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Sleep and Asthma Outcomes in Urban Children: Does Atopic Dermatitis Increase Risk?

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Urban minority children with asthma are at increased risk for disruptions in sleep and sleep loss due to socio-contextual stressors (poverty, stressors of urban living) and challenges related to following complex asthma treatment regimens.[1-2] Atopic dermatitis (AD) is frequently comorbid in children with asthma and can increase the risk for poor quality sleep, including difficulty falling asleep, nighttime awakenings, time awake after sleep onset, difficulty awakening in the morning, and daytime sleepiness; sleep disturbance is reported in 47% to 80% of children with AD.[3-9] Thus, AD and asthma can have negative consequences on children's morbidity, sleep, and daily functioning.[1-2,10] Our study sought to assess whether differences in sleep exist between urban children with asthma, urban children with asthma plus AD, and urban healthy controls (with neither asthma or AD). We also examined differences in asthma outcomes and associations between asthma and sleep outcomes in children with asthma plus AD and asthma alone.

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Data are from the Nocturnal Asthma and Performance in School study ("NAPS"), a study of asthma and sleep in a sample of urban, ethnically diverse children (ages 7-9) with persistent asthma. Data from a total of 371 children were reviewed: 206 children with persistent asthma only, 35 children with asthma plus AD and 130 healthy controls (Table 1).

Children with caregiver-reported physician diagnosis of asthma or asthma symptoms in the previous 12 months were included; each child had a current prescription for an asthma controller medication *or* caregiver-reported recurrent daytime or nighttime symptoms, activity limitation, rescue medication use, *or* 2 or more oral steroid bursts in the prior 12 months. Diagnosis of persistent asthma was confirmed by study clinician using EPR-3 guidelines (https://www.nhlbi.nih.gov/sites/default/files/media/docs/asthsumm.pdf-accessed5/5/2020). The diagnosis of concurrent AD was obtained via physician query or extrapolated from the use of topical CS therapy from the medication list. Healthy controls needed to be free of asthma, AD, and any chronic medical condition. Children were excluded from the study if they were on stimulant medications for attention deficit/ hyperactivity disorder, had moderate to severe cognitive impairment, another pulmonary condition, or a sleep disorder.

Data were collected during the fall and early winter period of each study year. Asthma outcomes included asthma-related lung function-assessed from twice daily measurements of FEV1 (Forced Expiratory Volume) via a handheld device (Jaeger AM2+; ERT; Yorba Linda, CA) over a four-week period, and the Asthma Control Test (ACT) in children with asthma. Sleep outcomes were measured objectively using actigraphy via home monitoring (Actiwatch 2- Philips Respironics, Pittsburgh, PA, USA) over the same four-week period, recording sleep efficiency (the % time asleep/total time in bed for the night), the mean number of awakenings of at least three minutes, and sleep duration (total time between evening sleep onset and morning waking).

Using a series of generalized linear models, we assessed whether there were differences between groups (asthma plus AD vs asthma alone vs health controls) in (1) sleep outcomes, (2) asthma outcomes (asthma plus AD vs asthma alone) and (3) sleep outcomes stratified by ethnicity. Models were specified to allow for all two-way comparisons between groups. We additionally assessed associations between sleep and asthma by group (asthma plus AD, asthma alone) using a similar modeling approach.

There were significant group differences in sleep efficiency ($F=5.82$, $p=.003$) and number of nighttime awakenings between children with asthma alone, asthma plus AD, and healthy controls ($F=3.55$, $p=.03$). Children with asthma plus AD had lower efficiency ($b=-2.07$, $SE=.68$, $p=.002$) and greater number of awakenings ($b=1.14$, $SE=.45$, $p=.01$) vs. healthy controls. There were no significant differences in sleep duration between children with asthma alone, asthma plus AD, and healthy controls, p's>.05.

In children with asthma plus AD, Latino children had shorter sleep duration on average compared to their African American (AA) and Non-Latino White (NLW) counterparts ($F=8.31$, $p=.001$); however, no significant ethnic differences in efficiency or awakenings were observed by health status in this group. In children with asthma alone, AA children had

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lower sleep efficiency (F=3.21, p=0.04) than Latino and NLW children, and Latino and AA children had shorter sleep duration (F=7.73, p=0.01) than NLW children. There were no significant differences in sleep duration, sleep efficiency or number of awakenings in healthy urban children by ethnic/racial group.

Overall, there were no differences in lung function (FEV1, p=0.65), poorly (ACT score ≤ 19) or well controlled asthma (ACT score ≥20) (p=0.48) in children with asthma alone versus those with asthma plus AD.

For children with asthma plus AD, a greater number of awakenings was related to a lower mean FEV1 (b=−1.36, SE=.67, p=.03). In children with asthma alone, more optimal sleep efficiency was related to better asthma control (b=.21, SE=.08, p=0.03).

Results from this well-characterized sample of urban children showed that urban children with asthma and AD may be at higher risk for poorer sleep outcomes. Specifically, overall quality of sleep appeared to be poorer and there were greater nighttime awakenings in this group. Ethnic and racial disparities in sleep outcomes were observed in children with asthma plus AD as well as children with asthma alone compared to their urban healthy peers. Latino and AA children with asthma alone and Latino children with asthma plus AD appeared to be at greater risk for sleep loss and poorer quality sleep than their NLW peers. Interestingly, AD did not appear to increase risk for poorer asthma outcomes in children. More research needs to be completed with larger urban samples of children with asthma plus AD and asthma alone to confirm these findings. Interventions that consider specific challenges that may negatively impact sleep outcomes in urban children with asthma and AD are needed, particularly in those of Latino and AA descent.

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Abbreviations/Acronyms:

(AA)	African American
(ACT)	Asthma Control Test
(AD)	atopic dermatitis
(FEV1)	Forced Expiratory Volume
(L)	Latino
(NLW)	Non-Latino White

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Table 1

Participant characteristics: Full sample and by group

	Sample, N=371	Asthma+AD, N=35	Asthma Alone, N=206	Healthy Controls, N=130
Ethnicity *				
Latino	167(45%)	15(43%)	108(52%)	44(39%)
AA	125(34%)	16(46%)	63(31%)	46(35%)
NLW	79(21%)	4(11%)	35(17%)	40(31%)
Gender, Male	192(52%)	21(60%)	102(50%)	69(53%)
At/below poverty threshold	228(66%)	20(59%)	139(71%)	69(60%)
Number of children in home	2.70(1.30)	2.76(1.39)	2.66(1.37)	2.76(1.13)
Number of adults in home	1.80(0.80)	1.88(0.73)	1.76(0.83)	1.83(0.78)
Sleep Outcomes				
Efficiency *	87.05(3.42)	85.74(4.05)	86.79(3.58)	87.81(2.79)
Duration	556.06(35.48)	561.42(36.49)	554.29(35.06)	557.25(35.93)
Awakenings *	5.08(2.34)	5.84(2.82)	5.18(2.45)	4.70(1.92)

Mean (std deviation) reported for continuous measures; N(%) for categorical measures. AA=African American; NLW=Non-Latino White.

* $p<.05$ between group differences