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Sleep in young children with asthma and their parents

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Abstract

Sleep problems are common in healthy young children, as well as in older children and adolescents with asthma; yet little is known about the sleep patterns and sleep issues of young children with asthma. Further, when young children have sleep disruptions, parental sleep is also typically disrupted. The purpose of this study was to characterize sleep in young children (one to four years) with and without asthma and their parents. Parents of young children ($n = 364$) from the general community completed measures of sleep patterns and sleep issues in their children and in themselves. Compared to children with well-controlled asthma or no asthma, children with poorly controlled asthma had poorer sleep patterns, more difficulty falling asleep, and more sleep disruptions (i.e. restless sleep, frequent apneas and gasping during sleep, and frequent sleep terrors). Parents of children with poorly controlled asthma indicated their own sleep was regularly disrupted, and they had frequent night awakenings due to attending to, and stress caused by, their child's health needs. Children with poorly controlled asthma and their parents demonstrated significant sleep issues. Clinical implications for working with young children with asthma and their parents are discussed.

Keywords

Asthma; parent sleep; preschoolers; sleep duration; sleep patterns; toddlers

Introduction

Sleep problems are common in youth with asthma (Daniel et al., 2012; Meltzer et al., 2014), including prolonged sleep onset latency, frequent night wakings, and daytime sleepiness, even when asthma symptoms are well controlled (Chugh et al., 2006; Horner et al. 2011; Sadeh et al., 1998; Stores et al., 1998; Yuksel et al., 2007). Yet only one study has examined sleep patterns in young children, with no significant differences found between young children with and without asthma (Tirosh et al., 1993). However, this study neither examined differences between children with well-controlled and poorly controlled asthma nor considered the impact of asthma and child sleep disruptions on parental sleep.

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Around 20–30% of healthy, typically developing children experience sleep disturbances (Mindell et al., 2006; Sadeh et al., 2009), resulting in behavior, emotional, and cognitive problems (Beebe, 2011). As asthma symptoms and disease management have been shown to contribute to sleep disruptions in older children, this is also likely true for younger children. Further, sleep may mediate the relationship between asthma and reported outcomes, including behavior problems (Blackman and Conaway, 2012; Blackman and Gurka, 2007; McQuaid et al., 2001).

While sleep is disrupted by nocturnal asthma symptoms, there is evidence that disrupted or deficient sleep leads to increased daytime asthma symptoms (Hanson and Chen, 2008; Meltzer et al., 2015), suggesting that sleep may play a mechanistic role in asthma expression. As empirically validated behavioral treatments are highly efficacious in treating sleep problems in young children (Mindell et al., 2006; Meltzer and Mindell, 2014), it is essential to gain a better understanding of the relationship between sleep and asthma in young children.

When young children have difficulty sleeping, their parents also have difficulty sleeping. Research has demonstrated that parents of children with chronic illnesses experience significant disruption to sleep and daytime functioning, resulting in increased maternal depressive symptoms and missed days of work (Diette et al., 2000; Meltzer and Mindell, 2006). Further, maternal depression has the potential to increase child asthma morbidity and healthcare utilization (Pak and Allen, 2012). As parents are required to be medical providers within their own home, it is important to understand the sleep disruptions experienced by parents of young children with asthma, allowing for an intervention point to improve parent mood and family functioning.

The purpose of this study was to compare sleep in young children with asthma (both poorly controlled and well-controlled) and without asthma and their parents. We hypothesized that compared to young children without asthma, young children with asthma would have poorer sleep patterns (i.e. later bedtime, more nighttime awakenings, shorter total sleep time) and more sleep issues, including negative sleep onset associations (i.e. parental presence at bedtime) and sleep disturbances, with differences more pronounced for children with poorly controlled asthma. Finally, we expected parents of young children with asthma would have more sleep disturbances related to their child's health compared to parents of young children without asthma, with differences more pronounced for parents of young children with poorly controlled asthma.

Methods

Participants

Participants were 364 parents of young children (one to four years) who completed an online survey about sleeping patterns in young children and their parents. Participants were recruited through a national online research panel (ZoomPanel; SurveyMonkey, Palo Alto, CA, USA) that included over 3 million members in the United States. While the overall panel members are representative of the US Census data, there is no guarantee that sample respondents will be nationally representative. To reach preestablished quotas that ensured an

even distribution for asthma (total $n = 200$) versus no asthma (total $n = 160$), as well as age (one to four years: $n = 50$ per age year for asthma, $n = 40$ per age year for no asthma) and gender (male and female: $n = 25$ per age year for asthma, $n = 20$ per age year for no asthma), 1300 members responded to an invitation to view the survey in the summer of 2012. We purposely over recruited youth with asthma to reach our preestablished quotas. No additional inclusion/exclusion criteria were utilized. Online survey panels have been used in health-related studies (Cella et al., 2010; Flood et al., 2010, 2011; Forrest et al., 2016; Long, 2007) and have been shown to be reliable and valid compared to household surveys (Bethell et al., 2004; Klein et al., 2007). This study was approved by the institutional review board, and all participants provided informed consent.

