulate is associated with social competence in preschoolers in low-income families (Lengua et al., 2015; Mendez, Fantuzzo, & Cicchetti, 2002) and early school achievement (Schmitt, McClelland, Tominey, & Acock, 2015). Children in low-income families are at risk for poor outcomes in these areas compared to their more affluent peers, and one of the hypothesized pathways is through self-regulation (Evans & Kim, 2013; Raver et al., 2011). Therefore, fostering the development of self-regulatory skills early in childhood may be particularly important for children living in poverty (Buckner, Mezzacappa, & Beardslee, 2009). It is widely known that parenting shapes young children's development of self-regulation (reviewed in Bridgett et al., 2015), but moderators of the influence of parenting on self-regulation may also be important. Consistent with the differential susceptibility model, a wide body of work suggests that numerous factors—including a child's temperament or biology—can alter the way that the environment (i.e., parenting) affects children's developmental outcomes (Ellis, Boyce, Belsky, Bakermans-Kranenburg, & van Ijzendoorn, 2011). Sleep, a foundational component of early development that is critical to infant mental health, has been hypothesized to moderate associations between relational processes and child outcomes. The current study examines the association between parenting behaviors and toddler self-regulation skills, and considers toddler nighttime sleep duration as a moderator of this association.

Toddlerhood (approximately 1–3 years of age) is a sensitive period in the development of self-regulation, particularly with regard to how parenting may influence these adaptive skills (reviewed in Calkins & Bell, 1999). During the second year of life, children's self-regulation skills emerge rapidly, along with increasing autonomy (reviewed in Kopp, 1989) and increased social perspective-taking capacities (Vaish, Carpenter, & Tomasello, 2009). Caregivers play a central role in supporting children's regulation efforts early on, and as children grow older, they gradually become more able to independently self-regulate (Calkins & Hill, 2007). Individual differences in self-regulation during this period are associated with the quality of parenting (Brophy-Herb, Stansbury, Bocknek, & Horodynski, 2012). Of importance to the current study are data showing that young children from low-income families are at increased risk for difficulties with self-regulation due to the socioeconomic stressors their caregivers face (reviewed in Evans & Kim, 2013) and that

their self-regulation developmental trajectories show high variability (Brophy-Herb et al., 2012; Raikes, Robinson, Bradley, Raikes, & Ayoub, 2007). Identifying factors that account for such inter-individual differences in low-income families has important implications for understanding how parenting shapes children's self-regulatory abilities and for tailoring interventions to promote self-regulation as a key component of school readiness.

## Parenting and Development of Self-Regulation

Children's social interactions in the first two years of life predominantly occur in the context of their primary caregivers, and such experiences shape their self-regulation development (reviewed in Kopp, 1989, and Zeman, Cassano, Perry-Parrish, & Stegall, 2006). Parents who interact with their children with affection, positive emotions, and enjoyment/pleasure create an emotionally responsive and supportive socialization context (Eisenberg, Sadovsky, & Spinrad, 2005; Hastings et al., 2008; Valiente et al., 2006), which is likely to foster adaptive self regulation and executive function in their children (reviewed in Bernier, Carlson, & Whipple, 2010).

Moreover, through reading their children's cues, anticipating transitions, redirecting attention and/or responding to their children's needs in a timely manner, caregivers help their children effectively cope with negative arousal under stressful conditions. Children learn how to practice these skills in the context of the caregiving relationship. Over time, such co-regulation experiences help children develop self-directed strategies to regulate their own emotions and behaviors when facing challenges (Brophy-Herb et al., 2012). Thus, sensitive caregiving during the earliest years facilitates young children's development and internalization of adaptive individual self-regulation skills to cope with stress. Indeed, prior research has indicated that sensitive, responsive parenting is associated with toddlers' concurrent self-regulation skills (Calkins & Johnson, 1998; reviewed in Kopp, 1989).

Some of the earlier emerging self-regulation skills observed in toddlerhood include the ability to inhibit a behavior, and the ability to divert attention away from a desired object (Eisenberg, Smith, Sandovsky, & Spinrad, 2004). Among preschool-aged boys from low-income families, children whose mothers provided more positive control (i.e., positive involvement, guidance, encouragement of child compliance accompanied by positive affect and enjoyment) during dyadic interactions were more likely to engage in attention shifting away from the source of frustration under challenging conditions (Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002). In contrast, maternal preemptive interference, an intrusive parenting behavior that precluded children's independence or exploration, was associated with toddlers' increased distress in response to frustrating tasks (Calkins & Johnson, 1998). Empirical studies have also demonstrated a longitudinal association between earlier warm and sensitive parenting and later toddler effortful control and self-regulation (Eiden, Edwards, & Leonard, 2007; Kochanska, Murray, & Harlan, 2000; Taylor, Eisenberg, Spinrad, & Widaman, 2013). However, these effects appear to be bidirectional; recent studies have found that toddlers' executive function skill predicts maternal intrusiveness and responsiveness later on (Eisenberg, Taylor, Widaman, & Spinrad, 2015; Merz, Landry, Montroy, & Williams, 2017).

The association between parenting and the development of self-regulation in early childhood is thus well established (reviewed in Bernier, Carlson, & Whipple, 2010; Karreman, van Tuijl, van Aken, & Deković, 2006). Children who are more highly susceptible to self-regulation difficulties (e.g., difficult temperament) also appear to be more susceptible to the effects of parenting, with effects lasting at least into middle childhood (Pluess & Belsky, 2010). Differential susceptibility to parenting based on infant temperament has been demonstrated both in typically developing samples (Kim & Kochanska, 2012) and samples of children at higher risk (e.g., NICU graduates; Poehlmann et al., 2011). Genetic risk factors likely play an important role. For example, for children at higher risk based on genotype, a secure attachment relationship in toddlerhood appeared to function as a protective factor against poor regulatory capacity at preschool age (Kochanska, Philibert, & Barry, 2009).

