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Racial disparities and sleep among preschool aged children: a systematic review

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ABSTRACT

Sleep disorders and sleep insufficiency are common among preschool-aged children. Studies among school-aged children show disordered sleep is often more prevalent among racial minority groups. The primary aim of this systematic review was to critically appraise empirical data to elucidate the relationship between race and key sleep variables among children aged 2 to 5 years old. By systematically searching PubMed, Web of Science, and EBSCO databases, we identified empirical research articles conducted in the United States that investigate this relationship. We searched for variables relevant to (1) insufficient sleep duration, (2) poor sleep quality, (3) irregular timing of sleep, including sleep/wake problems and irregular bedtime onset and wake times (4) and sleep/circadian disorders. Nine studies satisfied the criteria for inclusion: five investigated nocturnal sleep duration, five investigated bedtime-related variables, four investigated daytime sleep (napping), three investigated total sleep, two investigated sleep quality, and one investigated wake times. Four studies specifically addressed racial and demographic differences in sleep variables as the primary aim, while the remaining five contained analyses addressing racial and demographic differences in sleep as secondary aims. Non-Hispanic white, white, or European-American race was used as the reference category in all studies. The results provided consistent evidence that white, non-Hispanic children were more likely to go to bed earlier and more regularly, have longer nocturnal sleep, and nap less than most racial and ethnic minorities. Combined, this literature presents a compelling narrative implicating race as an important factor in sleep patterns among a preschool age population.

Introduction

Sleep deficiency and sleep disorders among preschool children are common and extensive.[1] An estimated 20–60% of children between the ages of 2 and 5 years old experience at least one sleep issue.[1–6] Inadequate and disordered sleep have been associated with numerous cognitive, behavioral, and psychosocial impairments such as increased delinquent behavior and mood issues,[7–10] weight gain and obesity,[11–13] risk of injury requiring medical attention,[14,15] depression,[16,17] anxiety,[17,18] and other health problems. Although many studies have demonstrated the important role that biologic regulatory processes play in childhood sleep patterns,[19,20] more recent research has also shown the importance of environmental and cultural factors on child sleep behavior.[20–22] For example, a recent study demonstrated significant cross-cultural differences in sleep practices and their associated sleep problems across 14 countries.[23] Within the United States, pediatric sleep patterns vary by race/ethnicity, and socioeconomic status (SES), typically with minority or disadvantaged groups bearing poorer sleep-associated health outcomes.[10,24,25] These findings suggest that sleep-related health problems are in part the product of modifiable sleep behaviors and thus may be partially mitigated with properly tailored interventions.

There has been an increasing body of work investigating racial disparities and sleep variables among school-aged children, highlighted by a recent systematic review of 6–19-year-old students that found racial disparities in at least one sleep variable in all 23 studies included in the review.[26] However, racial disparities among younger children between the ages of 2 and 5 years old are less well-characterized. Children undergo key developmental changes in sleep patterns during these early years, shifting from a biphasic

Abbreviations: MeSH, Medical Subject Heading; SES, Socioeconomic status; PRISMA, Preferred Reporting Items for Systematic Reviews; PROSPERO, International Prospective Register of Systematic Reviews; DBQI, Downs and Black Quality Index; RCT, Randomized controlled trial; CASP, Critical Appraisal Skills Programme; LBW, Low birth weight; NREM, Non-rapid eye movement.

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sleep schedule characterized by both nocturnal sleep and daytime naps to a sleep pattern more concentrated at night; by 5 years old, the sleep structure more closely resembles adults.[27,28] These changes are a natural extension of the biological mechanisms that regulate sleep–wake cycles which are modulated by external factors such as living environment and familial/cultural factors.[20,23,29,30]

Sleep practices between the ages 2 and 5 years old can influence emotional, behavioral, biological, cognitive, and social development later in life,[11,31–34] yet a clear epidemiologic understanding regarding the role of race/ethnicity on sleep patterns specifically during this sensitive period has not been established. Such work is essential for developing culturally tailored programs that seek to improve sleep patterns in all children. The primary aim of this study is to comprehensively review existing research investigating the relationship between race/ethnicity and sleep variables among children aged 2 to 5 years old. Results from this study will also guide the development of a preliminary evidence base that may elucidate plausible mechanisms and direct future research in this area.

Methods

Search strategy and information sources

This systematic review was conducted following the reporting guidelines and criteria described in the Preferred Reporting Items for Systematic Reviews (PRISMA).[35] All English-language peer reviewed articles examining sleep disparities among diverse preschool-aged children were included in the database searches without date restrictions. Medical Subject Headings (MeSH) and keywords were used to search PubMed (initial search performed on January 3, 2018), and analogous methods were used in Web of Science, PsychINFO, and CINAHL databases (initial search performed on January 4, 2018). The initial search was later expanded to include napping and bedtime terms (performed on April 5, 2018). Our search strategy was informed by prior literature reviews on sleep disparities among racial and cultural minorities and peer-reviewed by librarians at the Emory Woodruff Health Sciences Center Library with expertise in systematic reviews for public health. All database searches were repeated on May 1, 2018 and no additional studies were found.

