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It's Time to Put the Nap in Nutrition and Physical Activity Self-Assessment for Child Care (NAPSACC): A Systematic Review Demonstrating the Impact of Child Care on Sleep Outcomes in Early Childhood

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Abstract

Background: Child care–based interventions have largely neglected sleep as an important health behavior for obesity prevention. Child care sleep environments and caregiver practices likely differ from home sleep environments and parent practices.

Methods: We summarize findings of past research examining how child care arrangement, dose, and attendance impact young children's sleep using steps outlined by the Preferred Reporting Items for Systematic Reviews and Meta-analyses methodology. Keywords related to sleep and child care were entered into PubMed, PsycINFO, and CINAHL, yielding a total of 3535 articles.

Results: Twenty-three studies were included in the data extraction process. There was evidence indicating that child care arrangement type, dose, and attendance impact various sleep outcomes among children 0–5 years old. Considerable variation across studies with regard to child care comparison groups and sleep outcomes assessed made making comparisons across studies difficult. However, child care outside the home and increased time spent in child care were commonly positively associated with daytime sleep and negatively associated with nighttime sleep. Child care outside the home was also associated with 24-hour sleep, with decreased sleep observed among infants and toddlers but increased sleep observed among preschool-age children receiving outside care, especially in settings with mandatory naptime.

Conclusion: The findings of this review demonstrate that child care impacts children's sleep. More research is needed to understand best practices for promoting sleep across child care settings and inform intervention efforts. Integrating sleep into evidence-based child care obesity prevention interventions, such as Nutrition and Physical Activity Self-Assessment for Child Care, would assist in efforts to reduce obesity risk among young children.

Keywords: child care; children; infant; preschool; sleep; toddlers

Introduction

Childhood obesity remains a significant global public health problem, given increasing and persistent prevalences across settings and associated health consequences.[1,2] Prevention efforts focused in early childhood are important because children with obesity often become adults with obesity,[3] and habits for obesity-related health behaviors are often established during early childhood.[4] Likewise, early prevention efforts focused in child care settings are important given how many children spend time in child care. For example,

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an estimated 74% of 3- to 5-year-olds in the United States, and 39% of 3- to 5-year-olds globally, are in child care.[5,6] Consequently, numerous child care–based obesity prevention interventions have been developed and tested, with varying levels of success.[7–13]

An exemplar of success that has received national recognition is Nutrition and Physical Activity Self-Assessment for Child Care (NAPSACC). NAPSACC, for which Diane Ward was the founding director, is an evidence-based program that assists child care providers in creating environments that foster healthy habits to prevent childhood obesity.[14] Various studies have demonstrated that NAPSACC is effective at positively impacting child care nutrition and physical activity environments.[15–21] However, consistent with most other interventions across the field of childhood obesity,[22–25] the program does not assess or target sleep, despite a now established body of evidence demonstrating that insufficient sleep in early childhood is an additional risk factor for obesity.[26–32] For example, a meta-analysis by Chen et al. revealed a significant linear dose–response relationship between 24-hour sleep duration and combined overweight and obesity, specifically in young children.[27] The relationship between sleep and obesity is complex, influenced by biological, behavioral, and contextual factors. Notably, insufficient sleep may increase obesity risk through various pathways including hormonal disruptions affecting appetite regulation, reduced physical activity due to fatigue, and increased exposure to obesogenic environments.[29,33] Furthermore, sleep characteristics beyond duration such as sleep quality, timing, and consistency may also influence obesity risk, though these factors have been less studied in young children.[29,34–36] Nonetheless, bidirectional relationships between sleep and dietary and physical activity behaviors provide justification for targeting sleep in obesity prevention interventions, and findings from intervention studies have demonstrated that sleep interventions, especially when paired with dietary and physical activity interventions, can be protective against obesity.[37]

Many children rely on daytime sleep (i.e., naps) to meet their sleep needs through their preschool years,[38] as reflected by the American Academy of Sleep Medicine, including naps in their recommended sleep duration hours for infants, toddlers, and preschoolers.[39] Thus, assessing and targeting the child care sleep environment in addition to nutrition and physical activity environments are also important for obesity prevention. Studies have shown that sleep environments vary considerably across child care sites, and providers sometimes employ strategies that do not align with evidence on sleep promotion.[40–42] An important limitation of the current literature though has been the focus on sleep-related practices across sites of a singular type of child care (i.e., child care centers or family child care homes); thus, variability across different child care arrangements has yet to be critically examined. Results from studies reporting sleep outcomes for children with varied child care arrangements, doses, and attendance likely reflect differences in naptime policies, sleep-related provider practices, and environmental factors, all of which could be intervened on. In this article, we systematically review the literature on associations between child care arrangement, dose, and attendance and sleep outcomes in early childhood and discuss the potential of integrating sleep into NAPSACC and other evidence-based childhood obesity prevention interventions.

Methods

Search Strategy and Information Sources

This review, which was registered in the PROSPERO database (CRD42024508992), followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) methodology.[43,44] The search was conducted by a health sciences librarian between March 8 and 26, 2024, in three databases: PubMed, PsycINFO, and CINAHL. Medical Subject Headings and search terms were used to identify articles mentioning "sleep" and "childcare." Studies not written in English and animal studies were excluded. No date restrictions were used. The full search strategy is available in Supplementary Appendix.

Eligibility Criteria

This review, which examines how child care impacts children's sleep, used the following eligibility criteria: (1) includes participants under the age of 5 years (with studies including older children in addition to children under age 5 eligible); (2) includes at least one clinical sleep outcome (e.g., nap frequency, 24-hour sleep duration, bedtime); and (3) compares child sleep outcomes among different child care arrangements (e.g., child care center, family child care home, nanny, no child care). Both between-subject (e.g., comparing sleep of children who were in child care vs. not or in one type of child cares vs. another) and within-subject (e.g., comparing sleep of children in child care on home days vs. child care days) comparisons were eligible. Single-group descriptive studies without comparisons were excluded. Likewise, studies that assessed the impact of different provider practices around sleep, but only for a single type of child care arrangement, were excluded. All study designs (e.g., cross-sectional, longitudinal, and experimental studies) were eligible.

Screening Process

Articles identified by the search strategy were imported into Covidence, an online management system for systematic reviews, for screening and data extraction. Duplicate articles were automatically removed in Covidence prior to the initial screening of titles and abstracts. Titles and abstracts were independently screened by two coauthors to identify potential studies for inclusion, with discrepancies resolved by the senior author. Articles deemed relevant were subsequently screened at the full-

text level and assessed for inclusion using the eligibility criteria. Again, screening at the full-text level and application of the eligibility criteria were independently done by two co-authors, with discrepancies resolved by the lead author. Additionally, we screened the references of all articles meeting our eligibility criteria; references were screened by one co-author at the title and abstract level and two co-authors at the full-text level.

