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CLINICAL REVIEW

ABCs of SLEEPING: A review of the evidence behind pediatric sleep practice recommendations

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SUMMARY

The ABCs of SLEEPING mnemonic was developed to serve as an organizing framework for common pediatric sleep recommendations. The mnemonic stands for 1) **a**ge appropriate **b**edtimes and wake-times with **c**onsistency, 2) **s**chedules and routines, 3) **l**ocation, 4) **e**xercise and diet, 5) no **e**lectronics in the bedroom or before bed, 6) **p**ositivity 7) **i**ndependence when falling asleep and 8) **n**eeds of child met during the day, 9) equal **g**reat sleep. This review examines the empirical evidence behind the practices and recommendations captured by the ABCs of SLEEPING mnemonic for children aged 1 to 12. A search was conducted of key electronic databases (PubMed, PsycINFO, CINAHL, & EMBASE) to identify English articles that included the concepts of sleep, insomnia, and/or bedtime. 77 articles were eligible for inclusion and were coded to extract key details and findings regarding the relations between sleep practices identified in the ABCs of SLEEPING mnemonic and sleep outcomes. Findings provided preliminary support for many of the recommendations that are commonly made to families regarding healthy sleep practices. However, more robust investigations are needed to better understand the causal contributions of healthy sleep practices to the onset and maintenance of children's sleep problems.

Despite the critical role that sleep plays in children's development and daily functioning, children's sleep durations are steadily declining [1], and pediatric sleep problems are pervasive [2]. Twenty to 30% of children experience clinically significant sleep problems [2], and approximately 70% of children experience at least one sleep-related problem a few nights a week [3]. While a small percentage of children experience intrinsic sleep disorders that require medical attention (e.g., sleep apnea), the vast majority presents with behavioural sleep problems which most frequently manifest as difficulties initiating sleep (e.g., bedtime problems), difficulty maintaining sleep (e.g., night time waking), or early morning awakenings. Even modest sleep restrictions (e.g., 1 h for four nights) negatively impact children's emotional, behavioural, and cognitive functioning [4,5]. Moreover, the impact and stress of pediatric sleep problems extends beyond the child, to their parents and families [6–8].

The wide-ranging impacts of sleep problems underscore the importance of their identification and treatment. Unfortunately, rates of behaviourally based sleep problems vastly outnumber the availability of sleep specialists [9]. Within these constraints, non-sleep specialists (e.g., pediatricians, general practitioners, social workers, psychologists, and nurses) already involved in children's care play a critical role in the identification and treatment of sleep problems. However, non-sleep specialists report lacking the knowledge, skills, training, time, and resources to adequately address sleep problems [10]. Research in primary care settings corroborates these reports, directly demonstrating that non-sleep specialists (e.g., primary care providers) rarely identify [11] or adequately address [12] pediatric sleep problems.

A number of researchers have called for the development of resources and tools that facilitate non-sleep specialists' ability to identify and manage pediatric sleep problems [10,13,14]. Existing research demonstrates that even the introduction of a simple mnemonic (i.e., BEARS, which stands for **b**edtimes, **e**xcessive daytime sleepiness, night **a**wakenings, **r**egularity and duration of sleep, and **s**noring) can help non-sleep specialists (i.e., pediatric residents) better identify sleep problems [15]. Additional resources and tools are needed to facilitate non-sleep specialists' ability to make appropriate recommendations and clinical decisions about how to

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manage sleep problems once identified [14]. Recognizing this gap in the literature, our research team developed the ABCs of SLEEPING mnemonic to capture constructs and practices that are commonly targeted by recommendations aimed at promoting healthy sleep [2,16]. The mnemonic is the ABCs of SLEEPING, which stands for "1) **a**ge appropriate **b**edtimes and wake-times with **c**onsistency, 2) **s**chedules and routines, 3) **l**ocation, 4) **e**xercise and diet, 5) no **e**lectronics in the bedroom or before bed, 6) **p**ositivity, 7) **i**ndependence when falling asleep, and 8) **n**eeds of child met during the day, 9) equal **g**reat sleep" [17].

This article uses the ABCs of SLEEPING mnemonic as an organizing framework for 1) outlining common pediatric sleep recommendations 2) reviewing and evaluating empirical research that speaks to these recommendations, and 3) identifying areas where further research is needed. The article focuses on children aged 1–12 as this encompasses the time period after most children can be expected to have developed the ability to sleep through the night (i.e., ~9 mo to 1 y), wherein parents play a major role in their children's sleep practices and routines. In organizing the article around the ABCs of SLEEPING mnemonic we hope to facilitate the ease with which non-sleep specialists will be able to readily recall and access the knowledge gained from reading this article, thus enhancing the clinical utility of the review. Ultimately, we hope the ABCs of SLEEPING mnemonic in tandem with this review will help to meet the identified need for comprehensive, accessible, time efficient, evidence-based resources to support non-sleep specialists' ability to provide guidance and recommendations to families around pediatric sleep problems.

Method

Search method

Four key electronic databases (PubMed, PsycINFO, CINAHL, & EMBASE) were searched in February and March of 2014 to identify all published articles that included the concepts of children AND sleep, AND/OR insomnia, AND/OR bedtime. Keywords were chosen to capture the population of interest and sleep, the major topic of interest.

Eligibility criteria

Studies were included if they met the following criteria 1) written in English 2) peer-reviewed 3) focused on samples of children where the mean age at the time that sleep was assessed ranged from 1 to 12 y 4) participants were healthy typically developing children free from mental or physical health conditions, other than behavioural sleep problems (or separate data for a healthy control group was available) 5) included a measure of sleep quality or quantity 6) directly measured one of the constructs captured by the ABCs of SLEEPING mnemonic 7) focused on the influence of one of the constructs captured by the ABCs of SLEEPING mnemonic on sleep outcomes, and 8) confirmatory or explicitly hypothesis-driven studies. Case studies, small-n designs, and qualitative studies were not included. While review papers were not included in the formal review and coding process, findings from the current review were considered in light of conclusions from recent and relevant systematic reviews where available.