Inclusion and exclusion criteria

Studies were included if they satisfied the following criteria: (1) conducted empirical research using observational or experimental study designs using populations in the United States, (2) had one or more measure of sleep deficiencies as the sleep variable, (3) distinguished between racial/cultural groups, and (4) included discernable groups between 2 years (24.00 months) and 5 years (71.99 months) of age. If the study did not provide specific age groups, but categorized the subjects by grade (i.e. preschool, kindergarten, grade school), only preschool groups were used, as the PubMed MeSH term "preschool" is defined as a child between the ages of 2 and 5 years old.

Studies investigating multiple age groups were included, however only data from the relevant age range (2-5 years) were used. In longitudinal or follow-up studies, only data presented that are consistent with the age range were included; for example, if a study looked at children ages 3-5 years old, and repeated measurements on the same individuals at ages 10 and 15 years old, only baseline measurements were used.

Studies with overlapping age ranges unable to be separated were included if ≥75% of the study population fell within the age range of interest. To determine the proportion of children within the desired age range, we made parametric assumptions and calculations based on the type of data available, such as means, standard deviations, or ranges, in the individual studies (i.e. assumed T-, chi-squared, or uniform distributions). The rationale for this novel approach was that the proportion of children outside the desired age range would not meaningfully affect the outcome, and that preserving data from these studies would provide critical insight into the variables of interest in this systematic review. As such, if the sufficient proportion of the population did fall within the age range of interest, we used this information in concordance with a priori knowledge, plausibility, and expert considerations to make a final decision on an individual basis.

Editorials, letters, case studies, practice guidelines, and case reports were excluded. Gray literature, such as unpublished data, working papers, and non-peer reviewed studies, was also excluded. If multiple studies conducted analyses on the same (or substantially overlapping) dataset only one was included. The decision for which study to include was made based on relevance to the aims of this review and strength of design/analysis and confirmed by all authors.

Sources management and review strategy

All citation information was imported and stored in Endnote reference management software (Version X8.1, Clarivate Analytics, Philadelphia, USA). Duplicates were removed after the results from all four databases were added. Records were then imported into DistillerSR Software (Evidence Partners, Ottawa, Canada) for the screening and decision-making processes. The records were thoroughly screened by two reviewers (JS and SH) and marked as included or excluded based on information in the title and abstract. Excluded articles that were considered relevant to the aims of this study were flagged for manual searching of references. Records marked for inclusion by at least one reviewer repeated the screening process using the full text. All full-text articles marked for inclusion in the second screening by at least one author were discussed by the entire review team (all authors) for a final decision. References of all included articles and other relevant flagged articles were manually searched to identify additional potential articles. Additionally, key experts were consulted to both recommend additional sources and verify the final list of included studies. Lastly, internet search engines (i.e., Google, Bing) and key websites (i.e., National Sleep Foundation) were manually searched for any additional resources.

Sleep variable measures

Broadly, this review investigated sleep variables that could be considered sleep deficiencies. Variables for sleep deficiencies were informed by previous research in the field and our initial database search protocol included terms relating to: (1) sleep duration, (2) sleep quality, (3) timing of sleep (including sleep/wake problems and irregular bedtime onset and wake times), and (4) sleep/circadian disorders. Based on the results from the search, specific sleep variables included in the study were subsequently categorized into bedtime-related variables, nocturnal sleep duration, daytime sleep (napping), and total sleep duration.

Data extraction

Data from the final list of selected studies were extracted and stored in a spreadsheet created in Microsoft Excel (Macintosh version 15.41, Microsoft Corporation, Redmond, WA, USA). Key data that were summarized included: study design, setting, research period, sample size, age group, geographic location, relevant sleep variables, covariates, and result estimates, as well as other relevant descriptive information (i.e. objective/subjective measurement tools). Regardless of study determination, this review considered statistical significance as a $P < .05$. One reviewer (JS) completed the initial data

extraction, and a second reviewer (SH) then confirmed the data extraction process. Any issues or concerns with data extraction were brought to the full review team for decision-making.