Measures

Parent report of asthma.—To determine whether a young child had asthma, parents were asked

Has your child (a) ever been diagnosed with asthma or reactive airway disease by a health care provider and/or (b) had multiple episodes of wheezing over the past 12 months and/or (c) been prescribed a rescue or quick-relief medication (Albuterol, Ventolin, Proventil, Maxair, proAIR, Xopenex, or Primatene Mist) for breathing problems (wheezing, coughing, shortness of breath)?

A positive response resulted in a child being assigned to the asthma group.

Test for Respiratory and Asthma Control in Kids.—The Test for Respiratory and Asthma Control in Kids (TRACK) is a 5-item parent-completed measure of respiratory control in preschool-aged children with asthma symptoms (Murphy et al., 2009). This measure demonstrates good discriminant validity and reliability. Scores range from 0 to 100, and scores below 80 are suggestive of poorly controlled asthma (Murphy et al., 2009).

Brief Infant Sleep Questionnaire.—The Brief Infant Sleep Questionnaire (BISQ) is a brief parent-report questionnaire that includes questions about sleep patterns and sleep-related behaviors in young children designed to be administered online. The BISQ has been shown to be valid and reliable compared to actigraphy and sleep logs (Sadeh, 2004) and has been used in both large international studies of sleep in young children (Sadeh et al., 2009), as well as an intervention outcome measure for sleep in young children (Mindell et al., 2011a, 2011b).

Patient-Reported Outcomes Measurement Information System® Sleep Disturbance Item Bank (Short Form).—The Patient-Reported Outcomes Measurement Information System® (PROMIS®) Sleep Disturbance Item Bank is an 8-item self-report measure of sleep disturbances, sleep quality, and satisfaction with sleep. This measure has been shown to be valid and reliable in multiple populations of adults with and without sleep disorders when administered online (Buysse et al., 2010; Cella et al., 2010).

Additional parent sleep items.—Three additional items qualitatively measured reasons for parental sleep disruptions (Meltzer and Booster, 2016; Meltzer and Mindell, 2006),

focusing on the frequency of sleep disruptions in the past seven days due to (1) attending to the child's health needs, (2) stress related to the child's health needs, and (3) stress not related to the child's health needs.

Data analysis

Descriptive statistics were used to characterize the data using means, percentages, and standard deviations. One-way analysis of variance was used to compare group differences for continuous data (with the F statistic and η^2 effect size reported). Post hoc analyses were performed to examine differences between the three groups (poorly controlled asthma, well-controlled asthma, no asthma). Chi-square analyses (χ^2) were used for categorical variables, with Cramer's V effect size reported. All analyses were conducted using IBM SPSS version 21, using a significance level of $p < .05$ for all analyses.

Results

Participants

Parent report was initially used to designate asthma versus no asthma; however, the TRACK scores were used to further refine participant groups as follows: poorly controlled asthma ($n = 79$), well-controlled asthma ($n = 121$), and no asthma ($n = 164$). Demographic data for the three groups are found in Table 1. Parents of children with poorly controlled asthma had, on average, a greater number of years of education than parents of children without asthma. Although statistically significant, the differences were small. There were no other statistically significant demographic differences found between children with and without asthma.

Sleep patterns

Compared to both children with well-controlled or no asthma, children with poorly controlled asthma had a significantly later bedtime and longer sleep onset latency (Table 2). Compared to young children without asthma, young children with both poorly controlled and well-controlled asthma had more night wakings and longer night wakings. Children with no asthma had a longer stretch of nocturnal sleep by more than one hour compared to children with poorly controlled asthma. Total nighttime sleep duration and wake times did not differ between groups. Young children with poorly controlled asthma napped more frequently than children with well controlled or no asthma but the duration of daytime sleep was not significantly different between groups. Overall, parents of young children with asthma rated their child's sleep quality as poorer than children without asthma.