Selection of studies and charting

Fig. 1 provides an overview of the article review process. Across the four databases, 12,099 articles were identified; 8,277 unique records remained after duplicates were removed. The titles and abstracts of each of these unique records were independently reviewed by two of the co-authors (SA and MH). Fig. 2 was used to guide this title and abstract review. Titles and abstracts that indicated that the article directly measured and reported on practices represented in the ABCs of SLEEPING mnemonic and sleep outcomes were included for full article screening (if a determination could not be made on the basis of the title and abstract the full article was screened for eligibility). A total of 295 articles underwent full article screening by two independent screeners. The first author (SA) reviewed and resolved points of disagreement in consultation with the two senior authors on the paper (AC and PC). A total of 218 articles were excluded (see Fig. 1 for reasons for exclusion), leaving 77 articles eligible for inclusion. All 77 articles were read and charted by the first author (SA) using an author-developed data extraction form. Charting included extracting reference details, demographic information, design characteristics, outcome measures, and relevant key findings. Key findings were coded based on which of the ABCs of SLEEPING practices they addressed. Coding was not mutually exclusive (i.e., articles that spoke to multiple practices were coded in multiple places). A study-specific basic classification scheme was operationalized for rating the level of empirical support identified for different recommendations. The classification scheme considers 1) the quantity of empirical support for a given recommendation 2) the consistency of empirical support identified across different studies, and 3) the types of studies that are being reviewed to make a determination around the level of empirical support. Empirical support for recommendations was rated as being strong, moderate, limited, equivocal, insufficient, or non-support. The rating system is hierarchical in nature; the most confidence can be placed in recommendations classified as having strong or moderate support, and the least in those classified as equivocal or insufficient. However, it should be noted that a rating of equivocal or insufficient reflects a limitation in research and does not necessarily mean that a recommendation may not be helpful. The exception to this is recommendations falling in the non-supportive classification, which indicates that existing research calls into question the appropriateness or utility of the recommendation. Operational definitions for each classification are explicitly outlined in Table 3.

Results and Discussion

Table 1 details the first author, publication year, basic design elements, and sample characteristics of all 77 included articles, and provides an overview of which of the ABCs of SLEEPING practices are addressed by each article. Sixty-two percent (48 studies) used a cross-sectional design, 17% (13 studies) used a longitudinal design, and 21% (16 studies) were trials/interventions that targeted one or more of the practices represented in the ABCs of SLEEPING mnemonic. In terms of overall sample characteristics, 18% (14 studies) included infants aged 1–12 mo, 36% (28 studies) included toddlers aged 1–2 y, 45% (35 studies) included preschoolers aged 3–5 y, 53% (41 studies) included early school-age children aged 6–9 y, and 39% (30 studies) included middle school-age children aged 10–12 y. In terms of measuring sleep outcomes, 60% (46 studies) included parent-reports, 26% (20 studies) included self-report, 19% (15 studies) included actigraphy, 17% (13 studies) included parent completed sleep diaries, 3% (two studies) included observer ratings of sleep behaviours, and 5% of studies used some other form of sleep assessment (i.e., sleep video recordings, audiotapes of night wakings, teacher reports of daytime sleepiness, and a child completed diary were each used in one study). It should be noted that percentages for sample characteristics and measures may add up to >100% as many articles reported on children that fell into multiple age groups and/or used multiple forms of measurement. Table 2 provides a breakdown of study characteristics organized by

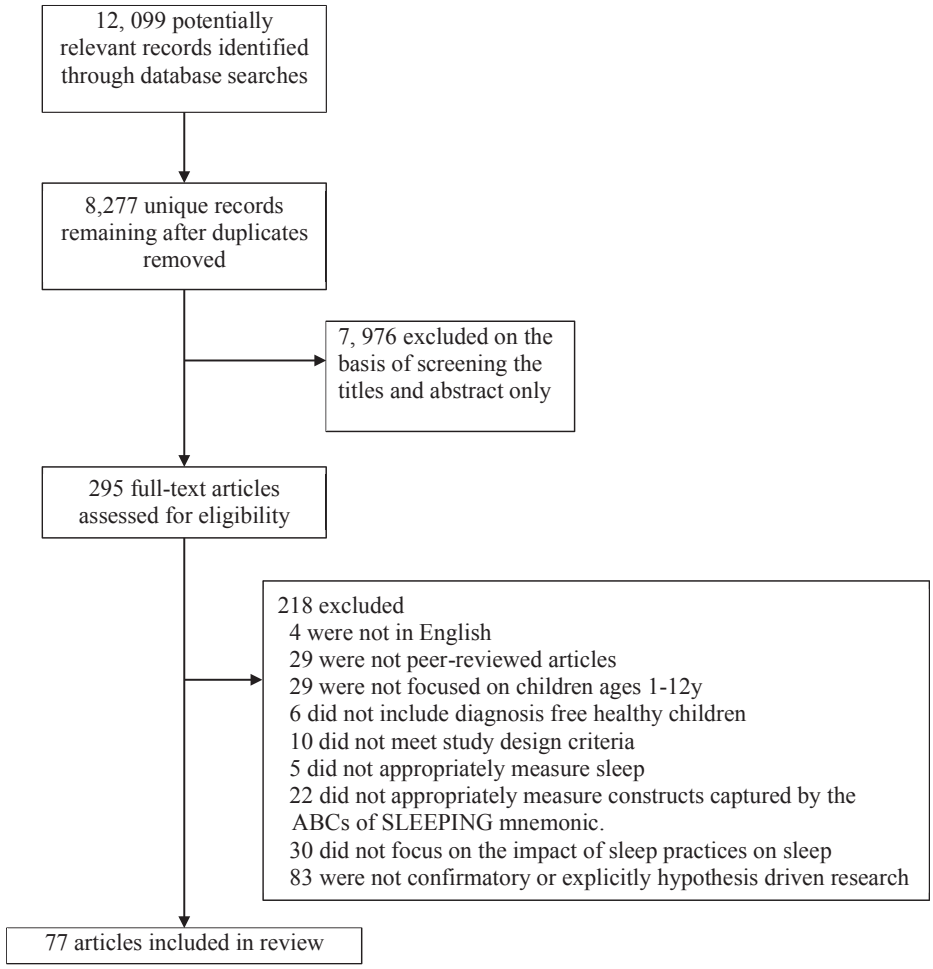

Fig. 1. Flow diagram detailing the identification and screening of articles for inclusion in the ABCs of SLEEPING review. Note: ABCs—**a**ge appropriate **b**edtimes and wake-times with **c**onsistencys; S—**s**chedules and routines; **l**—Location; **e**—Electronics; E—**e**xercise and diet; P—**p**ositivity; I—**i**ndependence; N—**n**eeds met during the day.