Child factors are increasingly recognized as factors that can alter the way parenting relates to child outcomes (Ellis et al., 2011). With regard to executive function, a construct related to self-regulation, several studies have found that child factors such as ethnicity (Rhoades, Greenberg, Lanza, & Blair, 2011), gender (Clark et al., 2013), and prenatal cigarette exposure (Mezzacappa, Buckner, & Earls, 2011) moderate the association between parenting and executive function (reviewed in Fay-Stammbach, Hawes, & Meredith, 2014). These factors, however, are fixed, and not susceptible to change with later intervention. Thus, modifiable child factors such as sleep have begun to receive more attention as potential moderators of the association between parenting and child self-regulation.

## Sleep and Self-Regulation

Although sleep is biologically regulated, it is also influenced by the environmental context in which children develop (reviewed in Jenni & LeBourgeois, 2006, and Sadeh, Tikotzky, & Scher, 2010), and is a modifiable health risk behavior (Mindell et al., 2011; reviewed in Mindell & Owens, 2015). Thus, sleep is a child-based factor that may increase children's susceptibility to the effects of parenting, and it is also subject to change through interventions. Sleep is hypothesized to contribute to the development of neurocognitive and executive functioning skills that are foundational for effective self-regulation (Touchette, Mongrain, Petit, Tremblay, & Montplaisir, 2008; reviewed in Turnbull, Reid, & Morton, 2013). Sleep loss is associated with poorer self-regulation and cognitive processing among school-aged children (Gruber, Cassoff, Frenette, Wiebe, & Carrier, 2012; Molfese et al., 2013), and data from experimental work has shown similar effects on emotion processing in relatively small samples of toddler-aged children (Berger, Miller, Seifer, Cares, & Lebourgeois, 2012; Miller, Seifer, Crossin, & Lebourgeois, 2015). Self-regulation is often considered foundational to early childhood mental health (reviewed in Masten & Coatsworth, 1998), and disturbed sleep is common in children who have psychiatric disorders (reviewed in Gregory & Sadeh, 2016); some research findings suggest that sleep problems and/or sleep loss in childhood predict the later onset of mood and attentional disorders (reviewed in Gregory & Sadeh, 2016). Although some studies show that childhood sleep problems predict later psychiatric problems, but not the reverse (e.g., Johnson, Chilcoat, & Breslau, 2000), a recent systematic review suggests that the relationship is likely bidirectional (Alvaro, Roberts, & Harris, 2013). In adults, insufficient sleep is recognized as

central to psychopathology and linked to atypical processing of emotions (reviewed in Walker & Harvey, 2010) as well as poor self-regulation more generally (reviewed in Hagger, 2010; Mauss, Troy, & LeBourgeois, 2013), though associations between sleep and emotions are complex and likely to be bidirectional (Kahn, Sheppes, & Sadeh, 2013).

Early childhood is characterized by marked changes in sleep patterns and a high prevalence of sleep problems. Sleep becomes more consolidated over this developmental period, such that children spend less time sleeping during the day and more time sleeping at night (Acebo et al., 2005; Iglowstein, Jenni, Molinari, & Largo, 2003). Likewise, behavioral sleep problems are common among young children (reviewed in Honaker & Meltzer, 2016) and approximately 30% of toddlers and preschoolers are reportedly getting too little sleep (National Sleep Foundation, 2004). Sleep difficulties in 2- to 5-year-old children are associated with a multitude of difficulties, including risk for anxiety, depression, hyperactivity and impulsivity concurrently (Bates, Viken, Alexander, Beyers, & Stockton, 2002; Goodlin-Jones, Tang, Liu, & Anders, 2009; Lavigne et al., 1999; Reid, Hong, & Wade, 2009) and a year later (Jansen et al., 2011). Young children who do not get enough sleep also struggle to attain age-typical self-regulation, putting them at risk for later emotional and behavioral problems (Troxel, Trentacosta, Forbes, & Campbell, 2013). In fact, infants and toddlers with later bedtimes and less total sleep time tend to have more internalizing problems than those with earlier bedtimes and more sleep (Mindell, Leichman, DuMond, & Sadeh, 2017). Therefore, toddlerhood is an important age at which to study the interplay of the sleep and self-regulatory systems. Although the empirical evidence supporting sleep as central to self-regulation during the toddler and preschool years is growing (Berger et al., 2012; Bernier, Carlson, Bordeleau, & Carrier, 2010; Miller et al., 2015; Schumacher et al., 2017), few if any studies have focused on both sleep and self-regulation in children from low-income familes at these developmental periods, despite their documented risk for poor functioning in both areas (El-Sheikh et al., 2013; Evans & Kim, 2013; Singh & Kenney, 2013).

Beyond its direct associations with children's functioning, sleep has also recently been posited to affect how children are differentially susceptible to environmental influences. For instance, among infants, greater positive associations are observed between maternal sensitivity and attachment security in children who exhibit more consolidated sleep (i.e., greater proportion of night to day sleep) than those with poor nighttime sleep consolidation (Bernier, Bélanger, Tarabulsy, Simard, & Carrier, 2014). Similarly, associations between maternal sensitivity and later behavioral outcomes among infants are stronger in those who obtain more nighttime sleep than in those who sleep for shorter durations at night (Bordeleau, Bernier, & Carrier, 2012). Prior work also showed that response inhibition is related to adaptive self-regulation strategy use in preschool-age children, but this relationship disappeared when child sleep was restricted by about 3 hours (Schumacher et al., 2017). Poor integration of cognitive and emotional processes in this manner may place children at risk for future psychopathology (reviewed in Blair & Dennis, 2010), and children from low-income families who are not getting adequate sleep may be particularly susceptible to later problems (El-Sheikh, Kelly, Buckhalt, & Hinnant, 2010). Thus, considering sleep as a moderator of the association between parenting and self-regulation in

early development may provide key insights into how to promote positive developmental outcomes for children growing up in high-risk contexts such as poverty.