Quality assessment

Individual papers were evaluated using a modified Downs and Black Quality Index (DBQI) score framework, a validated checklist for assessing the reporting, external validity, bias, confounding, and power of research studies.[36] The full scoring system consists of 27 questions relevant to both randomized and non-randomized trials that assess specific aspects of reporting and study design, such as the study's ability to address principal confounders and reporting of random variability for the variables. Each question in the index is given a score of "1" if the study satisfactorily addresses the question, and "0" if the study does not appropriately address the question. As the database search yielded no randomized control trials (RCTs), we removed nine questions deemed relevant only to RCTs. Of the 18 remaining questions four were not applicable to cross-sectional studies, yielding a maximum score of 14 for cross-sectional studies and 18 for cohort studies. Additional checklists for individual study designs provided by the Critical Appraisal Skills Programme (CASP) were used to further evaluate bias and inform decision making in the individual studies.[37]

Results

Search results

A detailed flowchart of potential studies is provided in Fig. 1. Our electronic and manual search strategy resulted in 1519 unique citations after removal of duplications (n = 989). From these citations, we identified 85 for further evaluation based on information provided in the title and abstract. After full-text review of these studies, 13 (15%) did not include sleep variables relevant to this review, 23 (27%) did not have discernable racial/ethnic exposure groups, 13 (15%) did not provide adequate information to distinguish desired age groups, 22 (26%) studies were not in the United States, four (5%) studies were gray literature or published in non-peer reviewed form, and one (1%) study used duplicate data. A total of nine studies met inclusion criteria after full text review.[38–46]

Characteristics of included studies

The characteristics of the nine included studies are summarized in Table 1. The date of publication for included studies ranged from 2005 to 2017. Among these, five were prospective cohort studies, three were cross-sectional studies, and one was a retrospective cohort. Sample sizes of included studies ranged from 62 to 3217, with a median of 1043 participants. The study population in three studies

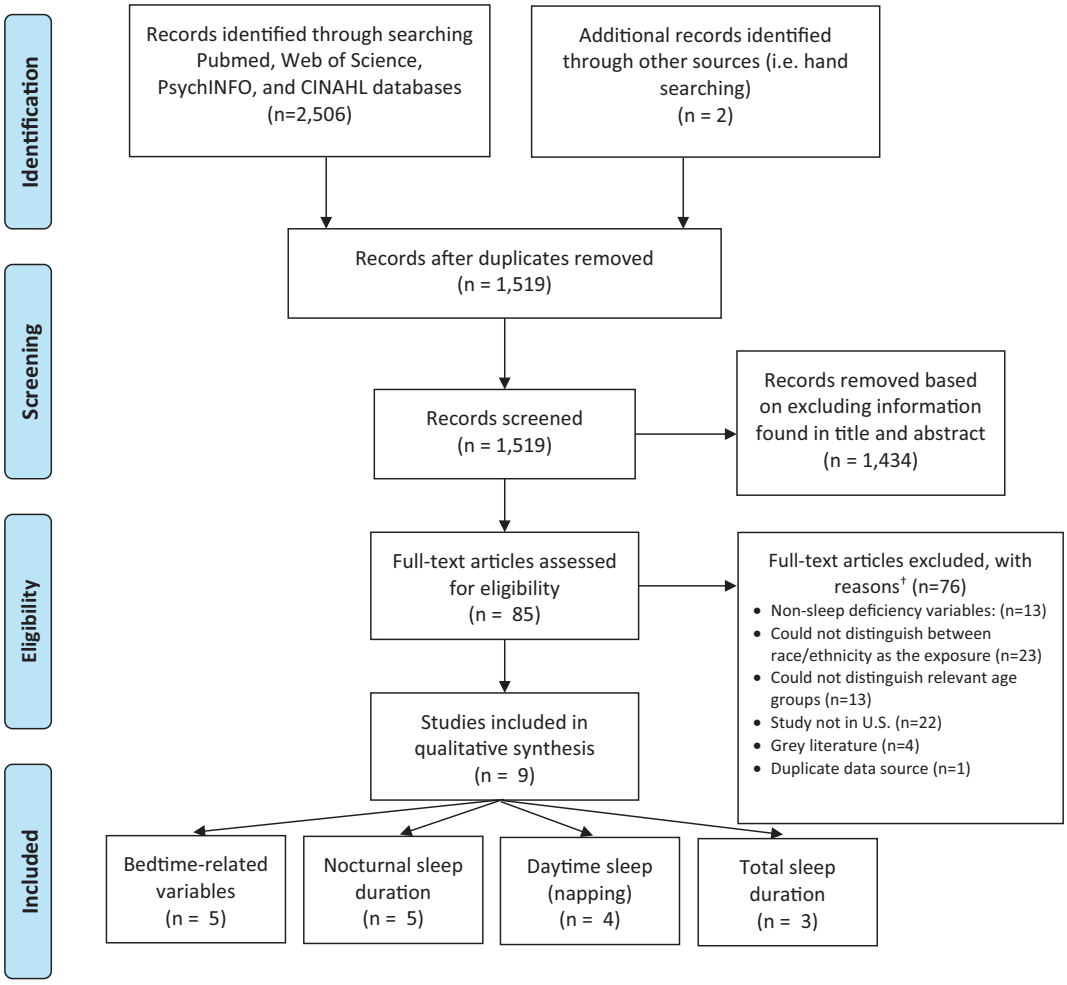

Fig. 1. Flow diagram of search results yielding the final studies investigating key sleep variables. †Primary reason, in order of priority. Studies may have multiple reasons for exclusion upon inspection of full text.