Sleep issues

More parents of children with asthma reported their children had sleep problems compared to children without asthma (Table 3). Similarly, children with asthma were more likely to have a sleep onset association that included parental presence (e.g. being rocked, parent lying next to child).

For all sleep disturbances, significant differences were found between groups, with the greatest occurrence of sleep issues in children with poorly controlled asthma, followed by

children with well-controlled asthma. This includes parent reported difficulties falling asleep (3 times per week), restless sleep, apneas, gasping during sleep, and sleep terrors.

Parent sleep disturbances

Compared to parents of young children without asthma, parents of children with poorly controlled asthma reported that in general their own sleep was more disturbed (Table 4). In addition, parents of young children with asthma had more frequent night awakenings due to attending to their child's health needs and stress related to their child's health. However, there were no group differences in terms of parents' sleep disruption due to general stress unrelated to their child's health needs (e.g. bills, work).

Discussion

As expected, this study found that young children with poorly controlled asthma had later bedtimes, longer sleep onset latency, and with more frequent and longer nocturnal awakenings than young children with well-controlled or no asthma. Significant differences were also found for the frequency and duration of nocturnal wakings between children with well-controlled asthma and children with no asthma. Together these findings highlight sleep disruptions in young children with asthma, most notable in children with poorly controlled asthma, but also when asthma is well-controlled, similar to previous findings in older children and adolescents (e.g. Daniel et al., 2012; Horner et al., 2011; Meltzer et al., 2014).

This study also found that young children with asthma had more sleep problems than young children without asthma, including difficulties initiating sleep, restless sleep, and symptoms of sleep disordered breathing. This last finding is especially important as asthma and sleep apnea are associated in older children and adolescents (Goldstein et al., 2015; Kheirandish-Gozal et al., 2011; Ross et al., 2012). Frequent sleep terrors were reported for almost half of the young children with poorly controlled asthma and 20% of children with well-controlled asthma, a finding similar to previous work showing an association between increased sleep terrors and more severe nocturnal symptoms of asthma (Fagnano et al., 2011). The trigger for sleep terrors is poor quality or insufficient sleep, thus sleep disruptions in young children with asthma likely contribute to more sleep terrors. Clinically some families report more sleep terrors prior to an asthma exacerbation or with poorly controlled asthma, even in the absence of daytime asthma symptoms. Thus, frequent sleep terrors should be further queried in order to determine if the events are related to the child's asthma.

Parental presence at bedtime was more common among parents of children with asthma. This may be a result of parents wanting to monitor their child's breathing overnight. Although it is generally desirable for a child to learn to fall asleep independently, it is difficult to tell a worried parent to not monitor their child's sleep. However, some families find limit setting challenging when a child has a chronic illness (Ievers et al., 1994; Morawska et al., 2008). For these families, it would be helpful to provide parents with strategies to both manage daytime behaviors (e.g., Garbutt et al., 2015), as well as teach children to fall asleep independently (e.g., Meltzer, 2010).

Not surprisingly, compared to parents of young children without asthma, twice as many parents of children with well-controlled asthma and more than four times as many parents of children with poorly controlled asthma reported regular sleep disruptions due to nocturnal caregiving. Further, 13% of parents of children with well-controlled asthma and 30% of parents of with poorly controlled asthma reported sleep disruptions due to stress related to their child's health. This is similar to caregivers of children with other chronic illnesses (Meltzer and Mindell, 2006), including older children with asthma (Cheezum et al., 2013; Meltzer and Booster, 2016). Yet brief interventions have been shown to improve sleep in family caregivers of adult patients (McCurry et al., 1998; Secker and Brown, 2005).

Future research is needed to address the methodological limitations of this study, including potential sample bias introduced by using an internet panel and reliance on parental report rather than objective measures of sleep (e.g. actigraphy, polysomnography). Although we did not find demographic differences between groups, minorities were underrepresented, thus results may not be generalizable. Finally, the cross-sectional study design precludes us from drawing conclusions about a directional relationship between asthma and sleep concerns in young children.

However, the characterization of sleep in young children with and without asthma and their parents is a novel contribution to the literature. These findings are particularly important because previous longitudinal research has indicated that poorer asthma control status is associated with lower asthma health-related quality of life (Li et al., 2016). Findings are also relevant for clinicians working with this population, highlighting the importance of optimizing asthma treatment in young children. In addition, clinicians should understand that parents of young children with asthma are likely sleep deprived, which may contribute to their own difficulties with emotion regulation and adherence to prescribed treatment regimens. Finally, while nocturnal caregiving is an unavoidable part of asthma, many parents reported sleep disruptions due to stress about their child's health. Providing parents with tools to manage stress and anxiety during the night may facilitate improved sleep quality.