Data Extraction and Quality Appraisal

Data extraction and quality appraisal were conducted separately by two co-authors using an Excel spreadsheet, with discrepancies resolved by the lead author. We extracted the following data: last name of first author, year of publication, analytical sample size, geographic location, age range of participants, sex/gender distribution of participants, racial/ethnic composition of the sample, study design, comparison groups, sleep outcomes, sleep measures, covariates adjusted for in analyses, and findings. For quality appraisal, we used the "Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies" developed by the National Heart, Lung, and Blood Institute.[45] The tool, which consists of 14 criteria, assigns quality ratings as follows: (1) 10–14 points ("good"), (2) 5–9 points ("fair"), and (3) 0–4 points ("poor").

Results

Search Results

The initial search yielded 3736 studies from PubMed, 1588 results from PsycINFO, and 1590 results from CINAHL. An additional 8 studies were flagged for screening via reference search, for a total of 6922 studies identified for screening. After removing 3387 duplicates, 3535 articles were screened at the title and abstract level, of which 3479 studies were excluded. A full-text review was conducted of 56 articles, 33 of which were excluded (see Fig. 1 for reasons). A total of 23 studies met the eligibility criteria and moved on to data extraction and quality appraisal.

Characteristics of Included Studies

The 23 included studies were published between 1949 and 2023 and included 71,552 participants between the ages of 0–5 years from 9 countries: Japan (n = 8),[46–53] Canada (n = 4),[54–57] United States (n = 4),[58–61] France (n = 2),[62,63] Australia (n = 1),[64] Bangladesh (n = 1),[65] China (n = 1),[66] Malaysia (n = 1),[67] and United Kingdom (n = 1).[68] There was a wide range of sample sizes across studies, with the smallest analytical sample being 30 and largest being 39,813. The age range of participants also varied across studies. Some studies included children of a single age (e.g., 2-year-olds), some included children from a relatively narrow age range (e.g., 1- to 2-year-olds), and others included children in the full 0- to 5-year age range. The gender/sex distribution of the sample was commonly reported, with at least 43% of participants across reporting studies (n = 20) female. The racial/ethnic composition of the sample was less commonly reported with varied representation of racial/ethnic minorities across reporting studies (n = 10). Most studies (n = 17) were cross-sectional,[46–55,57–59,62,66–68] but there were 6 longitudinal studies.[56,60,61,63–65] While the majority of studies (n = 15) adjusted for at least one potential confounder in the analyses, only 2 studies received an overall quality appraisal rating of "good" compared with 21 studies that received a rating of "fair" (see Table 1).

A variety of sleep outcomes were assessed across studies including, but not limited to, duration, efficiency, napping frequency, bedtime, social jet lag, chronotype, and sleep difficulties. Four studies used actigraphy,[51,54,61,66] but most (n = 19) relied on parent or child care provider-reported sleep measures. Types of comparisons made were classified into three groups: child care arrangement comparisons (n = 14), child care dose comparisons (n = 6), and child care-day versus home-day comparisons (n = 6). Two studies included multiple types of comparisons.[64,67]

Child care Arrangement Comparisons

Thirteen studies examined sleep outcomes across different child care arrangements,[49,50,54–57,59,60,62–64,67,68] with Chen et al.[64] classifying child care arrangements into two ways. First, the authors cross-sectionally examined sleep outcomes between children who had a single child care arrangement (reference group) and those with multiple child care arrangements and no child care at 9 months and 2.5 years.[64] No child care was associated with shorter weekday nighttime sleep at 9 months, but not 2.5 years, compared with having a single child care arrangement.[64] Next, the authors classified children based on their child care arrangements at both 9 months and 2.5 years as either non-attenders, late attenders, early attenders, consistent attenders, or inconsistent attenders (see Table 2 for descriptions of each).[64] With this classification, they found child care arrangement moderated the effect of age on nighttime sleep duration such that late attenders and inconsistent attenders increased both their weekday and weekend nighttime sleep duration at a slower rate than nonattenders.[64]

The remaining studies included simpler classifications of child care, comparing sleep outcomes between children based on the type of care they were receiving, but the categories for type of care varied across studies.[49,50,54–57,59,60,62,63,67,68] Four studies included categories enabling comparisons between children who were receiving any care versus none,[50,54,55,57] four studies included categories enabling comparisons between children receiving in-home care versus out-of-home care,[60,62,63,68] two studies included only children who were in child care but of different types,[59,67] one study included categories enabling comparisons between children in child care with obligatory naps versus not,[49] and one study did not specify what the child care setting comparison categories were.[56]