the ABCs of SLEEPING mnemonic. Table 3 offers a brief summary of the level of support for recommendations reviewed (note: operational definitions for level of support ratings outlined in table 3). The level of support varied widely for common pediatric sleep recommendations. Limited empirical support was identified for at least some of the recommendations within each of the areas captured by the ABCs of SLEEPING mnemonic, with some recommendations being classified as having strong empirical support. Only the recommendation that children avoid exercising too close to bedtime (i.e., within 1–4 h) was classified as having non-support. Current pediatric sleep recommendations and key findings from all 77 included studies that shed light on the level of empirical support behind current sleep recommendations are reviewed below.

*ABCs: **a**ge appropriate **b**edtimes and wake-times with **c**onsistency*

Current recommendation and rationale

Recommendations include ensuring that children nap, go to bed, and wake up at times that allow them to obtain age-appropriate amounts of sleep. The National Sleep Foundation recommends that for every 24 h cycle toddlers (1–2 y olds) obtain 11–14 h of sleep, preschoolers (3–5 y olds) obtain 10–13 h, and school-children (6–13y olds) obtain 9–11 h of sleep [18]. In addition, it is recommended that children go to bed no later than 21:00 h [19], maintain a regular sleep schedule with consistent naptimes (where appropriate; e.g., in infancy and toddlerhood), bedtimes and wake-times (i.e., no more than 30–60 min variations in sleep schedules).

Evidence

As shown in Table 1, seven articles were coded under **a**ge appropriate **b**edtimes and wake-times with **c**onsistency (ABCs). All seven articles (100%) identified an association between at least one sleep outcome and aspects relating to ABCs. Articles are further categorized based on whether they addressed the timing (i.e., when children go to bed and wake up), amount of sleep (i.e., sleep duration), or regularity of sleep schedules (i.e., the consistency of their bedtimes and wake-times across different days).

Age-appropriate bedtimes, wake-times, and naps. Four studies [19–22] were identified that addressed aspects relating to bedtimes, wake-times, or naps. Three of the studies [19,21,22] that explicitly examined the relations between late bedtimes (defined as later than 21:00 h) and sleep outcomes found that late bedtimes are consistently tied to poorer sleep outcomes (i.e., shorter sleep durations, increased night awakenings, and longer sleep onset latency). One study [19] indicated that for toddlers—an age group for whom the ABCs recommendations encourages napping—the absence of regularly scheduled naps is associated with poorer sleep outcomes (i.e., longer sleep onset latency and less total nighttime sleep). The last study [20] provided indirect support for the importance of setting age-appropriate bedtimes—children allowed to decide their own bedtimes spent less time in bed than children who had a set bedtime.