## Current Study

The toddler years are characterized by rapid development in both self-regulation and sleep. Findings from an established literature have shown that parenting is central to the development of young children's self-regulation skills. Yet, whether the association between parenting and self-regulation differs as a function of sleep in young children remains unknown. The current study addresses this knowledge gap by utilizing observational data from a self-regulation challenge task to examine the association between parenting and toddler self-regulation, and considers whether the association differs among toddlers exhibiting varying nighttime sleep durations. Further, this study is focused on children from low-income families, who are at relatively high risk for both self-regulation and sleep difficulties. As suggested by prior work (Chiang et al., 2016; Schumacher et al., 2017; Tu, Erath, & El-Sheikh, 2015) which is informed by the differential susceptibility model (Ellis et al., 2011), we hypothesize that toddler sleep will moderate the association between parenting and toddler self-regulation such that toddlers who obtain less nighttime sleep and are exposed to negative parenting will have poorer self-regulation skills than those who obtain more sleep. We also examined effects of positive parenting and demographic covariates in an exploratory manner.

## Method

### Participants

Participants were toddlers (51.8% male, 46.8% non-Hispanic white; see Table 1 for participant characteristics) and their mothers who were enrolled in a longitudinal study of child self-regulation and eating behavior between 2010 and 2014 [Miller, Rosenblum, Retzloff, & Lumeng, 2016]. Families were recruited from Women, Infants and Children (WIC) programs, Early Head Start programs, and other community agencies serving low-income families in the Midwest. Most ($N$ = 186) dyads entered the study when the child was age 21 months; 58 entered the study when the child was age 27 months. For the current study, data from the child's first point of contact with the study (either 21 or 27 months of age) were included. Families were universally low-income at enrollment (defined as a member of the family being eligible for Medicaid, WIC, food stamps, or Head Start).

Children were included if they were born at 36 weeks of gestation or more without significant perinatal or neonatal complications and not large or small for gestational age at birth; child had no history of food allergies, serious medical problems, or significant developmental delays; mother and child were English-speaking; the biological mother was the child's legal guardian; and the mother was at least 18-years-old and had less than a 4-year college degree. Participants in this analysis were required to have complete data for parent-reported toddler sleep and observed parenting and toddler self-regulation ($N$ = 171; 120 families with 21-month data, 51 families with 27-month data) and those with complete versus incomplete data did not differ with regard to child sex, race/ethnicity, maternal age, or maternal education; however, participants with complete and incomplete data differed

respectively on mother marital status (43.7% married versus 23.7% married); toddler age (*M* = 22.9 months versus *M* = 21.5), and income (*M* = $25,313.79 versus *M* = $18,464.29).

Sample characteristics are shown in Tables 1 and 2. Toddlers sex was evenly distributed, and about half the sample were identified by mothers as non-Hispanic white. Children's average parent-reported weekday bedtime was 20:50, and their average weekday wake time was 8:06, resulting in an average of 11 hours 16 minutes (SD = 69 minutes; range = 7 to 14 hours). Total parent reported toddler nighttime sleep duration ranged from 7 to 14 hours. Nearly all children took regular naps (97.7%), with an average napping duration of 1 hour 51 minutes (SD = 43 minutes) per day. Fifty-six percent of mothers in this sample were unmarried, and 62.6% had at least a high school diploma or GED. The average income to needs ratio of this sample was at the poverty line (M = 0.99), and the mean of the midpoint of the income range was $25,313.79 (SD = $15,440).

## Procedure

This study was approved by the University of Michigan Institutional Review Board and written informed consent was obtained from all mothers. Visits to assess mother-child interactions and child self-regulation took place on the same day in the family's home. This visit began with mother-child free play, and the child then completed a series of standardized challenge tasks with a trained examiner. All tasks were videotaped for later observational coding. Data for the current study were derived from the Free Play and No-Touch Cookie tasks (Gilliom et al., 2002).

**Free Play Task.—**For the Free Play, the mother was told "You and your child can take a few minutes to get settled. I'll put the toys out and you can go ahead and make yourself comfortable and spend time together as you normally would." Standard age-appropriate free play toys (e.g., blocks, wooden puzzle, vehicle, and manipulative toy) were provided and the mother and child were videotaped playing alone for 2 minutes (the examiner joined for the final 3 minutes). Only the 2-minute mother-child-alone free play was coded.

**Standardized Challenge Task.—**The No-Touch Cookie task (Gilliom et al., 2002) is designed to assess a child's ability to wait and self-regulate in a tempting situation. The examiner gave the mother a cookie (after confirming that the child liked that type of cookie) in a clear plastic bag and instructed the mother to keep it in view but out of reach of the child while she completed some questionnaires (2 minutes).

## Measures

**Observational Coding of Affect and Behavior.—**Maternal affect and behavior were coded from video during the Free Play and No-Touch Cookie task based on prior work (Booth, Rose-Krasnor, McKinnon, & Rubin, 1994). Teams of independent coders (i.e., separate coding teams for parent and child variables) were trained to achieve a reliability standard of Cohens' Kappa > .70, and ongoing reliability was evaluated on a set of 20% of observations for each coding scheme to protect against coder drift. Disagreements were resolved by consensus as needed. All affect and behavior were coded in 10-second intervals

for the duration of each task, and variables were created to represent mean maternal affect and behavior, and proportion of time children engaged in each self-regulation strategy.