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Table 1.

Demographic characteristics of study sample.

	Poorly controlled asthma ($N^a = 79$)	Well-controlled asthma ($N = 121$)	No asthma ($N = 164$)	p	Effect size b
	Percent (number)	Percent (number)	Percent (number)		
Child age				.974	.042
12–23 months	27.8 (22)	23.1 (28)	25.0(41)		
24–35 months	26.6 (21)	24.0 (29)	25.0(41)		
36–47 months	24.1 (19)	25.6 (31)	24.4 (40)		
48–59 months	21.5 (17)	27.3 (33)	25.6 (42)		
Male child	49.4 (39)	50.4 (61)	49.4(81)	.983	.010
Child race				.156	.142
White	83.5 (66)	79.2 (95)	69.2 (110)		
Black	6.3 (5)	10.8 (13)	11.9 (19)		
Asian	6.3 (5)	4.2 (5)	6.3 (10)		
Native American	.0 (0)	.8 (1)	1.9 (3)		
Other	3.8 (3)	1.7(2)	13 (8.2)		
Declined	.0 (0)	3.3 (4)	2.5 (4)		
Hispanic	8.9 (7)	8.3 (10)	11.9 (19)	.451	.071
Parent age (years)				.946	.062
18–24	2.5 (2)	7.4 (9)	6.1 (10)		
25–34	43.0 (34)	41.3 (50)	40.9 (67)		
35–44	38.0 (30)	33.9 (41)	34.1 (56)		
45–54	8.9 (7)	10.7 (13)	11.0(18)		
55+	7.6 (6)	6.6 (8)	7.9(13)		
Relation to child				.099	.121
Mother	45.6 (36)	57.0 (69)	60.4 (99)		
Father	40.5 (32)	29.8 (36)	23.8 (39)		
Grandparent	13.9 (11)	9.9 (12)	12.2 (20)		
Other	.0 (0)	3.3 (4)	3.7 (6)		
Region of United States				.400	.092
Northeast	27.8 (22)	24.8 (30)	19.5 (32)		
South	29.1 (23)	37.2 (45)	40.2 (66)		
Midwest	19.0 (15)	23.1 (28)	22.0 (36)		
West	24.1 (19)	14.9 (18)	18.3 (30)		
Income (USD)				.709	.121
Under 15,000	6.3 (5)	9.1 (11)	6.7(11)		
15–24,999	8.9 (7)	7.4 (9)	8.5 (14)		
25–34,999	10.1 (8)	13.2 (16)	15.2 (25)		
35–49,999	8.9 (7)	7.4 (9)	14.0(23)		

	Poorly controlled asthma ($N^a = 79$)	Well-controlled asthma ($N = 121$)	No asthma ($N = 164$)		
	Percent (number)	Percent (number)	Percent (number)	p	Effect size ^b
50–74,999	22.8 (18)	24.0 (29)	21.3 (35)		
75–99,999	19.0 (15)	13.2 (16)	14.0 (23)		
More than 100,000	21.5 (17)	17.4 (21)	14.6 (24)		
Declined	2.5 (2)	8.3 (10)	5.5 (9)		
Years of education ^{c,d}	15.5 (2.6)	14.8 (2.3)	14.7 (2.4)	.023	.021

^a N represents sample size.

^bReported effect size is η^2 for continuous variables (small = .02; medium = .13; large = .26) and Cramer's V for categorical variables (small = .07; medium = .21; large = .35).

^cData for years of education presented as mean (standard deviation).

^dPost hoc analysis indicates poorly controlled asthma significantly different than no asthma.

Table 2.

Sleep patterns in young children with and without asthma.