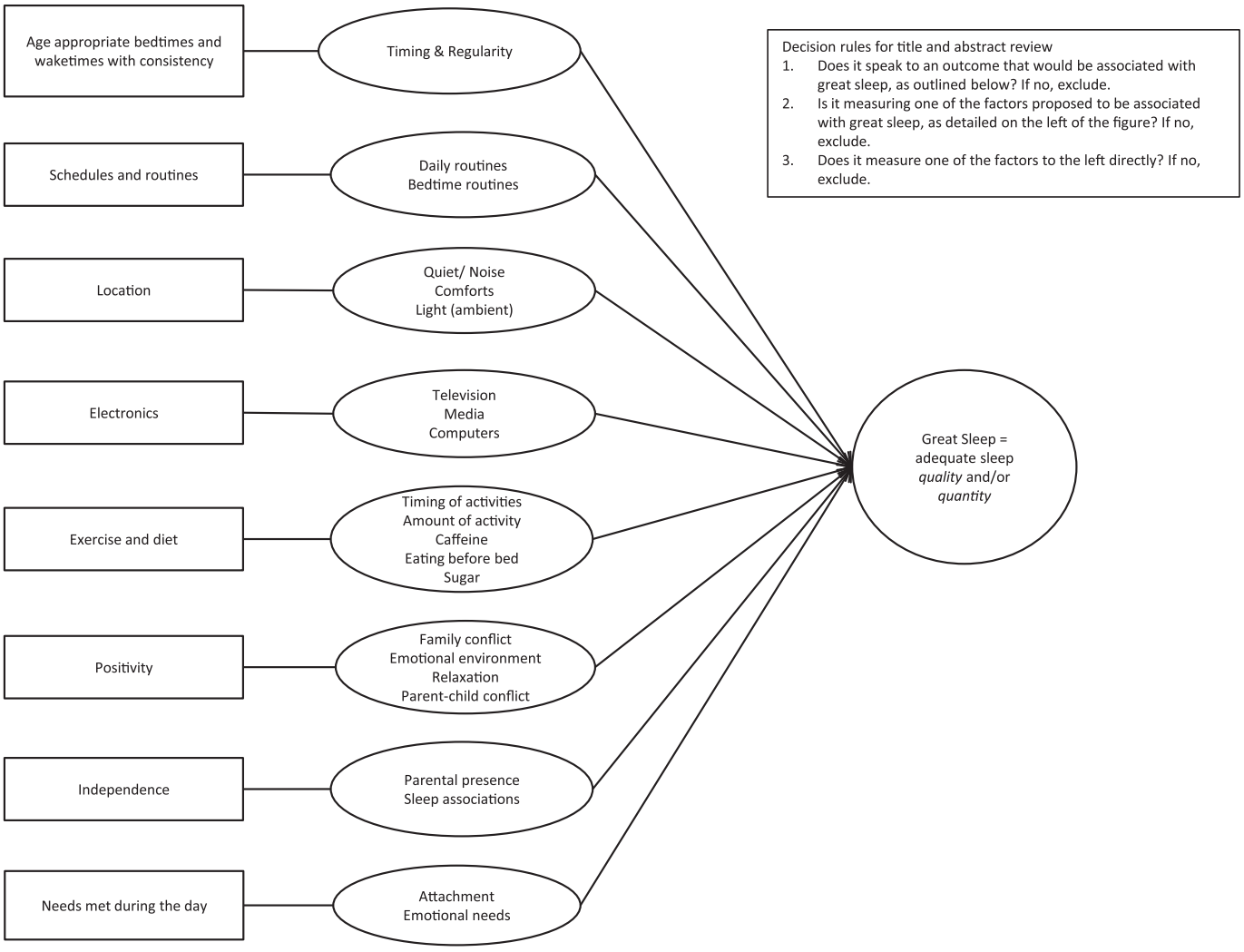

Fig. 2. Conceptualization graph for title and abstract review.

Age-appropriate sleep amounts. One of the studies [23] reported on a trial that included individualized recommendations aimed at ensuring that children obtained adequate amounts of sleep; this intervention led to improvements in sleep onset latency, night wakings, sleep continuity, and parent reports of sleep problems. We did not identify any other studies that reported on the relationship between age-appropriate sleep amounts and sleep outcomes. This is likely an artifact of the study design of this review. While many studies included sleep amounts/duration as an outcome, only the one study spoke to the association between age appropriate sleep amounts and other sleep outcomes. It is important to note that the topic of what constitutes age-appropriate sleep amounts is a somewhat controversial issue that cannot be fully explicated within the context of this review. The recommended range of hours contained herein are based on the National Sleep Foundation's (NSF) current guidelines, that stem from the consensus of 18 international sleep experts after they reviewed findings from 312 articles [18] that were beyond the scope of this review (i.e., they examined the relationship between sleep amounts and non-sleep outcomes such as daytime functioning). The current NSF guidelines also include a wider range of hours that some of the experts felt 'may be appropriate' for some people. We have only included the narrower 'recommended range' that experts were able to agree were appropriate for optimal functioning. For more information, we would encourage readers to review the National Sleep Foundation's research identifying age-appropriate sleep time durations [18] and a recent article on the challenges of defining optimal sleep durations [24].

Regularity. Four of the studies [22,25–27] addressed the relationship between the regularity of sleep schedules and sleep outcomes. Three studies [22,25,27] provided consistent support for the recommendation that regularity around sleep schedules (e.g., bedtimes, wake-times, and naptimes) is positively related to various sleep outcomes (e.g., sleep onset, indices of sleep problems, sufficient sleep duration). For example, children with more irregular bedtimes were more likely to obtain insufficient sleep [22], and children experienced delays in sleep-onset on days when they took naps that were not part of their regular sleep schedule [27]. Another study [25] found that children with regular sleep schedules and durations had fewer parent-reported sleep problems two years later. The fourth article [26] provided mixed evidence for this recommendation. Findings from this study indicated that preschoolers that had a fixed weekend bedtime had earlier sleep onset, and that non-routine naps on the weekends were associated with later sleep onset. However, indices of sleep efficiency were comparable on weekdays and weekends, despite statistically significant differences in weekday vs. weekend sleep onset and sleep end times. We did not identify any studies that more specifically examined the impact of the amount of variability in sleep schedules on sleep outcomes. Both longitudinal [25] and cross-sectional

Table 1
Summaries of all studies that meet inclusion criteria.