Table 1
Characteristics of included studies that examine racial/ethnic sleep disparities in US preschool aged children (ages 2–5 years old)

First Author and Year	Study Sample[a]	Study Sample Representation	Study Design (DBQI Score[b])	Race/ Ethnic Categories[c]	Variable(s) Relevant to Review[c]	Brief Summary of Findings[c]	Relevant Mechanisms from Authors
Hale (2009)[38]	3-year-olds born in 1998–2000 participating in the FFCW Study[d] (n = 3217)	Nationally representative, oversampled low-SES households	Prospective Cohort (17)	White, Black, Hispanic	(1) Regular bedtimes; (2) Hour of bedtime; (3) Bedtime enforcement; (4) Presence of bedtime routine; (5) Bedtime routine engagement	Black, Hispanic, and socially disadvantaged families are less likely to provide regular bedtimes and bedtime routines	Increased stress in households; Culture/tradition; Lack of awareness of benefits of bedtime routines
Montgomery-Downs (2006)[41]	2 combined cohorts of 3–7 year-olds followed from 2001–2002 (Cohort 1) or 2000–2004 (Cohort 2) (n = 173)	Jefferson County Public School System (Louisville, KY)	Retrospective analysis of two community-based cohorts (17)	White, Black, Other	Total nighttime sleep time, broken into sleep stages using polysomnographic measurements	Black children had lower Stage 1 sleep and higher Stage 2 sleep	None suggested
Wilson (2014)[42]	Preschool children (mean age: 4.1 years) in Head Start programs (n = 133)	Low income families in Detroit and Lansing, MI	Cross-Sectional (14)	White, Black, Hispanic, Other	(1) Nighttime sleep duration (bedtimes and wake times) and (2) Daytime nap frequency and duration	Non-Hispanic White children were more likely to have longer sleep durations and have earlier bedtimes	Cultural influences (i.e. wean time)
Vaughn (2015)[39]	3–5 year-old preschoolers (n = 62)	Middle-class families attending an early education center in Southeast US	Prospective Cohort (18)	White, Black, Other	(1) Nighttime sleep duration (composite variable) and (2) Sleep quality; Variables determined using actigraphy	(1) Ethnic minority children slept less at night and (2) had lower sleep efficiency than did European American children	Attachment security, family relationships, and family functioning
Williams (2013)[43]	2–5 year-olds; Data from 1997, 2002, and 2007 waves of Child Development Supplement of PSID[e] (n = 2832, 2520, and 1424, respective of waves)	Nationally Representative	Prospective Cohort (14)	White, Black, Hispanic, Other	Total sleep duration	The median hours of sleep for Blacks and Whites track closely during ages 2–5, with "other" and Hispanic ethnicities being slightly higher than both Blacks and Whites (Williams, Fig. 2A)	None suggested
Burnham (2015)[40]	2-year-olds from 2001 ELCS-B cohort[f] (n = 3050)	Nationally Representative	Prospective Cohort (17)	White, Black Hispanic	(1) Daytime Nap Duration; (2) Proportion of children taking daytime naps	(1) Black children napped longer, and Hispanic children napped shorter, than white children; (2) No differences in proportion of children taking a nap among ethnicities	Cultural differences in nighttime routines and bedtimes
Schlieber (2017)[44]	3–4 year olds from 2009 FACES[g] study (n = 2868)	Nationally Representative	Prospective Cohort (18)	White, Black Hispanic	Adherence to regular bedtime	A higher proportion of White children had a regular bedtime compared to all other races	"Caregiving characteristics" may differ between racial/ ethnic groups
Crosby (2005)[45]	2–8 year olds from three separate community surveys (n = 1043, entire cohort of 2–8 year old children; n = 783 for 2–5 year old children)	Southern Mississippi	Cross-Sectional (14)	White, Black	(1) Daytime nap duration; (2) Nighttime sleep duration; (3) Total sleep duration	(1) Black children napped more but (2) had less nocturnal sleep than did White children; (3) total sleep duration was nearly identical; (4) no differences in napping prevalence at age 2, but substantial differences between Black and White children from 3–5 years	(1) Differences in awareness of afternoon sleep tendencies; (2) cultural differences; (3) genetic differences
Patrick (2015)[46]	Preschool aged children (mean age: 3.9 years) in daycare facilities (n = 191)	Urban/ suburban communities of Philadelphia	Cross-Sectional (14)	White, Black	(1) Hour of bedtime; (2) Bedtime routine consistency; (3) Wake time; (4) Nighttime sleep duration; (5) Daytime sleep duration; (6) Total sleep duration	Black children reported: (1) later bedtimes, (2) lower bedtime routine consistency, (3) similar wake times, (4) shorter nighttime sleep durations, (5) longer daytime sleep durations, and (6) shorter overall sleep durations.	Increased stress in the household among Black families compared to white families