**Predictor: Maternal Affect and Behavior during Free Play.—**Maternal affect and behavior toward the child was coded in 10-second intervals during the Free Play task using the Maternal Warmth and Control Rating Scale (Booth et al., 1994). Maternal affect and behavior were observed across five domains: *Positive Affect* (e.g., warm, pleasant, and/or joy; coded as 0 = none, 1 = moderate positive expression, 2 = outright affection), *Negative Affect* (e.g., sad, anxious, and/or embarrassed; 0 = none, 1 = moderate negative expression, 2 = outright negative expression), *Negative Control* (e.g., intrusive, ill-timed behaviors; 0 = none, 1 = moderate negative control, 2 = outright negative control), *Sensitivity & Guidance* (e.g., supportive, well-timed behavior; −1 = miss or inappropriate response, 0 = none, 1 = minimal, 2 = extended) and *Hostile Affect* (e.g., anger, irritability). Videos were coded by 6 trained coders, and average interrater reliability for maternal affect and behavior codes ranged from Kappa = .73 to .94. Hostile Affect was not included in analyses because it was very rarely observed (5 cases total) in this sample. Because of low variability, maternal affect and behavior variables were dichotomized at the median. For some variables (Negative Affect, Negative Control), this meant it was categorized into absent (0) versus present (>.01), whereas for variables that were observed with more frequency, the true median (Positive Affect, Mdn = 0.30; Sensitivity & Guidance, Mdn = 0.57) was used.

**Predictor: Child Weekday Nighttime Sleep Duration.—**Mothers reported on their child's "usual bedtime on weeknights" and "usual wake time on weekday mornings". From these times, average nighttime sleep duration per weekday was calculated and reported in hours. Weekday sleep was examined in lieu of weekend or whole-week averages in order to obtain a more accurate estimate of a child's daily sleep.

**Covariates: Socioeconomic Status, Demographic Characteristics, and Home Environment.—**Mothers reported on their income and family size (used to calculate Income-to-Needs Ratio), race/ethnicity (Non-Hispanic white vs. Hispanic or not white), education (high school diploma/GED or less vs. more than high school), marital status (married vs. unmarried), age, and their child's gender, age, and race/ethnicity. Mothers also completed the Confusion, Hubbub, and Order Scale (CHAOS), which is a validated and reliable 15-item questionnaire measure designed to assess the level of confusion and disorganization in the child's home environment ( = .81 in our sample; Matheny, Wachs, Ludwig, & Phillips, 1995).

**Outcomes: Child Self-Regulation.—**In the No-Touch Cookie task, child self-regulation in the presence of the mother was observed. The presence (1) or absence (0) of several different Self-Regulation Behaviors (e.g., *Active Self-Distraction*, *Passive Waiting, Social Bids/Information Gathering*, *Physical Comfort Seeking*, and *Focus on the Delay Object*) during 10-second intervals of the No-Touch Cookie task was coded based on prior work (Gilliom et al., 2002). Videos were coded by 3 trained coders, and inter-rater reliability for Self-Regulation Behavior codes ranged from Kappa = .83 to .99. Each variable is reported as proportion of 10-second intervals during which the child engaged in a given self-regulation

behavior (i.e., range from 0 to 1). Several of these variables (*Passive Waiting*, *Social Bids/Information Gathering*, *Physical Comfort Seeking*) occurred with relatively low frequency in this dataset (57% to 81% of participants had no instances of the behaviors), and so they were not included in analyses. The self-regulation behaviors addressed in this paper were *Focus on Delay Object* (e.g., looking at, talking about, or reaching for the cookie, or trying to end the delay), and *Active Self-Distraction* (e.g., purposeful behavior that directs attention away from the cookie). These variables showed strong negative inter-correlations ($r = -.93$, $p < .01$), thus, we combined them into one composite variable. This composite variable was calculated by averaging the proportion scores for Active Self-Distraction and Focus on the Delay Object (reversed). Higher scores represent more effective disengagement from the desired object, which is a key self-regulation goal during toddlerhood.

## Analysis Plan

Analyses were conducted in SPSS version 24 (IBM Corp., Armonk, NY). Bivariate correlations examined the association between toddlers' nighttime sleep duration, mothers' observed affect and behavior, and toddlers' observed self-regulation. Pearson correlations were used for correlations between continuous variables (child sleep duration, child self-regulation), point-biserial correlations were used for correlations between continuous and dichotomous variables (maternal affect and behavior), and Phi coefficients were used for correlations between dichotomous variables.

A series of regression analyses were conducted in order to build a more comprehensive later model to estimate the effects of parenting, child sleep duration, and demographic and home environment factors on child self regulation. First, demographic and home environment variables were investigated to determine which covariates would be included in the model, then parenting variables, child sleep duration and their interactions were included in the model to test whether parenting variables and their interactions with sleep duration are related to the outcome. On the basis of these results, a comprehensive regression model was built that included demographic covariates, parenting variables, and parenting by sleep interactions.

Because of negative skewness in the outcome variable, the child self-regulation variable was natural log transformed ($ln(2\text{-}y)$)[1] for use in the regression analyses to improve normality; as a result of this transformation, lower values represent better child self-regulation. Each potential covariate (income to needs ratio, maternal marital status, maternal education, maternal race/ethnicity, child sex, child age, child race/ethnicity, CHAOS score) was entered into a regression model predicting child self-regulation. Any covariates that reached at least a marginal level of significance ($p < .10$) were included in the next step of analyses.

Next, regression analyses were used to examine how child sleep duration and observed parenting together predicted observed child self-regulation. Analyses were run with each parenting variable (dichotomously coded, as described above) and child nighttime sleep duration predicting child self-regulation, controlling for covariates that were determined by the previous step. For instance, one regression model predicted child self-regulation with

[1]Note that this transformation resulted in $\beta$s being negative for positive associations and positive for negative associations.

child sleep duration, maternal positive affect, and the sleep duration by maternal positive affect interaction, controlling for covariates. Interaction effects investigated whether the effect of parenting on child self regulation was different depending on the child's duration of nighttime sleep.