	Poorly controlled asthma ($N^a = 79$)	Well-controlled asthma ($N = 121$)	No asthma ($N = 164$)			
	Mean (standard deviation)	Mean (standard deviation)	Mean (standard deviation)	Test statistic	p	Effect size ^b
Bedtime	9:12 (1:14)	8:46 (1:06)	8:42 (0:56)	$F(2,361) = 6.39$	.002 ^c	.034
Sleep onset latency (minutes)	28.5 (17.6)	21.4 (13.1)	22.5 (15.4)	$F(2,361) = 5.77$	.003 ^c	.031
Night wakings, frequency	2.0 (1.5)	1.0 (1.2)	.64 (1.0)	$F(2,361) = 35.60$	<.001 ^{c,d}	.165
Night wakings, duration (minutes)	60.6 (59.2)	25.1 (34.7)	11.7 (21.2)	$F(2,361) = 46.97$	<.001 ^{c,d}	.206
Longest stretch of sleep (hour)	6.8 (2.9)	7.1 (3.0)	7.9 (2.9)	$F(2,361) = 4.20$	.016 ^e	.023
Total sleep time at night (hour)	9.0 (1.8)	9.0 (1.6)	9.2 (1.6)	$F(2,361) = .92$	.401	.005
Wake time	7:37 (1:30)	7:27 (1:12)	7:32 (1:20)	$F(2,361) = .39$	.681	.002
Number of daily naps	1.4 (1.0)	1.1 (.9)	.9 (.6)	$F(2,361) = 12.05$	<.001 ^c	.063
Duration of daytime sleep (hour)	1.8 (1.1)	1.6 (1.1)	1.5 (1.0)	$F(2,361) = 2.02$	.112	.012
Sleep quality ^f				$\chi^2(6) = 27.07$	<.001	.193
Very well	11.4 (9)	35.5 (43)	39.0 (64)			
Well	45.6 (36)	33.9 (41)	40.9 (67)			
Fairly well	31.6 (25)	25.6 (31)	16.5 (27)			
Fairly poorly/poorly	11.4 (9)	5.0 (6)	3.7 (6)			

^a N represents sample size.^b Reported effect size is η^2 for continuous variables (small = .02; medium = .13; large = .26) and Cramer's V for categorical variables (small = .07; medium = .21; large = .35).^c Post hoc analysis indicates poorly controlled asthma significantly different than both well-controlled asthma and no asthma.^d Post hoc analysis indicates well-controlled asthma significantly different than no asthma.^e Post hoc analysis indicates poorly controlled asthma significantly different than no asthma.^f Data for sleep quality presented as percent (number).

Table 3.

Sleep issues in young children with and without asthma.

	Poorly controlled asthma ($N^a = 79$)	Well-controlled asthma ($N = 121$)	No asthma ($N = 164$)			Effect size (Cramer's V^b)
	Percent (number)	Percent (number)	Percent (number)	Test statistic	p	
Child has a sleep problem	51.9 (41)	24.8 (30)	12.2 (20)	$\chi^2(2) = 44.83$	<.001	.351
Parent sleep onset association	67.1 (53)	48.8 (59)	39.0 (64)	$\chi^2(2) = 16.83$	<.001	.215
Difficulty falling asleep 3 times/week	64.5 (49)	34.8 (40)	21.3 (30)	$\chi^2(2) = 40.16$	<.001	.348
Frequently has restless sleep	83.5 (66)	50.4 (61)	30.5 (50)	$\chi^2(4) = 60.79$	<.001	.289
Frequently stops breathing during sleep	50.6 (40)	19.0 (23)	1.2 (2)	$\chi^2(4) = 122.40$	<.001	.410
Frequently snorts/gaps during sleep	57.0 (45)	25.6 (31)	6.7 (11)	$\chi^2(4) = 112.27$	<.001	.393
Frequently has sleep terrors	48.1 (38)	19.8 (24)	2.4 (4)	$\chi^2(4) = 97.23$	<.001	.365

^a N represents sample size.^b Cramer's V effect size: small = .07; medium = .21; large = .35.

Table 4.

Sleep in parents of young children with and without asthma.

	Poorly controlled asthma ($N^a = 79$)	Well-controlled asthma ($N = 121$)	No asthma ($N = 164$)			
	Percent (number)	Percent (number)	Percent (number)	Test statistic	p	Effect size ^b
PROMIS sleep disturbance T-score ^a	60.5 (7.3)	58.2 (8.8)	56.3 (9.1)	$F(2,361) = 6.38$	.002 ^c	.034
Parent sleep usually/ always disrupted in past 7 days due to						
Attending to child's health needs	38.0 (30)	20.7 (25)	9.1 (15)	$\chi^2(2) = 38.52$	<.001	.290
Stress related to child's health	30.4 (24)	13.2 (16)	4.3 (7)	$\chi^2(2) = 57.52$	<.001	.384
Stress unrelated to child's health	27.8 (22)	31.4 (38)	23.8 (39)	$\chi^2(2) = 4.95$	.111	.110

^a N represents sample size.^bReported effect size is η^2 for continuous variables (small = .02; medium = .13; large = .26) and Cramer's V for categorical variables (small = .07; medium = .21; large = .35).^cPost hoc analysis indicates poorly controlled asthma significantly different than no asthma.