[a] Sample size reflects the sample of 2–5-year-old children in the study, thus total study sample size may be larger.
[b] Downs and Black Quality Index.
[c] May not be primary exposures, variables, or associations of the study, but secondary/tertiary analyses relevant to the aims of this review.
[d] FFCW: Fragile Families and Child Wellbeing Study.
[e] PSID: Panel Study of Income Dynamics.
[f] ECLS-B: Early Childhood Longitudinal Study—Birth Cohort.
[g] FACES: Head Start Family and Child Experiences Survey.

Table 2
Detailed results of the association between race/ethnicity and key sleep variables investigated by ≥2 studies.

Study	*Measure*	*Covariates*	*Key Findings*
1. Bedtime-related variables			
Hale (2009)[38]	Logistic Regression	The authors developed a unique model for each variable, which may include child, maternal, and household covariates: *Child covariates:* age of child, sex, low birth weight; *Maternal covariates*: age, race, education, employment status, verbal test score, depressive symptoms, and language; *Household covariates:* family structure, number of adults/children in household, number of bedrooms, family's permanent income to poverty status	• No differences in the odds of having a bedtime • Whites have 1.4 and 1.3 times the odds of using a bedtime than Hispanic or Black children, respectively • Whites have 1.4 and 1.8 times the odds of having a bedtime routine than Hispanic or Black children, respectively • Whites have 1.5 and 1.8 times the odds of using a bedtime routine than Hispanic or Black children, respectively
	Linear Regression	Possible covariates same as above	• Whites go to bed about 15 and 8 minutes earlier than Hispanic or Black children, respectively (beta = −0.247 and− 0.135, respectively; $P < .01$)
Burnham (2015)[40]	Logistic Regression	SES, sex, Low birth weight	• White children have 1.72 times the odds of having a regular bedtime routine than Black children (CI: 1.17–2.52)
Wilson (2014)[42]	Linear Regression	Unadjusted (bivariate model)	• White/non-Hispanic ethnicity was associated having an ~18-minute earlier bedtime (vs non-White or Hispanic combined category) (beta = −0.31, $P = .039$)
Schlieber (2017)[44]	Comparison of Proportions	Unadjusted (two-way contingency tables)	• The proportion of White children who had a regular bedtime at least four weekdays (94.4%) was statistically higher than Hispanics (89.7%) and Blacks (82.5%) ($P < .01$)
Patrick (2015)[46]	Comparison of Means	Unadjusted (two-way contingency tables)	• Bedtime routine consistency was lower in Black children than in White children (used a 1–5 composite score, mean of scores) ($P \leq .05$) • Bedtimes of Black children were 27 minutes later than for White children ($P < .001$)
2. Nocturnal Sleep			
Study	*Measure of Association*	*Covariates*	*Key Findings*
Montgomery-Downs (2006)[41]	Comparison of Proportions	Unadjusted (two-way contingency tables)	• White children had a higher stage 1 percent and lower stage 2 percent than minority groups ($P = .004$ and 0.027, respectively)
Wilson (2014)[42]	Linear Regression	Child age, maternal education, and gender	• White/non-Hispanic ethnicity was associated with ~32 minutes longer weeknight sleep (vs non-white or Hispanic combined category) (beta = 0.53, $P = .005$)
Vaughn (2015)[39]	ANOVA	Sex, age	• European American children had higher composite scores for nighttime sleep duration than other ethnic status children ($P < .001$)
Crosby (2005)[45]	Linear Regression	Age, time (weekday/weekend), and age/time interaction	• Black children slept ~20 minutes less than white children on weeknights and slightly less on weekends
Patrick (2015)[46]	Comparison of Means	Unadjusted (two-way contingency tables)	• White children slept an average of 87.6 minutes longer than Black children ($P < .001$)
3. Total Sleep			
Study	*Measure of Association*	*Covariates*	*Key Findings*
Williams (2013)[43]	Comparison of Medians	N/A	• Median times track closely for White and Black children, though are lower than Hispanic and "other." No statistical test performed.
Crosby (2005)[45]	Linear Regression	Age	• Total sleep duration was nearly identical for both White and Black children
Patrick (2015)[46]	Comparison of Means	Unadjusted (two-way contingency tables)	• White children slept an average of 55.8 minutes in total longer than Black children ($P \leq .01$)
4. Nap-related Variables			
Study	*Measure of Association*	*Covariates*	*Key Findings*
Burnham (2015)[40]	Comparison of Proportions	Unadjusted (two-way contingency tables)	• No significant differences in the proportion of children taking naps by race/ethnicity at 2 years old
	Linear Regression	SES, sex, low birth weight, no bedtime, difficulty falling asleep	• Black children napped 13 minutes longer (beta = 0.22; $P < .01$) and Latino children napped 11 minutes shorter (beta = −0.18; $P = .05$)
Crosby (2005)[45]	Logistic Regression	Age, only child, single mother, maternal age, medical problem	• No significant differences in the proportion of children taking naps by race/ethnicity at 2 years old • Notable differences in napping proportions between Black and White children exist between the ages of three to five (no statistical tests done) • The odds of napping for Black children were> 6.5 times greater that of White children between the ages of 2-8 years old
Patrick (2015)[46]	Comparison of Means	Unadjusted (2-way contingency tables)	• Black children napped 42 minutes longer than white children ($P < .001$)