In order to account for multiple aspects of parenting in one model, a more complex final model was constructed by adding to the model any main effects that had been marginal or significant in the basic models, as well as the main effects and interactions for any interactions that had been marginal or significant in the basic models. Analyses were then repeated with 24-hour toddler sleep.

## Results

### Correlations.

Parent-reported child nighttime sleep duration was positively associated with observed maternal Sensitivity and Guidance, but was not correlated with any other maternal behaviors or child self-regulation (Table 2). Observed child self-regulation showed a marginal positive association with observed maternal Sensitivity and Guidance. Among the observed parenting variables, maternal Sensitivity and Guidance was positively associated with maternal Positive Affect. Maternal Negative Control was positively associated with maternal Negative Affect, and marginally positively correlated with maternal Positive Affect.

### Regression Analyses.

When child self-regulation was regressed on each potential covariate in separate analyses, the association was nonsignificant for income to needs ratio, maternal marital status, maternal race/ethnicity, child sex, child age, and CHAOS score. However, maternal education, $\beta = -.14$, $p = .07$, and child race/ethnicity, $\beta = .13$, $p = .09$, were both marginally associated with child self-regulation. Thus, both maternal education and child race/ethnicity were included in the next step of analyses.

When child self-regulation was regressed on each parenting behavior separately, with maternal education and child race/ethnicity as covariates, there was a marginal child sleep x maternal Negative Affect interaction, $\beta = -.15$, $p = .05$, a significant child sleep x maternal Negative Control interaction, $\beta = -.28$, $p < .01$, and a marginal main effect of maternal Sensitivity and Guidance, $\beta = -.13$, $p = .09$. Thus, the final model included maternal education, child race/ethnicity, child nighttime sleep duration, maternal Negative Affect, Negative Control, and Sensitivity and Guidance, and child sleep x Negative Affect and child sleep x Negative Control interactions. This overall model was significant, $R^2 = .13$, $F(8,170) = 3.015$, $p < .01$. There was a significant effect of child race/ethnicity on child self-regulation, $\beta = .18$, $p = .02$, with non-Hispanic white toddlers demonstrating better ability to disengage from a desired object ($M = 0.73$) than Hispanic or not white toddlers ($M = 0.62$). Maternal education was not significantly associated with observed child self-regulation in the final model. The main effect of child sleep duration on self-regulation was nonsignificant, $\beta = .12$, $p = .20$, suggesting that in the reference group (i.e., when Negative Affect and Negative Control are both 0), child sleep duration is not associated with child

self-regulation. Main effects for parenting were also nonsignificant, but both parenting by sleep duration by parenting interactions attained significance (Table 3). When children had less nighttime sleep, the presence of maternal Negative Affect, $\beta = -.16$, $p = .04$, and Negative Control, $\beta = -.28$, $p < .01$, were each associated with lower ability of children to disengage from a desired object relative to when parents showed no Negative Affect or Negative Control (Figure 1). As illustrated in Figure 1, the effect of parenting on child self-regulation depends on child sleep duration. Both maternal Negative Affect and Negative Control are associated with poorer child self-regulation only under the conditions of low child sleep duration.

We also considered 24-hour sleep (nighttime and daytime) as a predictor to account for napping, as most children still sleep during the day at this age (Iglowstein et al., 2003). Because 8 participants were missing data on napping, multiple imputation was used to estimate these values (note however, that no results changed when these cases were removed from analyses in lieu of multiple imputation). When total 24-hour sleep was utilized (vs. only nighttime sleep), the covariates (maternal education and child race/ethnicity), Negative Control, Sensitivity and Guidance, and the Negative Control by sleep interaction were marginal or significant in the basic models, and thus included in the final model. The overall model was significant, $R^2 = .11$, $F(7,170) = 2.89$, $p < .01$, and there was again a main effect of child race/ethnicity with non-Hispanic white children having higher observed self-regulation than Hispanic or not white children, $\beta = .19$, $p = .01$. The main effect of 24-hour sleep was nonsignificant, $\beta = .17$, $p = .28$, but there was a significant sleep by Negative Control interaction, $\beta = -.28$, $p = .01$; similar to results with parent-reported weeknight sleep, in the context of maternal Negative Control, less parent-reported sleep was associated with relatively lower ability to disengage from a desired object. There was also a marginal main effect of Sensitivity and Guidance, $\beta = -.14$, $p = .07$, with higher maternal Sensitivity and Guidance associated with greater ability to disegnge from a desired object.

## Discussion

In this study of toddlers and their mothers from low-income families, we investigated whether child sleep contributed to differential effects of parenting on child self-regulation. We found that toddlers' sleep duration and parenting—specifically negative parenting (e.g., maternal Negative Affect, Negative Control)—interact to predict toddlers' ability to disengage from a desired object. That is, negative parenting was only associated with lower self-regulation in the context of shorter child sleep. However, when accounting for other parenting factors, positive parenting (e.g., maternal positive affect, sensitivity and guidance) was not directly associated with child self-regulation, nor did it interact with child sleep to predict child self-regulation. Our results also suggest that demographic characteristics need to be considered. We found that Hispanic or non-white toddlers were less able to disengage from a desired object than non-Hispanic white toddlers. Mean differences in self-regulation among racial and ethnic groups are not typically found in studies of preschoolers when controlling for income (reviewed in Li-Grining, 2012), and an earlier study of 1.5, 3.5, and 6 year old boys using the same self-regulation coding scheme found no differences in self-regulation between African American and white children (Gilliom et al., 2002). Similarly, when income-to-needs ratio was included in the final regression model in the current study,

the effect of child race/ethnicity was reduced to nonsignificant. Thus, it is possible that these apparent differences in self-regulation in racial and ethnic groups may be better accounted for by socioeconomic status.