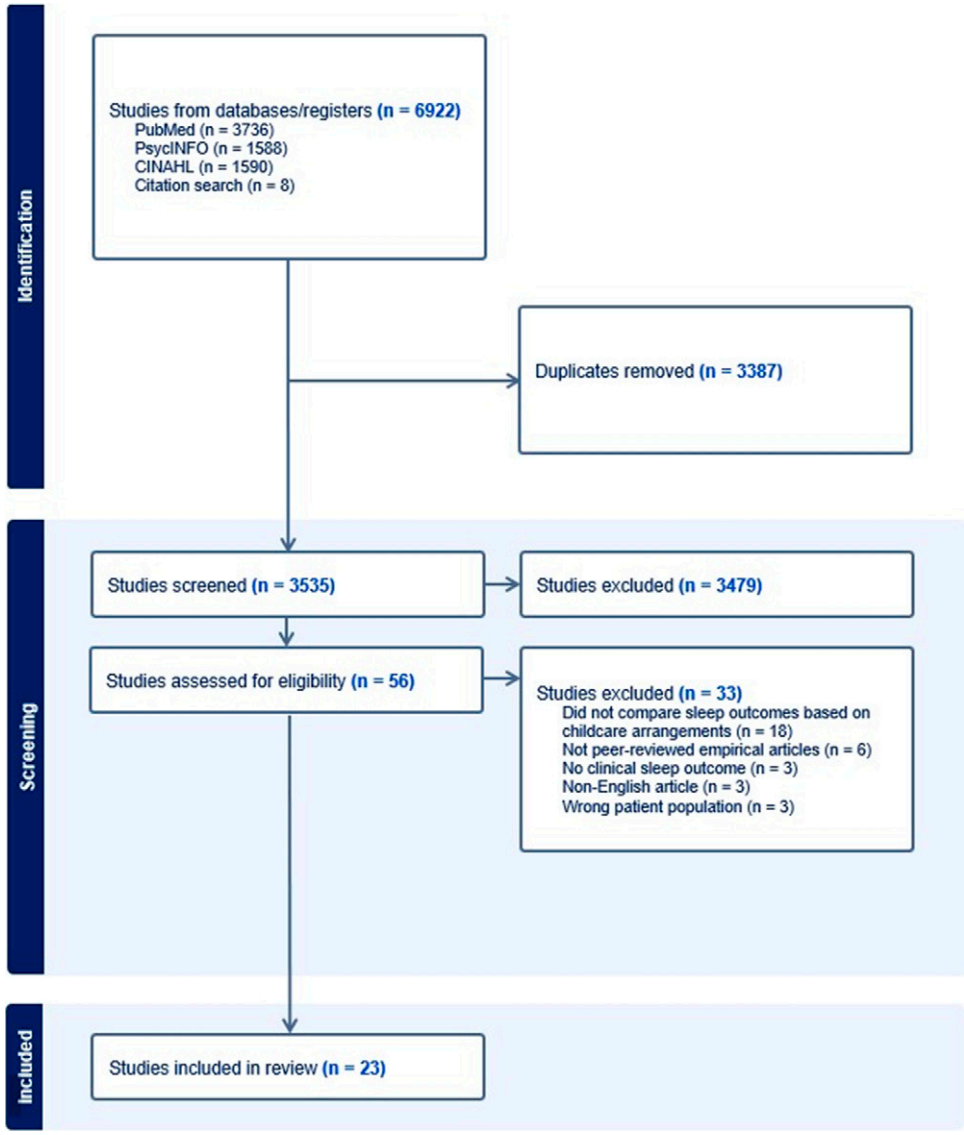

Figure 1. PRISMA flowchart. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-analyses.

Among the four studies with a no child care group,[50,54,55,57] two simply compared sleep outcomes among children with no child care versus any type of child care.[54,57] While Costanian et al. did not find differences in nighttime sleep duration among 1- to 2-year-olds who were in day care versus not,[57] Giannoumis et al. found that social jet lag, a measure of discrepancy between circadian and social clocks, which was measured via actigraphy, was greater in 0- to 5-year-olds who attended day care or preschool compared with children who did not.[54] The other two studies included two comparison groups in addition to the no child care group. Similar to Costanian et al.,[57] Newton et al.,[55] which compared nap patterns among 1- and 5-year-olds not in child care, 1- to 5-year-olds receiving non-parent guardian care or attending a child care center, and 1- to 5-year-olds in kindergarten, had no significant findings. However, Ikeda et al.[50] found that 4-year-olds attending child care centers had lower odds for short 24-hour sleep duration and late wake time and higher odds for short nighttime sleep duration, daytime napping, and bedtime later than 9:00 pm than those not in child care. Children attending preschool, on the contrary, had lower odds for daytime napping, late wake time, bedtime later than 9:00 pm, and bedtime later than 10:00 pm and higher odds for short 24-hour sleep duration and short nighttime sleep duration than those not in child care.[50]

Among the four studies comparing in-home care versus out-of-home care, one included three comparison groups while the others had just two.[60,62,63,68] Nevarez et al.[60] found that 0- to 2-year-olds in child care outside the home had shorter 24-hour sleep durations than those with in-home care. Reynaud et al.[63] found that 2- to 6-year-olds in child care outside the home had higher odds of being on the common night-waking trajectory compared with children with in-home care. Glass et al.[68] found that sleep disturbances were more common among 1- to 5-year-olds

Table 1. Sample and Study Characteristics ($n = 23$)

	Sample characteristics					Study characteristics		
First author (year)	Sample size	Age range	Country	% female	Racial/ethnic composition	Study design	Potential confounders adjusted for in analyses	Quality assessment rating
Beyens (2019)[58]	402	3–5 years	United States	NR	80% White, 7% African American, 6% Hispanic, 4% Asian or Pacific Islander, 2% multiracial, 1% Native American	Cross-sectional	Maternal education, maternal employment, household income, child's age	Fair
Burnham (2016)[59]	3050	2 years	United States	48%	53% White, 18% Black, 15% Latino, 2% Asian/ Pacific Islander	Cross-sectional	—	Fair
Chen (2017)[64]	4287	0–2 years	Australia	NR	NR	Longitudinal ($n = 3046$) Cross-sectional ($n = 7333$)	Breastfeeding, maternal employment status, single-parent family, child age, child sex, child global health rating, maternal aboriginal status, maternal immigration status, not speaking English at home, maternal education, weekly household income, parenting warmth scale, parenting hostile scale, average hours of child care per day	Good
Costanian (2017)[57]	3675	1–2 years	Canada	50%	96% Aboriginal	Cross-sectional	Gender, aboriginal status, immigration status, household income, maternal work status, maternal education, maternal marital status, household size, maternal gravidity, mode of delivery, maternal age, maternal health problems, maternal cigarette smoking during pregnancy, maternal alcohol use during pregnancy, preterm birth, birthweight, child health at birth, breastfeeding duration, nap duration	Fair
Doi (2014)[46]	383	4–6 years	Japan	50%	NR	Cross-sectional	—	Fair
Doi (2016)[47]	7826	3–5 years	Japan	49%	NR	Cross-sectional	—	Fair
Fujii (2022)[67]	33	3–6 years	Malaysia	52%	100% Malay ethnicity	Cross-sectional	Weekday vs. weekend (for comparisons between type of care)	Good
Fukuda (2002)[48]	441	3–6 years	Japan	48%	NR	Cross-sectional	Sex, age	Fair
Fukuda (2019)[49]	957	1–6 years	Japan	50%	NR	Cross-sectional	Age	Fair
Giannoumis (2022)[54]	78	0–5 years	Canada	50%	59% European, 26% non-European, 15% missing	Cross-sectional	—	Fair
Glass (1949)[68]	96	1–5 years		46%	NR	Cross-sectional	—	Fair

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Table 1. Sample and Study Characteristics (n = 23) *continued*