First author	Year	Design	*N*	Age group (*M*)	Sleep assessment	ABCs	S	L	E[1]	E[2]	P	I	N
Adam [37]	2007	Cross-sectional	1267	P, E, M (8.90 y)	Parent completed diary		✓		✓	X	+/–		
Adams [29]	1989	Trial	36	T (2.42 y)	Parent completed diary			✓				✓	✓
Alfano [93]	2009	Cross-sectional	88	E, M (n/a)	Self-report & parent-report								✓
Barlett [55]	2012	Longitudinal (13 mo)	1317	E, M (9.6 y)	Self-report				✓				
Bates [66]	2002	Cross-sectional	202	P (4.9 y)	Parent completed diary						+/–		
Bernier [70]	2013	Longitudinal (9mo)	85	T (n/a)	Parent-report						+/–		
Blunden [72]	2011	Trial	33	T, P (2.25 y)	Parent completed diary & parent-report						✓	✓	
Bordeleau [67]	2012	Longitudinal (3y)	70	T, P (1.07 y)	Parent completed diary						+/–		
Brown [47]	2008	Cross-sectional	96	P (4.08 y)	Parent-report			✓			✓		
Byars [6]	2011	Cross-sectional	160	T, P, E, M (5.66 y)	Parent-report						✓		
Calamaro [43]	2012	Cross-sectional	625	E, M (8.6 y)	Parent-report			✓	✓	✓			
Chahal [54]	2012	Cross-sectional	3389	M (5th graders)	Parent-report				✓				
Diethelm [62]	2011	Cross-sectional	594	T	Parent-report					+/–			
Eckerberg [78]	2004	Trial	95	I, T, P (1.23 y)	Parent completed diary							✓	
El-Sheikh* [74]	2006	Cross-sectional	54	E (8.85 y)	Self-report, parent-report & actigraphy						✓		
El-Sheikh* [88]	2007	Cross-sectional	166	E (8.72 y)	Self-report & actigraphy								✓
El-Sheikh* [89]	2007	Cross-sectional	166	E (8.72 y)	Actigraphy								✓
El-Sheikh* [73]	2012	Cross-sectional	268	E, M (9.44 y)	Self-report & actigraphy						+/–		
Field [31]	1999	Trial	24	T (n/a)	Observer ratings			X					
Field [30]	2001	Trial	23	I, T, P (1.5 y)	Parent-report, parent completed diary & observer ratings		✓						
Fisher [63]	1994	Longitudinal (10wk)	29	E, M (9.29 y)	Self-report & parent-report						✓		
Fukuda [27]	2002	Cross-sectional	441	P, E (5.10 y)	Parent-report		✓			✓			
Garrison [53]	2011	Cross-sectional	612	P (3–5 y)	Parent-report				✓				
Garrison [56]	2012	Trial	565	P (4.27 y)	Parent-report				✓				
Gregory [94]	2005	Cross-sectional	79	E, M (9.76 y)	Self-report								✓
Gregory* [64]	2008	Cross-sectional	189	E, M (8.8 y)	Self-report & parent-report						✓		
Gregory* [95]	2010	Cross-sectional	189	E, M (8.8 y)	Self-report								✓
Guerin [40]	2001	Cross-sectional	95	E, M (10 y)	Self-report		X						
Hale [32]	2011	Longitudinal (2y)	4274	P (3.21 y)	Parent-report		✓						
Hall [25]	2007	Longitudinal (4y)	2214	I, T, P	Parent-report	✓					✓		
Harris [97]	2013	Longitudinal (3y)	209	E, M (8.13 y)	Self-report								✓
Hayes [82]	1996	Cross-sectional	60	P (3.92 y)	Parent-report							+/–	
Hayes [86]	2001	Cross-sectional	67	P (3.8 y)	Parent-report							+/–	
Hayes [87]	2007	Cross-sectional	45	P (3.5 y)	Parent-report							✓	
Henderson [28]	2010	Cross-sectional	226	T, P, E (4.98 y)	Parent-report		✓				✓		
High [36]	2014	Trial	151	T (1.71 y)	Parent-report		X						
Iwata [26]	2011	Cross-sectional	48	P (5 y olds)	Actigraphy	+/–	✓			+/–			
Javadi [60]	2014	Cross-sectional	210	P, E (4.17 y)	Parent-report & parent completed diary					X			
Johnson [65]	2008	Cross-sectional	110	T, P (3.81 y)	Parent-report						✓		
Keller [84]	2004	Cross-sectional	83	P (4.19 y)	Parent-report							+/–	
Keller* [90]	2011	Longitudinal (2y)	176	E, M (8.68 y)	Self- report & actigraphy						✓		✓
Kelly* [7]	2011	Longitudinal (2y)	176	E, M (8.68 y)	Self-report & actigraphy						✓		
Kushnir [84]	2011	Cross-sectional	139	P, E (4.91 y)	Actigraphy & parent-completed diary							+/–	✓
Lemola [98]	2011	Cross-sectional	291	E (8 y olds)	Actigraphy								✓
Li [39]	2013	Trial	525	E, M (10.80 y)	Parent-report		✓						
Liu [48]	2003	Cross-sectional	517	E, M (11 y)	Parent-report			+/–				+/–	
Lundahl [75]	2013	Cross-sectional	122	E, M (9.48 y)	Parent-report						✓		
Martin [69]	2011	Trial	1850	P (~3 y)	Parent-report						✓		
Meijer [20]	2001	Cross-sectional	446	E, M (11.25 y)	Self-report	✓		+/–					✓
Minde [34]	1993	Trial	58	T (1.66 y)	Parent-completed diary & sleep video recordings		✓				✓	✓	
Mindell [33]	2009	Trial	405	I, T, P	Parent-completed diary & parent-report		✓						
Mindell [19]	2009	Cross-sectional	1473	I, T, P, E, M	Parent-report	✓	✓	✓	✓	✓		+/–	
Mindell [23]	2011	Trial	264	I, T (1.61 y)	Parent-report	✓	✓					✓	
Moore [80]	2007	Trial	19	T, P, E	Parent-report & audiotape							✓	
Nixon [21]	2008	Cross-sectional	519	E (7.26 y)	Actigraphy	✓			+/–	X	✓		
Öhrström [44]	2006	Cross-sectional	160	E, M (10.9 y)	Self-report Parent-report Actigraphy			+/–					
Orgilés [96]	2012	Cross-sectional	1128	E, M (10.13 y)	Self-report								✓
Owens [52]	1999	Cross-sectional	495	I, T, P, E, M (7.62 y)	Parent-report & teacher-report				✓				
Owens [22]	2011	Cross-sectional	253	P, E, M (3.4 y)	Parent-report	+/–			✓			✓	
Paavonen [51]	2006	Cross-sectional	295	P, E (5–6 y)	Parent-report				✓				
Padez [50]	2009	Cross-sectional	4511	E (7–9 y)	Parent-report				✓	✓			
Pesonen [59]	2011	Cross-sectional	275	E (8.1 y)	Actigraphy					+/–			
Ray [41]	2012	Longitudinal (2y)	676	M (10–11 y)	Self-report					X	✓		
Reid [79]	1999	Trial	49	T, P (2.39 y)	Parent-report							✓	
Reid [68]	2009	Cross-sectional	8868	T, P (2.99 y)	Parent-report						✓		
Rhoades [71]	2012	Longitudinal (4y)	361	I, T, P (~9 mo)	Parent-report						+/–		
Sadeh [76]	2000	Cross-sectional	140	E, M (9.85 y)	Actigraphy						+/–		
Scher [92]	2001	Cross-sectional	94	I, T (1.00 y)	Parent-report & actigraphy								+/–
Simard [91]	2013	Longitudinal (6mo)	55	T (~1.5 y)	Parent completed diary & actigraphy								+/–

(continued on next page)

Table 1 *(continued)*

First author	Year	Design	*N*	Age group (*M*)	Sleep assessment	ABCs	S	L	E^1	E^2	P	I	N
Spilsbury [45]	2005	Cross-sectional	449	E, M (9.5 y)	Child-completed diary			X			+/−		
Seymour [35]	1983	Trial	208	I, T, P, E	Parent-completed diary & parent-report		✓					✓	
Tan [46]	2004	Trial	86	M (5th grade)	Self-report			X					
Thompson [49]	2005	Cross-sectional	2068	I, T	Parent-report				✓				
Touchette [83]	2005	Cross-sectional	1741	I, T	Parent-report							✓	
Warren [77]	2006	Longitudinal (3y)	1222	I, T, P (~1 mo)	Parent-report						✓		
Westerlund [61]	2009	Cross-sectional	1265	E, M	Self-report					✓			
Zhang [38]	2010	Cross-sectional	4470	E, M (9.2 y)	Self-report & parent-report		✓		✓				
					# of articles providing at least some support for the importance of the ABCs of SLEEPING practices	7	13	7	14	8	26	17	14
					Total number of articles touching on each ABCs of SLEEPING practice	7	15	10	14	12	26	17	1