This study adds to the literature in several ways. Findings provide important descriptive information regarding associations between parenting, self-regulation, and parent-reported nighttime child sleep in an understudied population of children. As well, results suggest that child sleep, a modifiable health risk behavior (reviewed in Mindell, Kuhn, Lewin, Meltzer, & Sadeh, 2006), may alter how parenting can shape child self-regulation during toddlerhood, a sensitive period that is characterized by rapid changes in both sleep and self-regulation. Thus, child sleep appears to be one factor that contributes to children's differential susceptibility to parenting, and bolstering sleep during the toddler years may be critical. Understanding and identifying ways to enhance positive developmental outcomes for children in low-income families is important, as this population tends to experience disproportionate difficulties across multiple areas of functioning, including both sleep (El-Sheikh et al., 2010) and self-regulation (Raver, Blair, & Willoughby, 2012). Results are discussed with regard to parenting and self-regulation and the role of healthy sleep in early childhood, and provide suggestions for future research that may help to unpack the mechanisms of association.

Sensitive and responsive caregiving is widely known to promote young children's development of self-regulation skills (Calkins & Johnson, 1998). Consistent with prior research, this current study detected a marginal positive association between maternal sensitivity and guidance and child self-regulation in this sample of low-income families. However, also consistent with extant work (Karreman et al., 2006) the effect was small and was no longer significant when negative parenting was included in the model. Parenting is a multidimensional construct, and previous findings suggest that negative and positive aspects of parenting are associated differentially with different child self-regulation outcomes during early childhood (Karreman et al., 2006). Although negative parenting may be more strongly associated with poor self-regulation concurrently, it is important to consider how both positive and negative parenting may shape not only early capacities but also outcomes over the course of development. Recent work has suggested, for example, that positive parenting during toddlerhood may be important for children's mental health and adaptive outcomes in middle childhood (reviewed in Gardner & Shaw, 2009; Kochanska, Boldt, Kim, Yoon, & Philibert, 2015) and even adulthood (Raby, Roisman, Fraley, & Simpson, 2015), and that positive parenting may buffer children at increased familial (Raby et al., 2015) or genetic risk (Kochanska et al., 2015). Longitudinal studies examining such associations, particularly with children growing up in low-income families who experience high levels of risk (Evans & English, 2002), are critical for understanding the role of both positive and negative parenting during early development may shape long-term outcomes for this population.

Overall, it may be that the potential effect of either positive or negative parenting on children's development is strongest in the context of other risk factors (Kochanska et al., 2015; Poehlmann et al., 2011; Raby et al., 2015). In line with this idea, the current study found that parenting—in this case, negative parenting—was associated with poorer child self-regulation only among children who reportedly obtained less nighttime sleep. Thus,

children who suffer from shorter nighttime sleep appear to be disproportionately more susceptible to the effects of negative parenting. Despite recently published guidelines for sleep across childhood (American Academy of Pediatrics, 2016; Paruthi et al., 2016), the scientific, mechanistic, and developmental understanding of what constitutes adequate sleep for young children is still debated (Lewin, Wolfson, Bixler, & Carskadon, 2016) and a question that requires more population-based and well-controlled experimental studies of links between sleep and developmental outcomes. In sum, our results suggest that at least in this low-income population, the co-occurrence of shorter parent-reported child sleep duration and negative parenting were associated with poorer child self-regulatory skills, as evidenced by their reduced ability to disengage from a desired object.

Sleep is increasingly regarded as fundamental to the development of neurocognitive and executive function skills that underlie self-regulation capacity (reviewed in Turnbull et al., 2013). Insufficient sleep has also been associated with poor child behavioral and academic outcomes (Cremone et al., 2018), and this is a likely pathway through which the association may become established. Self-regulation is concurrently and longitudinally related to numerous important child outcomes including mental health (reviewed in Masten & Coatsworth, 1998), positive adjustment (Blair & Diamond, 2008; Lengua, 2002), social competence (Diener & Kim, 2004; Spinrad et al., 2006), and school readiness (Eisenberg et al., 2010). Our results build upon this body of work by suggesting that shorter parent-reported child sleep duration could shape how parenting relates to self-regulation during toddlerhood. When children are underslept they may be more vulnerable to the effects of negative parenting, potentially setting in motion a developmental cascade with long-term consequences. It is also possible, however, that negative parenting could contribute to toddlers' poor sleep—the cross-sectional nature of the current report does not allow us to distinguish the nature of the association, which could be bidirectional. Children experiencing insufficient sleep are likely to have a more difficult time regulating their emotions and behavior, which can prove challenging for parents who may also be experiencing concurrent sleep loss due to family stress (Lange, Dáu, Goldblum, Alfano, & Smith, 2017) and their child's poor sleep health (Moore & Mindell, 2013). In this dynamic context, caregivers may respond with more negative parenting, resulting in parent-child dyads becoming entrenched in patterns of negative affect and behavior that impede the parent-child relationship from optimally supporting children's development. In this study we did not find an association between toddlers' nighttime sleep duration and their negative affect during the self-regulation challenge task ($r = -.09$, $p = .24$), but it remains possible that children obtaining insufficient sleep have more difficulty with emotion regulation more broadly, contributing to negative cycles of parent-child interaction.