First author (year)	Sample characteristics					Study characteristics		
	Sample size	Age range	Country	% female	Racial/ethnic composition	Study design	Potential confounders adjusted for in analyses	Quality assessment rating
			United Kingdom					
Hossain (2021)[65]	30	3–5 years	Bangladesh	NR	NR	Longitudinal	—	Fair
Ikeda (2012)[50]	39,813	4 years	Japan	48%	NR	Cross-sectional	Location (e.g., large cities, rural), gender, number of older siblings, maternal education level, paternal education level, TV screen time, computer games screen time, maternal work hours, paternal work hours	Fair
Iwata (2011)[51]	47	5 years	Japan	43%	NR	Cross-sectional	Weekday vs. weekend, gender, cultural lessons, fixed bedtime, non-routine naps, fixed bathtime, sports lessons	Fair
Ji (2018)[66]	112	3–6 years	China	51%	94% Han Chinese, 6% minority	Cross-sectional	—	Fair
Komada (2012)[52]	967	0–5 years	Japan	49%	NR	Cross-sectional	Age	Fair
Nevarez (2010)[60]	1676	0–2 years	United States	49%	68% White, 14% Black, 5% Hispanic, 4% Asian, 9% Other	Longitudinal	Maternal age, maternal parity, maternal education, household income, child gender, child race/ethnicity	Fair
Newton (2023)[55]	702	1–5 years	Canada	46%	69% White, 6% Chinese, 2% South Asian, 3% Indigenous, 5% Black, 2% Arab/West Asian, 3% Filipino, 4% Latin American, 1% Japanese, 2% Other	Cross-sectional	Nighttime sleep problems, nighttime sleep duration, parental nap beliefs, reasons parents discourage napping, environmental confusion, parent naps, child age, child sex, child ethnicity, siblings, highest education in the household, family income, parent's occupational status, developmental milestones, birthweight, maternal alcohol use during pregnancy	Fair
Philbrook (2019)[61]	68	2–5 years	United States	54%	67% European American, 25% African American, 8% Other	Longitudinal	—	Fair
Plancoulaine (2015)[62]	1028	3 years	France	47%	NR	Cross-sectional	Gender, recruitment site, household income, parent education, isolated mother, physical activity, TV watching, food patterns, maternal BMI, night awakenings, parental presence when falling asleep, BMI z-score, maternal depression	Fair

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Table 1. Sample and Study Characteristics ($n = 23$) *continued*

	Sample characteristics					Study characteristics		
First author (year)	Sample size	Age range	Country	% female	Racial/ethnic composition	Study design	Potential confounders adjusted for in analyses	Quality assessment rating
Reynaud (2016)[63]	1346	2–6 years	France	47%	NR	Longitudinal	Recruitment site, parental education status, household income, maternal depression, child gender, child ponderal index, first child, passive smoking at home, TV viewing, atopic profile, ear nose throat infection, falling asleep with parental presence, bottle feeding at night, activity, shyness, emotionality	Fair
Shinomiya (2021)[53]	2312	1–2 years	Japan	50%	NR	Cross-sectional	Pre- vs. post-COVID-19	Fair
Touchette (2005)[56]	2223	0–2 years	Canada	45%	88% White, 3% Black, 2% Arab, 2% Asian, <1% Native Amerindian	Longitudinal	Age, sex, poor health status, prematurity, difficult temperament, maternal immigration status, parental behaviors at bedtime, parental behaviors after an awakening, given object to fall asleep, co-sleeping, breastfeeding, insufficient family income, maternal depression, maternal efficacy, maternal overprotectiveness, number of siblings	Fair

NR, Not reported.

Table 2. Results for Child Care Arrangement Comparisons (*n* = 14)

First author (year)	Comparison groups	Sleep outcome(s)	Measure(s)	Findings
Burnham (2016)[59]	• Relative care • Non-relative care • Center-based care	• Duration (nap)	Child care provider reported (interview)	Children cared for by a relative napped longer than those in either non-relative or center-based care
Chen (2017)[64]	• Single child care arrangement [referent] • Multiple arrangements • No child care	• Duration (nighttime [weekday and weekend]) • Difficulty falling asleep • Waking during the night • Restless sleep • Bedtime	Parent reported (questionnaire and diary)	Compared with children with a single child care arrangement, no arrangement was associated with shorter weekday nighttime sleep at 9 months; null findings for multiple arrangements; null findings for weekend nighttime sleep, difficulty falling asleep, waking during the night, and restless sleep; null findings at 2.5 years
Chen (2017)[64]	• Nonattenders (no child care at 9 months or 2.5 years) [referent] • Late attenders (child care at 2.5 years, not 9 months) • Early attenders (child care at 9 months, not 2.5 years) • Consistent attenders (child care at both 9 months and 2.5 years, no change in configuration) • Inconsistent attenders (child care at both 9 months and 2.5 years, change in configuration)	• Duration (nighttime [weekday and weekend]) • Difficulty falling asleep • Waking during the night • Restless sleep • Bedtime	Parent reported (questionnaire and diary)	In longitudinal analyses, child care arrangement moderated the effect of age on nighttime sleep duration such that late attenders and inconsistent attenders increased their weekday nighttime sleep duration at a slower rate than nonattenders; null findings for early attenders and consistent attenders; late attenders and inconsistent attenders also increased their weekend nighttime sleep duration at a slower rate than nonattenders; null findings for early attenders and consistent attenders; null findings for bedtime
Costanian (2017)[57]	• Day care use • No day care use	• Duration (nighttime; dichotomized as using 11 hours as cut point)	Parent reported (questionnaire)	Null findings for association between day care use and sleep duration (bivariate and adjusted analyses)
Fujii (2022)[67]	• Private kindergarten (full day, optional nap) • Public kindergarten (half day) and then child care facility after 12:00 pm (mandatory afternoon nap)	• Bedtime • Wake time • Nap start time • Nap end time • Duration (24-hour, nighttime, nap) • Frequency of naps	Parent and child care provider reported (diary)	Children attending public kindergarten in the morning and child care in the afternoon had longer 24-hour sleep durations than those attending private kindergarten on weekdays, and shorter 24-hour sleep durations on weekends; among those who napped on weekends, those attending private kindergarten had longer daytime sleep durations; null findings for nighttime sleep duration; the proportion of children who took a nap was higher among those attending public kindergarten in the morning and child care in the afternoon compared with those in private kindergarten overall and on weekdays and lower on weekends, but there were no apparent tests to examine if the differences were significant; null findings for bedtime, wake time, nap start time, and nap end time

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Table 2. Results for Child Care Arrangement Comparisons (n = 14) *continued*