Note: Articles where authors name is followed by an * may overlap with other articles. I—infants aged 1–12 mo; T—toddlers aged 1–2 y; P—preschool children aged 3–5 y; E—early school-aged children aged 6–9 y; M—middle school-aged children aged 10–12 y. *M* = mean age unless otherwise indicated. ✓ = finding that provides support for the importance of practices targeted by the ABCs of SLEEPING mnemonic; +/− = mixed findings that provide at least some evidence in support of the importance of practices targeted by the ABCs of SLEEPING mnemonic; X = findings that provide no support for the importance of practices targeted by the ABCs of SLEEPING mnemonic. ABCs—**a**ge appropriate **b**edtimes and wake-times with **c**onsistency; S—**s**chedules and routines; L—**l**ocation; E^1—**e**lectronics; E^2—**e**xercise and diet; P—**p**ositivity; I—**i**ndependence; N—**n**eeds met during the day.

[26–28] research corroborates the importance of regular, bedtimes, wake-times, and naptimes. Indeed, consistency seems to be key for setting the stage for healthy childhood sleep.

S: schedules and routines

Current recommendation and rationale

Schedules and routines are one of the key recommendations made for children with sleep problems. Sleep promoting recommendations for children often include establishing routines at bedtimes and wake times. Moreover, consistency in terms of their daytime activities (e.g., leisure activities, homework, and mealtimes) is also sometimes recommended.

Evidence

As shown in Table 1, 15 articles were coded under **s**chedules and routines (S). Thirteen (87%) articles identified an association between sleep outcomes and aspects relating to the importance of schedules and routines, two (13%) studies did not. Articles are further categorized based on whether they addressed aspects of bedtime routines or daily routines. Note that articles and findings focused on physical activity as a daily activity are discussed in the section on **e**xercise and diet.

Bedtime routines. Ten studies [19,23,28–36] were coded under bedtime routines. All but one study [36] provided clear support for the recommendation that bedtime routines can play a critical role in helping to set the stage for healthy sleep outcomes. Seven of these studies were trials [23,29–31,33–35] that focused on or included the introduction of relatively brief routines (i.e., >30 min) ranging from a simple 15-min massage [30], to a series of calming activities (e.g., bath-time, massage, story-telling; [29,33]) on sleep outcomes. Invariably, the introduction of routines led to improvements in sleep outcomes (e.g., bedtime resistance, sleep onset delay, night wakings, sleep continuity, parent-ratings of sleep quality).

Further evidence of the association between bedtime routines and positive sleep outcomes was identified in two cross-sectional [19,28] and one longitudinal [32] studies. These studies highlighted the importance of carefully considering what activities to include in bedtime routines, and keeping activities in bedtime routines consistent. In line with the routines introduced in the trial studies discussed above, routines that were associated with positive sleep outcomes generally included quiet calming activities (e.g., bath time, saying goodnight, giving a kiss/hug, softly singing), with some evidence suggesting that including a reading component may enhance the effect of the routine on children's sleep duration [19]. In contrast, the one study [36] that did not provide direct support for the bedtime routine recommendations identified no effect of higher rates of reading at bedtime (as measured by parent reports) on sleep outcomes [36]. The final study [28] found that good sleepers had more consistent bedtime routines, that consistency in terms of bedtime routines was positively correlated with sleep quality, and-as would be expected - routines that include active activities (e.g., snacking and drinking, or more active play) were associated with poorer sleep outcomes.

Critically, it was noted that while the survey studies included broader age ranges of children, all but one [35] of the trial studies included only infants, toddlers, and pre-schoolers. Overall, there is

Table 2
Study demographics organized by practices captured by the ABCs of SLEEPING mnemonic.

	Age range					Research design			Measures	
	I	T	P	E	M	Cross-sectional	Longitudinal	Clinical trial	Subjective	Objective
ABCs (n = 7)	3 (43%)	2 (29%)	4(57%)	4 (57%)	2 (29%)	5(71%)	1 (14%)	1 (14%)	5(71%)	2 (29%)
S (n = 15)	5 (33%)	8 (53%)	9 (60%)	8 (53%)	5 (33%)	7 (47%)	1 (7%)	7 (47%)	14 (93%)	3 (20%)
L (n = 10)	1 (10%)	3 (30%)	2 (20%)	6 (60%)	7 (70%)	7 (70%)	0	3 (30%)	9 (90%)	2 (20%)
E^1 (n = 14)	3 (21%)	3 (21%)	7 (50%)	10 (71%)	8 (57%)	12 (86%)	1 (7%)	1 (7%)	13 (93%)	1 (7%)
E^2 (n = 12)	1 (8%)	2 (17%)	5 (42%)	9 (75%)	5 (42%)	11 (92%)	1 (8%)	0	9 (75%)	3 (25%)
P (n = 26)	4 (15%)	12 (46%)	13 (50%)	12 (46%)	10 (38%)	14 (54%)	9 (35%)	3(12%)	24 (92%)	7 (27%)
I (n = 17)	6 (35%)	10 (59%)	12 (71%)	6 (35%)	3 (18%)	9 (53%)	0	8(47%)	17 (100%)	3 (18%)
N (n = 14)	2 (14%)	5 (36%)	2 (14%)	11 (79%)	7 (50%)	10 (71%)	3 (21%)	1(7%)	12 (85%)	7 (50%)

Note: I—infants aged 1–12 mo; T—toddlers aged 1–2 y; P—preschool children aged 3–5 y; E—early school-aged children aged 6–9 y; M—middle school-aged children aged 10–12 y. ABCs—**a**ge appropriate **b**edtimes and wake-times with **c**onsistency; S—**s**chedules and routines; L—**l**ocation; E^1—**e**lectronics; E^2—**e**xercise and diet; P—**p**ositivity; I—**i**ndependence; N—**n**eeds met during the day; G—**g**reat sleep. n = number of articles coded under that construct.