Finally, given that sleep is a modifiable health risk behavior that relates to self-regulation, interventions to improve sleep are likely to have high impact on young children's functioning across a broad range of domains. In fact, several sleep intervention trials have been conducted with infant and young child populations, with positive effects on child sleep, as well as child and maternal mental health (reviewed in Moore & Mindell, 2013). Several other recent studies have similarly identified child sleep as a protective factor in early childhood development. For example, nighttime sleep enhances the relation between maternal sensitivity and positive development in infants (Bernier et al., 2014; Bordeleau et

al., 2012). Additionally, when children are exposed to risk factors such as parental psychological control, higher sleep efficiency was protective against child anxiety symptoms (El-Sheikh, Hinnant, Kelly, & Erath, 2010). It is possible that improved sleep might facilitate children's ability to benefit from self-regulation prevention and intervention programs; this possibility will need to be investigated in future work. Collectively, our findings and those of others suggest that considering child sleep as a potential moderator of other contextual effects on multidimensional child outcomes is an important research direction.

### Strengths, Limitations and Future Directions.

A major strength of this study is its use of observational methods to assess both child self-regulation and parent behaviors in a naturalistic context (i.e., family homes) as measured by engagement in tasks that are common in their everyday life (i.e., free play, waiting for a desired food item). Nonetheless, several limitations should be noted. First, child sleep was assessed through parent report, which is an estimate of time in bed (bedtime to wake time) and can overestimate sleep duration (Kushnir & Sadeh, 2013) and does not take into account variability in bed time and wake time over multiple days. Future work using objective sleep assessment (e.g., actigraphy) that provides increased reliability via continuous measurement of sleep parameters in the natural environment is needed to address this limitation. Second, mothers only reported on one dimension of sleep health—sleep duration—and not other aspects sleep such as timing, quality, fragmentation, or sleep-related parenting practices. We did inquire about napping in this study, but as our assessments were not obtained through sleep diaries or actigraphy, we were also unable to capture the day-to-day variability in nap timing and duration that is common in toddlers. However, our results using parent-reported nighttime sleep and 24-hour sleep (nighttime plus nap) duration estimates were similar. Future studies using more time-sensitive measures are needed to tease apart the question of daytime versus nighttime child sleep duration as a moderator of parent-child interactions. Third, the cross-sectional nature of this study means that causality cannot be inferred, and our findings are likely bidirectional. As shown in previous studies, insufficient sleep in young children is associated with not only sleep disruption in parents, but also poor parental mood and parent-child relationships, bonding, and attachment (reveiwed in Moore & Mindell, 2013). Thus, it is conceivable that negative parenting was partly evoked by underslept toddlers who had difficulty regulating themselves. Lastly, this study included all low-income families, which is a benefit in terms of better understanding this population that is at higher risk for difficulties in multiple domains; however, socioeconomic status did not prove to be a significant predictor in our model and we were not able to compare our sample to a higher-income sample. Future work with more diverse samples could articulate the potential role of socioeconomic status in shaping these processes.

### Implications.

In sum, this study identified toddler sleep duration as a modifiable protective factor that relates to early self-regulation skills. In this sample, young children only showed poor self-regulation in the context of negative parenting when they attained less sleep. Thus, our data suggest that interventions to promote longer sleep duration for young children are indicated. Further research to understand the mechanistic associations among child sleep, parenting,

and self-regulation will enhance development of strategies for optimal sleep health in young children. Encouraging longer opportunities for sleep, especially in low-income higher-risk populations, may enhance children's ability to thrive in the context of other stressors.

## Acknowledgements:

This research was supported by grants T32 HD 079350 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) awarded to J. Lumeng, R01 HD 069179 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) awarded to A. Miller and J. Lumeng, and R21 MH110765 from the National Institute of Mental Health (NIMH) to M. LeBourgeois. The content of this article is solely the responsibility of the authors and does not necessarily represent the official views of the NICHD or NIMH. We thank the families for their participation in our research and to our research team at the University of Michigan for their assistance with data collection and coding.

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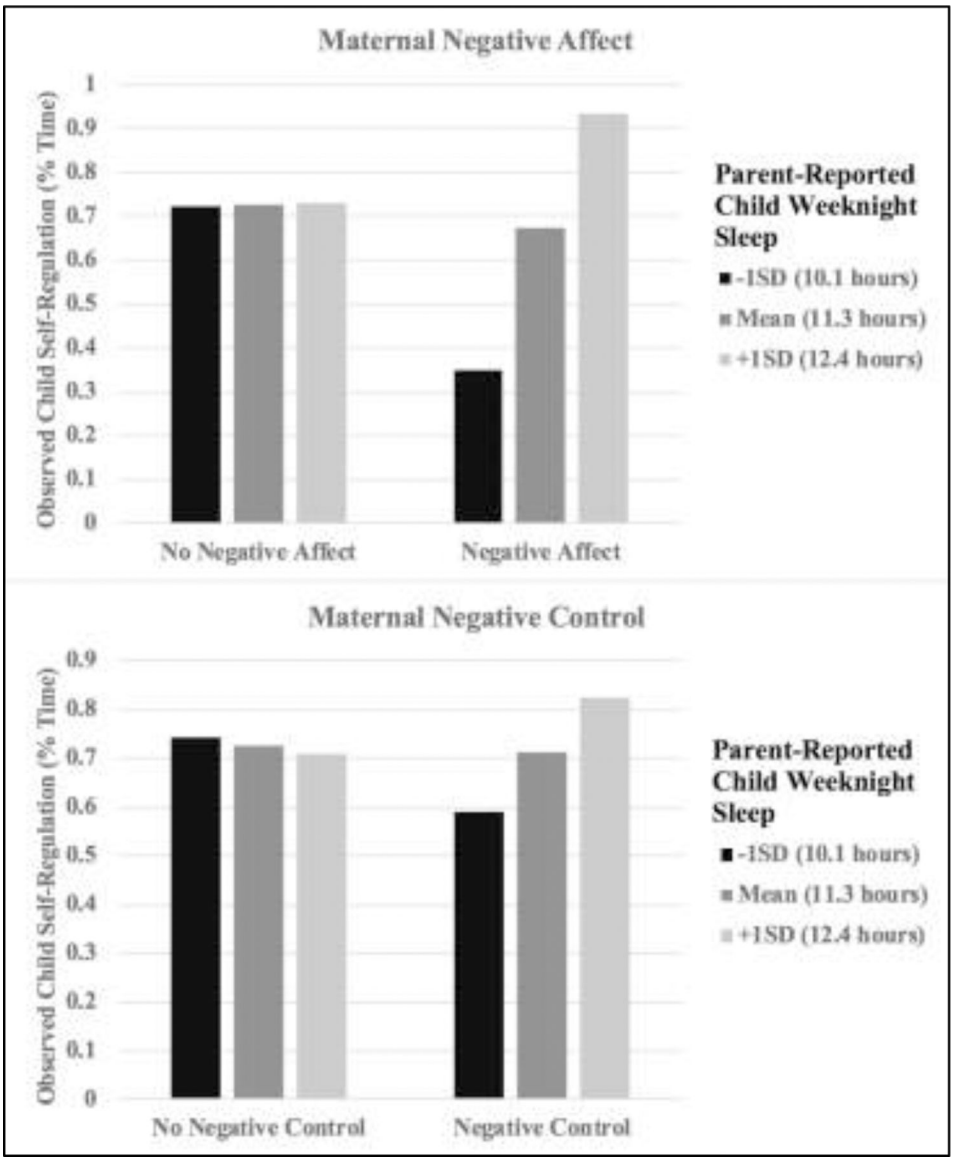