First author (year)	Comparison groups	Sleep outcome(s)	Measure(s)	Findings
Fukuda (2019)[49]	• Nursery school (1.5-hour obligatory nap) • Home or kindergarten (no obligatory nap)	• Bedtime (on weekdays)	Parent reported (questionnaire)	Children attending nursery school had later weekday bedtimes than children not attending nursery school, with differences increasing as children age
Giannoumis (2022)[54]	• Day care or preschool • No day care or preschool	• Social jetlag (defined as absolute difference in minutes between sleep midpoint on weekend days and weekdays)	Actigraphy	Social jetlag was greater in children who attended day care or preschool compared with children who did not
Glass (1949)[68]	• Nursery school • Home care	• Sleep disturbances (restlessness, wakefulness, bad dreams, sleepwalking, and/or refusal to be left)	Parent reported (questionnaire)	Sleep disturbances were more common among children who attended nursery school than those with home care, but there were no apparent tests to examine if the difference was significant
Ikeda (2012)[50]	• Child care center • Preschool • Nonattendance [referent]	• Duration (24-hour, nighttime, daytime; continuous and dichotomized for 24-hour and nighttime sleep using 10 hours and 9.5 hours as cut points, respectively) • Wake time (continuous and dichotomized using 7:30 am as cut point) • Bedtime (continuous and dichotomized using 9:00 pm and 10:00 pm as cut points) • Presence of daytime napping	Parent reported (questionnaire)	Sleep duration (24-hour, nighttime, and daytime, whether continuous or dichotomized), wake time (continuous and dichotomized), bedtime (continuous and dichotomized), and daytime napping differed across child care arrangements (bivariate analyses); children attending child care centers had decreased odds for short 24-hour sleep duration and late wake time, and increased odds for short nighttime sleep duration, daytime napping, and bedtime later than 9:00 pm compared with nonattenders (adjusted analyses); null findings for bedtime later than 10:00 pm; children attending preschool had decreased odds for daytime napping, late wake time, bedtime later than 9:00 pm, and bedtime later than 10:00 pm, and increased odds for short 24-hour sleep duration and short nighttime sleep duration (adjusted analyses)
Nevarez (2010)[60]	• Outside the home child care • In-home care	• Duration (24-hour)	Parent reported (questionnaire)	Children receiving outside of the home child care had shorter 24-hour sleep durations at 1 year (bivariate only) and 2 years (bivariate and adjusted analyses) than those with in-home care; null findings at 6 months
Newton (2023)[55]	• Exclusive parent/guardian care [referent] • Care by non-parent/guardian or center • Kindergarten	• Nap pattern (regular, intermittent, spontaneous, or non-napper; modeled using typical nap duration, typical timing of naps, weekly frequency of naps, proportion of sleep during the daytime, and proportion of naps which were spontaneous)	Parent reported (questionnaire)	Null findings for association between child care arrangement (with exclusive parent/guardian care as referent) and napping profiles (with non-napper as referent)

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Table 2. Results for Child Care Arrangement Comparisons ($n = 14$) *continued*

First author (year)	Comparison groups	Sleep outcome(s)	Measure(s)	Findings
Plancoulaine (2015)[62]	• Community child care (preschool, nursery school, or child care center) [referent] • Nursery assistant (external to the child's home) • In-home care (parent, family member, friend, nanny, or neighbor)	• Duration (24-hour; dichotomized with 12 hours as the cut point)	Parent reported (questionnaire)	Females receiving in-home care had higher odds of having short 24-hour sleep duration than those in community child care; null findings for boys; null findings for nursery assistant
Reynaud (2016)[63]	• Day care or preschool (large collective setting), at age 3 • Home care, at age 3	• Night-waking trajectory from age 2 to 5 (rare or common; modeled using dichotomized number of times per week child wakes during the night, with frequent night waking defined as waking every other night or more)	Parent reported (questionnaire)	Children attending day cares/preschools at age 3 had increased odds of being on the common night-waking trajectory compared with children with home care (bivariate and adjusted analyses)
Touchette (2005)[56]	• Day care setting (categories not specified)	• Longest stretch of nighttime sleep (dichotomized using 6 hours as the cut point)	Parent reported (questionnaire)	Null findings for association between day care setting and longest stretch of nighttime sleep at 5 months, 17 months, and 29 months

in child care outside the home than those with in-home care, though no tests of significance were included. Finally, Plancoulaine et al.[62] compared 24-hour sleep duration among 3-year-olds with in-home care, community child care, and out-of-home nursery assistants. The authors found that females in community child care had lower odds of having short sleep duration than those with in-home care.[62] There were no significant findings for males or having an out-of-home nursery assistant.[62]

Among the two studies where all children were in some form of child care but of different types,[59,67] Burnham et al.[59] found that 2-year-olds in relative care napped longer than those in either non-relative care or center-based care. Fujii et al.[67] found that 3- to 6-year-olds attending public kindergarten in the morning and child care facilities with mandatory naptime in the afternoon had longer 24-hour sleep durations than those attending full-day private kindergarten with optional naptime on weekdays and shorter 24-hour sleep durations on weekends. Furthermore, the authors found that among those who napped on weekends, those attending private kindergarten had longer daytime sleep durations.[67]

Fukuda et al.[49] also considered the impact of obligatory naps. They compared weekday bedtimes between 1- to 6-year-olds who attended nursery school with an obligatory 1.5-hour naptime and 1- to 6-year-olds who were at home or in kindergarten with no obligatory nap.[49] The authors found that children attending nursery school had later weekday bedtimes than children not attending nursery school, with differences increasing as children age.[49]

Finally, Touchette at al.,[56] who examined differences in the longest stretch of nighttime sleep among 0- to 2-year-olds based on day care setting without specifying categories, had no significant findings.

Child care Dose Comparisons

Of the six studies examining sleep outcomes based on child care dose,[47,48,51,53,58,64] three compared children who were in half versus full-day programs (see Table 3).[47,48,51] Doi et al.[47] found that among 3- to 5-year-olds, children in full-day care were more likely to have an evening-type chronotype than children in half-day care. Fukuda at el.[48] found that among 3- to 6-year-olds, children in full-day care went to bed later and had shorter nighttime sleep but napped more frequently than children in half-day care. Children in full-day care also had higher scores for sleep difficulties, frequency of staying up, bad mood at rising, unwillingness to go to school, and lower scores for subjective sleep sufficiency than children in half-day care.[48] Lastly, Iwata et al.,[51] who measured sleep via actigraphy, found that 5-year-olds in full-day care woke up earlier on weekends than those in half-day care. They did not find differences in sleep onset time or sleep efficiency.[51]

Two studies examined sleep outcomes based on days per week of child care attendance.[53,58] Beyens et al.,[58] who included 3- to 5-year-olds in their study, treated days

Table 3. Results for Child Care Dose Comparisons ($n = 6$)