Table 3
Evaluation of the level of empirical support behind common pediatric sleep recommendations across eight domains captured by the ABCs of SLEEPING mnemonic.

	Level of empirical support rating for specific recommendations:
Age appropriate **b**edtimes and waketimes with **c**onsistency and **s**ufficient duration.	• **Strong** support for ensuring that children nap, go to bed, and wake up at times that allow them to obtain age-appropriate amounts of sleep. • **Moderate** support for bedtimes no later than 9 pm. • **Moderate** support maintaining a regular sleep schedule with consistent naptimes, bedtimes, and wake-times. • **Insufficient** support for timing-specific recommendation that sleep schedules should not vary more than 30–60 min.
Schedules and routines	• **Strong** support for establishing bedtime routines. • **Insufficient** support for waketime routines. • **Insufficient** support for ensuring consistency in daytime routines.
Location	• **Limited** support for children's rooms needing to be dark when they go to sleep. • **Limited** support for children's bedrooms should be quiet through the night. • **Equivocal** support for avoiding sounds (e.g., music) as children fall asleep. • **Equivocal** support for children needing their own bedroom. • **Insufficient** support for children having a comfortable bed in a familiar bedroom.
Electronics	• **Strong** support for limiting access to electronics during and after bedtime by removing electronics from children's bedrooms. • **Insufficient** support for limiting electronic use within a 1-h window of bedtime.
Exercise and diet	• **Limited** support for children limiting caffeine consumption. • **Limited** support for children eating a healthy balanced diet. • **Limited** support for children not going to bed hungry, or consuming a large meal right before bedtime. • **Equivocal** support for children engaging in physical activity on a daily basis. • **Insufficient** support for children not eating too much close to bedtime. • **Non-support** for children avoiding exercise too close to bedtime (i.e., within 1–4 h).
Positivity	• **Moderate** support for establishing a positive atmosphere in the child's living environment. • **Limited** support for parents needing a positive attitude towards sleep. • **Limited** support for children being relaxed and calm before bed. • **Limited** support for children avoiding fun, exciting, or frustrating activities before bed.
Independence	• **Strong** support for children needing to learn to settle to sleep in their own beds without parents, so that they do not become dependent on parental presence to fall asleep at bedtime or after night wakings.
Needs met during the day	• **Moderate** support for ensuring children's emotional needs are met during the day. • **Insufficient** support for ensuring children's physiological needs are met during the day.
Great sleep	

Note: **Strong** = support for recommendation stems from at least three studies, including at least one well designed trial targeting recommendation in question, or corroboration from a recent and well-designed systematic review. Where more than three studies are reviewed, the majority of findings are in support of recommendation with no findings clearly contradicting recommendation; **Moderate** = support for recommendation stems from at least three studies, though studies may be limited to cross-sectional or longitudinal designs. Where more than three studies are reviewed, the majority of findings reviewed are in support of recommendation with no findings clearly contradicting existing recommendations; **Limited** = support for recommendation stems from less than three studies. No findings clearly contradicting recommendation in question. **Equivocal** = regardless of number of studies reviewed, findings across studies are too mixed or open to interpretation to provide clear support for recommendation; **Insufficient** = no findings directly address recommendation; **Non-supportive** = Regardless of number of studies reviewed, the majority of findings are contradictory to or inconsistent with what would be expected based on recommendation.

some evidence pointing to the potential importance of maintaining consistency in bedtime routines, a fairly convincing body of evidence highlighting the positive association between calming bedtime routines and sleep outcomes in children, and strong empirical data indicating that introducing bedtime routines helps to improve sleep in young children (infants, toddlers, and preschoolers). Further research is needed to determine the impact of introducing bedtime routines for school-aged children.

Daytime routines. Six studies [27,37–41] spoke to daytime routines and activities. One article [40] examined sleep outcomes (sleep duration and sleep quality) in children whose school schedule alternated from four days per week to four and a half days a week on a biweekly basis. Findings revealed no differences in sleep outcomes across the two weeks during which the study took place. These results could suggest that children's sleep patterns can readily adapt to changes in schedule and consistency is perhaps less important than recommended. However, it is worth highlighting that bi-weekly alternations in school schedules was the norm for this group of children, thus the results from this study do not provide convincing evidence that consistency in routines is not important as suggested. No other studies were identified that spoke to recommendations around consistency of daytime routines.

The five remaining studies [27,37–39,41] examined the relationship between sleep and various characteristics (e.g., activity type and start time) of children's daytime activities (e.g., mealtimes, homework, extracurricular activities, religious activities, socializing, schooling, childcare, etc.). In general, findings from across the studies provided support for the notion that daytime activities may play a role in modulating children's sleep patterns. Three of the studies [27,37,41] highlighted the importance of mealtimes for sleep outcomes. In particular, one study [37] indicated that children whose families spent time eating meals together had longer sleep durations. The second study [41] found that clear parental expectations around mealtimes predicted better sleep outcomes (i.e., longer sleep duration) two years later. This study also found that being home alone less often after school predicted better sleep outcomes two years later. Findings from across these three studies seem to point to an association between family involvement in children's daily activities and healthy sleep. The third study [27] that examined mealtimes focused on the timing of evening mealtimes. Findings indicated that earlier evening mealtimes were associated with earlier bedtimes in children. The mechanism through which daytime activities and sleep may be related seems largely to be the impact that these daytime activities have on bedtimes, wake times, and, by extension, time available for sleep. While we did not find many articles that spoke directly to the recommendations around maintaining consistent daytime schedules, findings from the identified studies add to the existing recommendations by highlighting the importance of ensuring that scheduled daytime activities are not competing with or interfering with sleep time. When the timing of these activities is beyond families' control (e.g., school start times, late sports practices) it is important to ensure that bedtimes or wake-times are adjusted so that children are able to obtain sufficient sleep durations within the constraints of the schedules that are imposed upon them.