**Figure 1:**

Association between maternal affect and behavior and observed child self-regulation in the context of varying child weeknight sleep duration.

*Note*. This graph was generated from a regression model examining the effects of maternal Negative Affect and Negative Control, child sleep duration, and their interactions on child self-regulation, controlling for maternal education, child race/ethnicity, and maternal Sensitivity & Guidance (see Table 3). In the Negative Affect panel, the mean values were entered for maternal education, child race/ethnicity, maternal Sensitivity & Guidance, and maternal Negative Control; in the Negative Control panel, mean values were entered for maternal education, child race/ethnicity, maternal Sensitivity & Guidance, and maternal Negative Affect. The data points depict the predicted child self-regulation value when a given parenting behavior (Negative Affect, Negative Control) was present (1) or absent (0), and child sleep duration was low (−1 SD), at the mean, or high (+1 SD). The Negative

Affect x child sleep duration interaction and Negative Control x child sleep duration interactions were both significant, reflecting significant differences in the slopes of the regression lines between the reference category and both Negative Affect and Negative Control. Both Negative Affect and Negative Control are associated with poorer child self-regulation only under the conditions of low child sleep duration.

**Table 1:**

Characteristics of the sample ($N = 171$).

| | Mean (SD) or *N* (%) |
|---|---|
| **Child** | |
| Sex | |
| Male | 88 (51.5%) |
| Female | 83 (48.5%) |
| Age (months) | 22.94 (2.76) |
| Race/ethnicity | |
| Non-Hispanic white | 80 (46.8%) |
| Hispanic or not white | 91 (53.2%) |
| **Maternal** | |
| Age (years) | 27.11 (5.25) |
| Family structure | |
| Unmarried mother | 85 (56.3%) |
| Married mother | 66 (43.7%) |
| Education | |
| High school diploma/GED or less | 64 (37.4%) |
| More than high school | 107 (62.6%) |
| Income to needs ratio (midpoint) | 0.99 (0.59) |

**Table 2.**

Descriptive statistics and correlations of child sleep duration, observed child self-regulation, and observed maternal affect and behavior ($N = 171$).

| | 1 | 2 | 3 | 4 | 5 | M (SD), Min - Max or N (% above median) |
|---|---|---|---|---|---|---|
| 1. Mother-Reported Child Weekday Nighttime Sleep (hours) | | | | | | 11.3 (1.1), 7.0 – 14.0 |
| 2. Child Self-Regulation[a] | .108 | | | | | 0.69 (0.31), 0 – 1 |
| 3. Maternal Positive Affect | .114 | −.017 | | | | 91 (53.2%) |
| 4. Maternal Negative Affect | −.006 | −.074 | .007 | | | 11 (6.4%) |
| 5. Maternal Negative Control | .008 | −.021 | .128$^{+}$ | .150$^{*}$ | | 49 (28.7%) |
| 6. Maternal Sensitivity & Guidance | .168$^{*}$ | .144$^{+}$ | .184$^{*}$ | −.027 | −.111 | 102 (59.6%) |

$^{+}p < .10$

$^{*}p < .05$

[a]proportion of time; higher score = better self-regulation

*Note:* Maternal affect and behavior variables are dichotomous (above (1) vs. below (0) median; for Negative Affect and Negative Control, this corresponds to presence (1) vs. absence (0) of the affect or behavior).

**Table 3.**

Regression Analyses: Observed parenting and child sleep duration as predictors of observed child self-regulation ($N = 171$).

| | Child Self-Regulation[a] | | | |
|---|---|---|---|---|
| | $R^2$ | F | β | *t* |
| **Model** | .13 | 3.02** | | |
| Maternal Education | | | −.09 | −1.19 |
| Child Race/Ethnicity | | | .18 | 2.29* |
| Child Weekday Nighttime Sleep (hours) | | | .12 | 1.28 |
| Mean Maternal Negative Affect | | | .06 | 0.77 |
| Mean Maternal Negative Control | | | .03 | 0.44 |
| Mean Maternal Sensitivity & Guidance | | | −.11 | −1.40 |
| Child Hours of Sleep x Mean Maternal Negative Affect | | | −.16 | −2.12* |
| Child Hours of Sleep x Mean Maternal Negative Control | | | −.28 | −2.93** |

*$p < .05$

**$p < .01$.

[a]Child self-regulation outcome is log transformed (*ln(2-y)*); βs being negative for positive associations and positive for negative associations