First author (year)	Comparison groups	Sleep outcome(s)	Measure(s)	Findings
Beyens (2019)[58]	• Days per week in child care (range: 0–7)	• Bedtime • Wake time • Duration (24-hour, nighttime, daytime) • Sleep consolidation (defined as nighttime duration/total duration)	Parent reported (questionnaire)	Child care attendance was associated with earlier wake times and shorter nighttime sleep duration; null findings for bedtime, 24-hour sleep duration, daytime sleep duration, and sleep consolidation
Chen (2017)[64]	• No child care [referent] • Hours in child care center • Hours in relative care • Hours in non-relative care	• Duration (nighttime [weekday and weekend]) • Difficulty falling asleep • Waking during the night • Restless sleep • Bedtime	Parent reported (questionnaire and diary)	In cross-sectional analyses, increased hours spent in relative and nonrelative care was associated with shorter weekday nighttime sleep compared with children who did not spend time in child care at 9 months; null findings for center-based care; null findings for weekend nighttime sleep, difficulty falling asleep, waking during the night, and restless sleep; at 2.5 years, increased hours spent in each of the three types of child care was associated with shorter weekday nighttime sleep compared with children who did not spend time in child care; null findings for weekend nighttime sleep, difficulty falling asleep, waking during the night, and restless sleep
Doi (2016)[47]	• Child care center (8 hours) • Kindergarten (4 hours)	• Chronotype (dichotomized as evening-type vs. morning- or neither-type)	Parent reported (questionnaire)	Children attending child care centers had increased odds for having an evening-type chronotype compared with children attending kindergarten
Fukuda (2002)[48]	• Half-day kindergarten (morning hours) • Full-day nursery school (open 9:00 am–5:00 pm, scheduled nap)	• Bedtime • Wake time • Duration (nighttime) • Number of naps per week • Sleep-related symptoms (difficulties with sleep onset, wakings after sleep onset, feelings of being fast asleep, frequency of staying up, subjective insufficiency of sleep, mood at rising in the morning, unwillingness to go to school, frequency of nightmares, night terror, sleep talking, teeth grinding, bed-wetting, sleep walking, sleep paralysis, non-24 hour sleep wake rhythm, seasonal changes of sleeping pattern)	Parent reported (questionnaire and diary) for all outcomes except number of naps per week which was provider reported (diary)	Children who attended full-day nursery school went to bed later and had shorter nighttime sleep but napped more frequently, than children who attended half-day kindergarten (bivariate analyses); children who attended full-day nursery school also had higher scores for sleep difficulties, frequency of staying up, bad mood at rising, and unwillingness to go to school, and lower scores for subjective sleep sufficiency than children who attended half-day kindergarten (multivariate analyses); null finding for wake time and other sleep-related symptoms

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Table 3. Results for Child Care Dose Comparisons ($n = 6$) *continued*

First author (year)	Comparison groups	Sleep outcome(s)	Measure(s)	Findings
Iwata (2011)[51]	• Half-day nursery school (open 9:30 am–1:30 pm) • Full-day nursery school (open 7:00 am–8:00 pm)	• Sleep onset time • Wake time • Efficiency	Actigraphy	Children who attended full-day nursery school woke up earlier on weekends than children who attended half-day nursery school (bivariate and adjusted analyses); null findings for weekdays, sleep onset time, and sleep efficiency
Shinomiya (2021)[53]	• Primarily in nursery school (attends nursery school 3+ days/week) • Primarily stays home (attends nursery school <3 days/week)	• Duration (24-hour and nighttime) • Bedtime • Wake time • Latency	Parent reported (diary)	Children attending nursery school 3+ days/week woke up earlier, went to bed later, had shorter sleep latency, and had shorter nighttime sleep durations compared with children who primarily stay home; null findings for 24-hour sleep duration

per week as a continuous variable. The authors found that increased child care attendance was associated with earlier wake times and shorter nighttime sleep durations.[58] Shinomiya et al.,[53] who included a younger sample (1- to 2-year-olds) in their study, dichotomized days per week of child care attendance. Consistent with Beyens et al.,[58] the authors found that children attending nursery school 3 or more days per week had earlier wake times and shorter nighttime sleep durations than those who attended less than 3 days per week.[53] They also had later bedtimes and shorter sleep latency.[53]

The last study examined sleep outcomes based on hours per week of child care attendance.[64] Specifically, Chen et al.[64] compared sleep outcomes among 0- to 2-year-olds based on hours per week spent at a child care center, in relative care, and in non-relative care compared with no child care (as the reference group). The authors found that increased hours spent in each type of child care was associated with shorter weekday nighttime sleep, but not weekend nighttime sleep, compared with children with no child care.[64] They did not find associations for difficulty falling asleep, waking during the night, or restless sleep.[64]

Child Care-Day Versus Home-Day Comparisons

Of the six studies comparing sleep outcomes of children enrolled in child care on days they attended care versus home days, five examined differences on weekdays versus weekends (see Table 4).[46,52,61,65–67] Doi et al.[46] found that 4- to 6-year-olds in child care had an earlier bedtime, lights off time, sleep onset time, wake time, get-up time, time when fully alert, and mid-sleep point on weekdays compared with weekends. Additionally, nighttime sleep duration, time in bed, and sleep inertia were shorter on weekdays compared with weekends.[46] Komada et al.[52] examined similar associations but among children with a wider age range (0- to 5-year-olds). While significance was not reported, children in their sample also had earlier bedtimes, earlier wake times, and shorter nighttime sleep durations on weekdays.[52] Earlier weekday wake times and shorter nighttime sleep durations were consistent with findings from Fujii et al.[67] Furthermore, Fujii et al.[67] found that 24-hour sleep duration was longer on weekdays among 3- to 6-year-olds in child care, with a higher proportion of children napping on weekdays versus weekends. However, bedtime did not differ significantly on weekdays versus weekends in this sample.[67] Ji et al.[66] also examined weekday/weekend differences in 24-hour sleep duration among 3- to 6-year-olds in child care but used actigraphy. Findings were opposite of Fujii et al.[67]; 24-hour sleep duration was longer on weekends than on weekdays.[66] Also contrary to the earlier bedtime findings of Doi et al.,[46] children in this sample were less likely to go to bed before 10 pm on weekdays than they were on weekends.[66] Lastly, Philbrook et al.,[61] who also used actigraphy to measure sleep, found that daytime sleep duration was longer on weekdays compared with weekends

Table 4. Results for Child Care-Day Versus Home-Day Comparisons ($n = 6$)