were nationally representative[40,43,44] and one was nationally representative but oversampled from low SES households.[38] Other studies were conducted in Kentucky, Michigan, Philadelphia, and the southeastern United States. Studies included multiple relevant sleep variables in their analysis. Across studies, five investigated nocturnal sleep, five investigated bedtime-related variables, four investigated daytime sleep (napping), three investigated total sleep, two investigated sleep quality, and one investigated wake times. Although a majority of the studies used subjective measures for sleep variables (i.e., parental surveys or interviews), one study used polysomnographic measurements and another used actigraphy to assess sleep duration and quality. Four studies specifically addressed racial and demographic differences in sleep variables as the primary aim, while the remaining five had these analyses as secondary aims. Non-Hispanic white, white, or European-American race was used as the reference in all studies.

Covariates

Covariates used for each specific analysis are presented in Table 2. Three of the four studies with racial disparities in relevant sleep variables as the primary aim adjusted for covariates,[38,40,45] whereas one presented a simple *t* test for comparison of means.[46] Among the five studies investigating racial disparities as a secondary aim, two adjusted for covariates,[39,42] two presented unadjusted results,[41,44] and one study presented results not evaluated by a statistical test and thus covariates were not applicable.[43] In general, covariates consistent across studies included age, sex, and a measure of SES. Other covariates that were considered to a lesser extent were low birth weight (LBW) and maternal characteristics (i.e. education, employment). Only one study reported investigating interaction between covariates, and found an interaction between age and day of the week (weekday/weekend).[45]

Bedtime-related variables

A total of five studies had bedtime-related variables.[38,40,42,44,46] Of these, three specifically compared bedtime hour with race/ethnicity using linear regression[38,42] or chi-squared test of proportions.[46] All three studies found that white, non-Hispanic children go to bed earlier than children of other races and one study also estimated that wake times were almost identical.[46] Estimates for how much earlier white children go to bed compared to other races vary from 8–27 minutes, however the strongest evidence comes from the only prospective cohort ($n = 3217$) which found that parents of white children reported their child going to bed 15 and 8 minutes earlier than reported by the parents of Hispanic or Black children, respectively ($P < .01$).[38] Four studies also investigated bedtime routines and/or routine consistency. All studies concurred that White children were more likely to have regular bedtime consistency (at least four of five weeknights)[38,44] and use a bedtime routine (i.e., read story)[38,40,46] than Black children. Notably, Hale et al[38] and Schlieber et al[44] also investigated these differences among White and Hispanic children and found that Hispanic children were also less likely to have and use a bedtime routine than White children. Studies presented both adjusted and unadjusted models and found consistent findings between approaches.

Nocturnal sleep

Of the five studies that investigated nocturnal sleep variables, four directly investigated nocturnal sleep duration[39,42,45,46] while two investigated nocturnal sleep qualities.[39,41] All studies investigating duration found that White children had longer nocturnal sleep duration compared to non-White children, ranging from ~20–88 minutes more per weeknight. While all other studies used parent-reported data, Vaughn et al[39] presents the only objective measure of sleep duration using actigraphy and drew the same conclusion as the studies using parent-reported instruments. However, although the authors report that ethnic minority children had shorter nocturnal sleep duration than white children, the authors created a composite score due to correlations in actigraphy indices and did not report specific sleep time durations. The authors also investigated sleep quality via actigraphy and found that ethnic minority children also had lower "sleep efficiency" than White children. Sleep efficiency interplays with sleep duration and is defined as the percentage of minutes spent asleep compared to overall time spent in bed. Although sleep efficiency provides some insight into how well the child may have slept, it does not consider intermittent wakefulness. Thus, a child with consistent yet severely truncated sleep duration may have a higher sleep efficiency than a child with longer yet intermittent sleep duration. However, in their study, Vaughn et al[39] report both shorter sleep duration and lower sleep efficiency in ethnic minority, preschool-aged children. Nevertheless, the interpretation of sleep efficiency should be taken with caution in the absence of specific sleep durations among these groups.