First author (year)	Comparison groups	Sleep outcome(s)	Measure(s)	Findings
Doi (2014)[46]	• Weekdays (attendance at a child care center or kindergarten) • Weekends (no attendance at a child care center or kindergarten)	• Bedtime • Lights off time • Sleep onset time • Wake time • Get-up time • Time when fully alert • Midsleep point • Duration (nighttime) • Time in bed • Time in bed and nap • Sleep latency • Sleep inertia	Parent reported (questionnaire)	On weekdays, children in child care had an earlier average bedtime, lights off time, sleep onset time, wake time, get-up time, time when fully alert, and midsleep point than they did on weekends; nighttime sleep duration, time in bed, and sleep inertia were also shorter on weekdays than weekends; null findings for time in bed and nap and sleep latency
Fujii (2022)[67]	• Weekdays (school days) • Weekends (home days)	• Bedtime • Wake time • Nap start time • Nap end time • Duration (24-hour, nighttime, nap) • Frequency of naps	Parent and child care provider reported (diary)	On weekdays, children woke up earlier and had shorter nighttime sleep duration, but longer 24-hour sleep duration than on weekends; null findings for bedtime, nap start time, nap end time, and daytime duration; the proportion of children who took a nap was higher weekdays compared with weekends, but there were no apparent tests to examine if the differences were significant
Hossain (2021)[65]	• Before the COVID-19 pandemic (attendance at preschool) • COVID-19 pandemic lockdown (no attendance at preschool)	• Duration (24-hour)	Parent reported (questionnaire)	Null findings comparing the 24-hour sleep duration of children in preschool before the COVID-19 pandemic (i.e., when they were attending preschool) and during the lockdown (i.e., when they were not attending preschool)
Ji (2018)[66]	• Weekdays (attendance at preschool) • Weekends (no attendance at preschool)	• Duration (24-hour; continuous and dichotomized using 8 hours as cut point) • Light sleep duration • Deep sleep duration • Bedtime (dichotomized using 10:00 pm as cut point)	Actigraphy	24-hour sleep duration was longer on weekends than on weekdays and children were more likely to go to bed before 10 pm on weekends than on weekdays; null findings for light sleep duration, deep sleep duration, and sleeping at least 8 hours
Komada (2012)[52]	• Weekdays (attendance at a nursery school, scheduled nap) • Weekends (no attendance at a nursery school)	• Bedtime • Wake time • Duration (nighttime, main/longest nap)	Parent reported (diary) for all outcomes except number of duration of main/longest nap which was provider reported (diary)	On weekdays, children in nursery school had an average bedtime that was 5 minutes earlier, an average wake time that was 24 minutes earlier, an average nighttime sleep duration that was 18 minutes shorter, and an average main/longest nap duration that was 25 minutes longer than they did on weekends, with differences more pronounced for older children, but there were no apparent tests to examine if any of the differences were significant
Philbrook (2019)[61]	• Weekdays (attendance at day care center) • Weekends (no attendance at day care center)	• Duration (nighttime, daytime)	Actigraphy	Children attending day care centers had longer daytime sleep duration (during the fall and spring) and shorter nighttime sleep duration (during fall only) on weekdays compared with weekends

among 2- to 5-year-olds in child care, while nighttime sleep duration was shorter. However, nighttime sleep was only shorter during the fall, not during the spring.[61]

The other study that examined sleep outcomes on child care-days versus home-days was by Hossain et al.[65] This study, which examined differences in 24-hour sleep duration among 3- to 5-year-olds who were attending preschool before the COVID-19 pandemic and during the COVID-10 pandemic lockdown, did not have any significant findings.[65]

Discussion

This systematic review synthesized findings from past studies examining associations between child care arrangement, dose, and attendance and sleep outcomes among children ages 0–5 years. Twenty-three studies were identified across diverse settings, with diverse comparison groups and child sleep outcomes. However, consistent with a previous systematic review conducted by Costa et al.,[69] there appears to be little research examining the longitudinal effects of child care on children's sleep outcomes. Note, Costa et al.'s[69] review of longitudinal effects of child care attendance on various health behaviors in children only identified 1 study that examined sleep. We identified 6 longitudinal studies. Furthermore, by also examining cross-sectional associations, for which we identified 17 studies, this article offers the most comprehensive review of associations between child care and children's sleep outcomes to date. Considerable heterogeneity across studies, with regard to both child care comparison groups and sleep outcomes assessed, precluded us from carrying out a meta-analysis. However, taken as a whole, findings indeed suggest that the sleep outcomes of 0- to 5-year-olds are impacted by child care arrangement type, dose, and attendance. Thus, promoting improved sleep practices in child care is important due to the role child care environments have on various aspects of children's sleep, including 24-hour sleep duration. Notably, simply increasing napping during child care is not the solution as it can be consequential (e.g., negatively impacting nighttime sleep), particularly for children who no longer need to nap to meet their sleep needs.[70]

Among the 14 child care arrangement comparisons made, significant differences for at least 1 sleep outcome were found among 11. Significant findings were present whether comparing children in child care versus not, comparing children in in-home care versus out-of-home care, or comparing children with obligatory naps versus not. Differences in sleep outcomes were also observed based on particular types of child care. While there were some mixed findings, being in child care, care outside the home, and obligatory naps were often positively associated with daytime sleep and negatively associated with nighttime sleep. Child care sleep policies mandating nap/rest time likely contribute to these findings, but other factors may also contribute. For example, children in child care, especially child care outside of the home, may be woken up earlier (e.g., so that parents can get to work on time) than those not in child care or receiving care in their home. Children in child care may also engage in more structured and/or movement-based activities, leading them to nap more. Finally, environmental factors and sleep-related caregiver behaviors may vary by child care arrangements in ways that impact children's sleep. Notably, Chen et al.'s[64] study was the only one that examined the impact of complex child care arrangements on children's sleep outcomes. Given the current state of child care (e.g., issues with cost and access),[5,6] more families may be relying on multiple child care arrangements to meet their needs. As such, further studies are needed in this area.

Of the six studies examining child care dose comparisons, all found significant differences for at least one sleep outcome. Similar to the child care arrangement comparison findings, whether comparing full-day care with half-day care or looking at days or hours per week in child care, child care was positively associated with daytime sleep and negatively associated with nighttime sleep. While the same factors may contribute to these findings, differences could also reflect child characteristics given the between-subjects design of studies. Specifically, age, which was not adjusted for in all studies, may be a confounder, influencing children's sleep outcomes and potentially the type and dose of care they receive. Future studies, especially those recruiting diverse children with a wide age range, should adjust for age and carefully consider other potential confounders in their analyses. Notably, adjustment for potential confounders was one of the criteria we assessed in our quality appraisal. Only 2 of the 23 studies included in this review received an overall quality appraisal rating of "good," compared with 21 studies that received a rating of "fair," indicating that there is room to improve the overall strength of evidence on this topic.

Finally, of the six child care attendance day comparisons, significant differences for at least one sleep outcome were found among five. Again, findings were mixed, but child care days (i.e., weekdays) were generally associated with increased daytime sleep and decreased nighttime sleep compared with non-child care days (i.e., weekends). Interestingly, Philbrook et al.[61] found that shorter nighttime sleep on weekdays versus weekends only occurred during the fall, not spring. As no other studies examined seasonality effects, further studies in this area are needed as children may make adjustments as the school year progresses. However, this finding could also reflect changes in sleep needs as children age. Notably, Philbrook et al.'s[61] study was one of just four studies that measured sleep via actigraphy. The overall strength of evidence on this topic would be improved with further studies using actigraphy or other objective measures of children's sleep, as parent and child care provider–reported measures are more prone to measurement error.

The heterogeneity of sleep outcomes assessed across the studies included in this review is both a strength and limitation. While it precluded us from conducting a meta-analysis, it is a strength in the current state of the literature given evidence that various characteristics of sleep, beyond just duration, impact children's health.[71] That said, the evidence linking childhood sleep and obesity risk largely centers around sleep duration, particularly 24-hour sleep duration. Across the studies included in this review, there were nine comparisons with 24-hour sleep duration as the outcome. Both of the studies examining how 24-hour sleep duration differed based on child care dose (e.g., number of days per week in child care) had null findings, and findings were mixed among the three studies examining how 24-hour sleep duration differed among children in child care on child care versus home days (i.e., one study found 24-hour sleep duration was longer on weekdays, one found 24-hour sleep duration was longer on weekends, and one had null findings). However, findings across the four studies examining how 24-hour sleep duration differed based on type of child care arrangement consistently demonstrated an association

Among younger children, Nevarez et al.[60] found that 1- to 2-year-olds in child care outside of the home had shorter 24-hour sleep durations than those with in-home care. This was possibly due to shorter daytime sleep (i.e., fewer/shorter naps) among children in child care outside of the home, though the authors did not measure daytime sleep duration. Differences in child care provider to child ratios and related constraints (e.g., difficulty implementing/adhering to individual sleep schedules, disruptions from crying babies, decreased ability to provide a private, quiet, and dark space for sleeping) between in-home and out-of-home child care settings likely impact daytime sleep duration, particularly among infants and toddlers. Interestingly, among older children (3+ years), child care outside of the home was associated with longer 24-hour sleep duration. Ikeda et al.[50] found that 4-year-olds not in child care had higher odds of short sleep duration than those attending child care centers. Unlike Nevarez et al.,[60] they also separately examined nighttime and daytime sleep, finding that these same children napped less and were less likely to have late bedtimes and short nighttime sleep.[50] Plancoulaine et al.[62] similarly found that 3-year-old females with in-home care had higher odds of short sleep duration than those in community child care both before and after adjusting for various potential confounders. Notably, this was the only study that adjusted for weight status (e.g., BMI z-score) in the analyses. As prior research has demonstrated that child care arrangements are associated with obesity risk,[72] this is another important gap in the literature, particularly with regard to understanding pathways through which child care sleep environments and practices may impact obesity risk.

Differences in nap routines and the structure across child care settings versus those implemented at home likely impact sleep as suggested by Fujii et al.,[67] who found that 24-hour sleep duration was longer on weekdays but shorter on the weekend for 3- to 6-year-olds in public kindergarten with mandatory naptime versus private kindergarten with optional naptime. This is consistent with research by Staton et al., which has demonstrated that mandatory naps are associated with increased daytime sleep duration but decreased nighttime sleep.[73,74] More studies examining which aspects of child care are associated with 24-hour sleep duration, and how this differs by age, are needed to inform efforts to optimize child care sleep settings. A developmental approach is likely needed in examining the impact of child care on children's sleep, necessitating nuanced interventions and policies. Notably, a systematic review from Staton et al.[38] found that while 98% of children under age 2 nap, only 6% of children still nap at age 5, and another systematic review by Thorpe et al.[70] found that napping after age 2 was associated with later nighttime sleep onset and reduced sleep quality and duration. It is important to note though, that while the three studies in the latter review that examined differences in 24-hour sleep reported no differences, suggesting that naps do not increase total sleep, but instead change the distribution of sleep, findings from other studies suggest that opportunities to nap are particularly important for certain populations for which sleep disparities have been documented (e.g., racial and ethnic minority children and those from families with low socioeconomic status).[60,75,76] However, mandating naptime for children who do not need to nap likely leads to increased sedentary behavior and may thus increase obesity risk,[77] again underscoring the importance of nuance.

The present systematic review was conducted using rigorous methodology and provides insight on the current state of research about how different child care settings impact children's sleep, but limitations are worth noting. First, it is possible that relevant studies were missed during our screening process as a result of our search strategy, which included three databases and our inability to review manuscripts that were written in languages other than English. Second, heterogeneity across studies prevented us from doing a meta-analysis, though patterns were observed with child care commonly positively associated with daytime sleep and negatively associated with nighttime sleep. Additionally, child care arrangement specifically was associated with 24-hour sleep duration but in opposite directions for infants and toddlers than for preschool-age children. However, given the "fair" quality appraisal assessment of most studies, and the lack of many cross-sectional studies to adjust for key potential confounders, caution is warranted when interpreting specific findings.

Conclusions

This review provides evidence that child care can impact children's sleep in various ways depending on the

type of child care, amount of time spent in child care, and child's age. Along with the strong body of evidence demonstrating that insufficient sleep increases risk for obesity among children,[29–32] our findings provide a clear rationale for the inclusion of sleep into child care-based obesity prevention research. Similar to conclusions drawn in a systematic review by Black et al.,[72] examining associations between child care arrangements and obesity risk, more research is needed to examine the pathways through which child care characteristics impact children's sleep and obesity risk and how this differs by age. Specifically, more research is needed to understand best practices for promoting sleep to decrease obesity risk across child care settings and developmental stages to inform intervention efforts. Given that many children in child care, particularly infants and toddlers, rely on sleeping during the day to meet their sleep needs,[38] child care factors that facilitate adequate sleep should be enhanced to optimize child care sleep settings. Similar to diet and physical activity, child care policies, environmental factors, and provider behaviors surely impact children's sleep and should therefore be assessed along with child sleep and obesity-related outcomes to identify intervention targets. A sleep section could easily be added to NAPSACC and other existing child care–based interventions that already assess and target diet- and/or physical activity-related practices and environments. Notably, integrating a sleep component to already highly successful programs such as NAPSACC would facilitate widespread reach and may increase efficacy as demonstrated by findings from Miller et al.'s[29] systematic review. Formative research is surely needed given that best practices for sleep promotion in child care are currently lacking, but not assessing and intervening on sleep in child care is a missed opportunity.

Impact Statement

Findings from this systematic review of associations between child care (arrangement, dose, and attendance) and sleep outcomes in early childhood provide rationale for the inclusion of sleep into child care–based obesity prevention research. Integrating sleep into evidence-based child care obesity prevention interventions could help reduce obesity risk among young children.

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Authors' Contributions

T.v.A. conceptualized the systematic review topic, supervised review activities, conducted extraction and quality assessment, and wrote and edited the article draft. B.O. conducted title/abstract and full-text screening, extraction, and quality assessment and drafted sections of the article. A.G., N.D., A.J., and S.C. conducted title/abstract and full-text screening and extraction and provided edits to the article. A.C. contributed to the discussion and critically reviewed and edited the article. All authors approved the final article as submitted and agreed to be accountable for all aspects of the work.

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Supplementary Material

Supplementary Appendix A1

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