Montgomery-Downs et al[41] used polysomnography to investigate ethnic differences in sleep stages and found that white children spent more time in Stage 1 and less time in Stage 2 sleep than children in minority groups (Black and "other" race). Stage 1 sleep is the non-rapid eye movement (NREM) stage of sleep where one transitions between being awake and falling asleep, whereas stage 2 sleep is the NREM stage accounting for about 50% of sleep duration when the body prepares for deep sleep.[47]

Nap-related variables

Of the three studies measuring nap-related variables, two investigated nap durations[40,46] and two investigated napping prevalence.[40,45] Both studies found that nap duration was significantly longer among Black children than White children (13–42 minutes). Burnham et al[40] further found that Latino children napped 11 minutes less than White children.

The two studies investigating the prevalence of napping between racial groups both reported a high proportion of children taking naps at 2 years old. Burnham et al,[40] which only sampled among 2-year-old children, found no statistical differences in the proportion of 2-year-old children napping by race (96% Black vs 90% White; stated by authors as not significant, test statistic not reported).[40] Crosby et al[45] sampled children from the ages of 2- to 8-year-old children and presented data for each year within this age range. The authors present concurring evidence among the proportion of 2-year-old children taking naps (95% for both Black and White children, stated by authors as not significant, test statistic not reported).

However, Crosby et al[45] report highly significant differences in napping prevalence between Black and White children as the child ages from 2 to 5 years old. The percentage of White children taking at least one nap per week declined sharply from ~95% to ~60% between the ages of 2 and 5 years. Conversely, the proportion of Black children taking at least one nap per week only slightly decreased in the same timeframe, from ~95% to ~90%. After combining all age groups, the authors report the odds of napping for Black children were over 6.5 times greater when compared to White children (OR 6.59; $P < .001$). Although this odds ratio includes children aged 2 to 8 years old, three-quarters of the children were between the relevant ages of 2 to 5 years old.

Total sleep over 24 hours

Three studies evaluated total sleep duration and presented mixed results.[43,45,46] Although Crosby et al[45] reported ~20 minutes longer nocturnal sleep for White children compared to Black children, the

authors found almost identical total sleep durations. Conversely, Patrick et al[46] similarly found White children had longer nocturnal sleep and shorter nap duration compared to Black children, yet the authors found that total sleep among White children was almost an hour more per day (~56 minutes; $P \leq .01$). Williams et al[43] likely present the strongest data from a nationally representative sample using three waves of sampling totaling 6776 participants.[43] The authors show that the median total sleep durations track very similarly for white and Black children until age five, although both are lower (~30 minutes) than the Hispanic and "other" race categories. Unfortunately, however, these data did not use a statistical test for ages relevant to this review and only a qualitative assessment can be done. Additionally, although we did not consider Vaughn et al[39] to have assessed total sleep by race/ethnicity, a post-hoc analysis indicated that children with longer nocturnal sleep durations did not necessarily have different nap durations during the day (though this analysis was not separated by race).

Discussion

This systematic review presents evidence of racial disparities in several key sleep variables among preschool aged children, though the limited number of included studies encourages more epidemiologic inquiry into this subject. Each study reported at least one sleep variables that was suggestive of poorer sleep health among racial and cultural minorities. There was striking consistency in evidence that White, non-Hispanic children were more likely to go to bed earlier and more regularly, have longer nocturnal sleep, and nap less than most racial and ethnic minorities. Although the majority of studies used parent-reported data, the two studies using more objective sleep measurements (actigraphy, polysomnographic measurements) were consistent with and reinforced the parent-reported findings. Although chronobiological mechanisms that regulate sleep structure vary from early childhood through adulthood, these results are consistent with findings in several recent epidemiological studies and systematic reviews investigating sleep disorders among older children (aged 6–19 years old) and adults.[24,26,48,49] In these studies, racial/ethnic minorities are observed as having poorer sleep duration and quality than their White geospatial contemporaries. Combined, these studies present a compelling narrative implicating race as an important factor in sleep disparities throughout the course of one's life.

Nocturnal sleep was the most common sleep variable investigated, with all studies indicating that White children obtained more sleep than racial and ethnic minorities. Although the most conservative estimate was that White children slept approximately 20 minutes more per night than Black children (range: ~20–88 minutes), this deficiency may impact childhood development. Recently, a randomized experimental study by Gruber et al found that students sleeping ~27 minutes longer improved social, cognitive, and emotional behavior.[50] Conversely, Black and Latino children were found to have napped longer than White children (range: 13–42 minutes), which may be a function of less nocturnal sleep in these groups.

The two studies investigating the proportion of children taking naps presented consistent results and concluded that there is no difference by race in napping prevalence at 2 years old.[40,45] However, only one of these studies examined napping prevalence beyond 2 years of age. In this study, the authors show dramatic differences emerge in napping prevalence among Black and White children and a multivariate logistic regression found the odds of napping were over six times higher for Black compared to White children. Although the strength of evidence leans more towards the presence of racial differences in the proportion of children napping between the ages of 2 and 5 years, the lack of additional studies for comparison highlights the need for more targeted research in this specific area.

Of the two studies that tested for racial differences in total sleep duration, one age-adjusted cross-sectional study found no difference in total sleep duration among Black and White children,[45] while another unadjusted comparison found that White children slept almost an hour more than Black children.[46] As discussed above, there is consistent evidence that White children have longer nocturnal sleep than Black children, and, conversely, Black children nap for longer durations than White children. Thus, these differences posit a plausible hypothesis that racial minorities recuperate lost sleep through napping, resulting in similar total sleep times. Importantly, in addition to the age-adjusted cross-sectional study, data from the only prospective cohort investigating total sleep supports this hypothesis; authors found that median total sleep duration tracked closely for Whites and Blacks throughout the ages of 2 to 5 years (while both were slightly lower than Hispanic and "Other" racial minorities). However, data for the ages relevant for this cohort study were only qualitative and no statistical tests were done.

Authors in seven of the nine studies speculated about mechanisms for these racial disparities in sleep variables. We provide a summary of these proposed mechanisms here not to scientifically endorse any one of the hypotheses, but rather to provide context around the current thinking. Differences in cultural influences and practices was consistently mentioned (six of seven, with the seventh suggesting increased stress among Black families). Although authors often mentioned cultural practices in broad terms, some mentioned specific mechanisms, such as attitudes and the acceptability of bedtimes and regular afternoon naps. Two authors[38,45] proposed racial and cultural differences in awareness and/or acceptance of sleep practices. Only one study suggested intrinsic biological mechanisms as a partial factor in racial disparities in addition to cultural practices.[45] Taken as a whole, the mechanisms posited by the authors suggest that these disparities may indeed be modified with targeted informational and interventional campaigns. The results of this study are likely to be of use to pediatricians, caretakers, and community leaders who serve racial and cultural minority children and who have questions regarding the sleep behaviors among these groups.

This study used rigorous, transparent, and systematic methodology to search the literature, which involved standardizing and registering our protocol and having it reviewed by university librarians trained specifically on systematic reviews. Thus, we are confident that the methodology yielded all studies that met our inclusion criteria. Additionally, findings were by-in-large drawn from contemporary studies (range 2005–2017), which are more likely to include cultural and sleep influences of current technology than studies from pre-2000s (i.e. ability to watch TV on a computer, ubiquity of smartphones). However, the study had several limitations stemming from the limited research in this specific area. Although studies presented relatively consistent evidence demonstrating racial differences in sleep variables, heterogeneity in analytical methodology precluded the ability to perform a meta-analysis. Ultimately, there are too few studies to develop a steadfast consensus on any variable in this review. Additionally, although some studies investigated sleep variables in Latino populations, most studies did not adequately investigate different minority races other than Black children; therefore, this analysis cannot draw meaningful conclusions regarding other races as they compare to whites or between Blacks or other races. Moreover, only four major categories of sleep variables were investigated by more than one study, and this review was unable to examine additional sleep variables such as sleep quality, sleep/wake problems (i.e., insomnia), or other relevant sleep variables. As such, only a partial glimpse of sleep disparities was established.

Numerous studies have demonstrated that adequate sleep is of particular importance among preschool-aged children, and sleep patterns during this age may influence lifelong sleep practices. Although there is a well-established association between race/ethnicity and

sleep in adult populations, this review has highlighted the need for continued research specific to the preschool age group. These findings highlight the need for additional, precise data investigating racial and cultural disparities in sleep variables. Elucidating sleep disparities among preschool children is a complex, multifactorial process that may be influenced by external factors related to SES such as physical home (i.e. siblings, sleeping location, home allergens) or neighborhood factors (i.e. population density, noise, violence), and other environmental issues (i.e. air quality). Future studies designed to investigate sleep issues among preschool-aged children should include robust racial and cultural information, as well as detailed external factors (i.e. place, SES), and objectively measure the presence or absence of sleep disparities among these groups. Additional research investigating the mechanisms for these disparities should be undertaken to provide a clearer understanding of the cultural and behavioral influences affecting sleep among preschool children. Although a recent systematic review concluded that evidence for the effectiveness of sleep interventions to stimulate healthy sleep in children is still inconclusive, the study found that the most successful interventions were those which included multifactorial approaches.[51] Understanding nuanced differences in sleep practices among racial groups may afford critical insight into developing such culturally tailored, interventions and policies that may result in lifelong health and behavioral improvements.

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