***L: l**ocation*

Current recommendation and rationale

Children should have a comfortable bed in a familiar bedroom where they consistently go and lie down when it is time to fall asleep. Consistent with stimulus control recommendations, the bedroom should be reserved primarily for sleeping (i.e., it should not be used for exciting or emotionally activating activities such as time outs) and should be free from exciting and distracting stimuli that compete with relaxation and sleeping. When children are going to bed to fall asleep, the bedroom should be dark, cool, and quiet. A dark room at night is important as light-cues play an important role in regulating sleep-wake cycles [42]. In particular, darkness cues the release of melatonin, a hormone that promotes sleep onset by making us feel drowsy and ready for sleep [42]. There are some mixed clinical perceptions regarding the use of music at bedtime. Theoretically, background music may facilitate sleep onset by serving as a sort of sleep time routine and/or lulling children into a relaxed state to prepare them for sleep. However, the practice is generally discouraged as it conflicts with the recommendation that children should fall asleep in a quiet environment. Where practically possible, it is also recommended that children have their own bedroom. This recommendation is tied closely to the notion that children need a quiet calm environment to sleep in—others in the bedroom may wake the child up and disturb their sleep.

Evidence

As shown in Table 1, 10 articles were coded under Location (L). Seven articles (70%) identified an association between at least one sleep outcome and the importance of aspects relating to location (i.e., children's bedroom environment). Three (30%) articles did not provide direct support for the current recommendations. Articles were further categorized based on whether they spoke to recommendations around light, noise, or room sharing.

Light. Two studies [20,43] provided support for the recommendation that children's rooms be dark when they go to sleep. Specifically, one study reported that nightlights are adversely associated with sleep duration [43] and the other indicated that sleep duration was positively linked to turning lights off immediately when children go to bed [20].

Noise. Five studies [31,44–47] addressed the relationship between different types of noise and sleep outcomes. Two of the articles examined the impact of introducing background music during naptime or bedtime and sleep outcomes. One of the identified articles [31] found that playing classical guitar music helped to facilitate sleep onset for preschool children during naptime. No other sleep outcomes were examined. The second article [46] addressing the impact of using background music (i.e., a 45 min CD) included a broader range of sleep outcomes. However, the findings from the study were difficult to evaluate as all children displayed improvements in sleep outcomes over the course of the trial, regardless of whether they were randomly assigned to the music group or a control group. Three studies [44,45,47] examined the relationship between noise levels inherent to the child's environment and sleep outcomes. One of the studies [44] provided partial support for the recommendation to maintain a quiet sleeping environment. Findings from the study indicated that noise from road traffic was adversely associated with sleep quality and daytime sleepiness, but unrelated to sleep outcomes assessed via actigraphy. The second article [45] failed to identify a relationship between noise inherent to children's living situation and sleep outcomes, however the authors of the study note that this unexpected finding may stem from a sampling issue (97% of households examined were rated as not “overly noisy”). The final article [47] included levels of residential noise as one component of an overall indicator of chaotic living conditions (i.e., a cumulative index of levels of residential noise, crowding, and family instability). Results indicated that chaotic living conditions were adversely associated with subjective reports of sleep problems, however due to the reliance on the cumulative index the unique impact of levels of residential noise on sleep outcomes was not clear. Overall, while there is a good theoretical rationale to suggest that children's sleep environments should be relatively quiet, the empirical evidence to support this recommendation is limited.

Room sharing. Three [19,20,48] of the articles addressed whether there is an advantage to children having their own bedroom. All three of the studies reported mixed findings regarding the relationship between sleep outcomes and room sharing. Results from all three studies suggested that there might be some benefits associated with children having their own room; room sharing was adversely associated with time in bed [20], sleep onset latency [19], and sleep anxiety [48]. However, for other sleep outcomes there was no apparent advantage of children having their own bedroom; room sharing was not associated with sleep quality [20], sleep problems [19], sleep duration [19,48], and daytime sleepiness [48]. In general, findings around room sharing were equivocal.

***E:** no **e**lectronics in the bedroom or before bed*

Current recommendation and rationale

It is recommended that electronic devices be kept out of children's bedrooms to limit access to electronics during and after bedtime, and that children avoid engaging with electronic devices (i.e., cell-phones, televisions, iPods, computers, etc.) too close to bedtime (i.e., within approximately 1-h of bedtime).

Evidence

As shown in Table 1, 14 articles were coded under electronics. All 14 (100%) articles identified an association between at least one sleep outcome and aspects relating to the importance of limiting access to and engagement with electronics.

Fourteen of the studies [19,21,22,37,38,43,49–56] addressed the relationship between aspects of electronics (e.g., TV, videogames, computers, cell-phones) use and sleep outcomes. The vast majority of studies provided unambiguous support for the importance of limiting children's electronics use. Findings indicated that adverse sleep outcomes (e.g., shortened sleep duration, delayed bedtimes, increased night wakings, increased daytime sleepiness, more subjective sleep problems) are associated with electronics being: accessible in the bedroom [19,43,52,54], used at bedtime [52], and used by children after their parents expect them to be asleep [54]. We did not identify any studies that more directly spoke to the recommendation around avoiding electronics too close to bedtime. Both cross-sectional and longitudinal studies reported adverse associations between increased levels of engagement with electronics use in general (e.g., throughout the day) and shortened sleep duration [37,38,49,50,52,54,55]. One study [51], even identified relationships between increased levels of passive TV exposure (e.g., having the TV playing in the background) and adverse sleep outcomes. Only one of the fourteen studies [21] did not find a significant association between increased electronics use (in this case television viewing) and sleep outcomes, however even in this case the effect was trending in the expected direction. Findings represented in this clinical review are consistent with the most recent systematic review [57] that included studies using samples of adolescents. In addition to the existing recommendations,

findings from three of the studies [51,53,56] provide evidence to suggest that the content of television shows in particular is associated with sleep outcomes. Overall, while there are likely important individual differences as to the types of shows that children find distressing, findings from the studies suggested that adult-directed (e.g., news, police, adult-series) and violent television shows were adversely associated with sleep. No articles were identified in our search that examined the relationship between the content accessed via other electronic use (e.g., video games, computer use, etc.) and sleep outcomes. While none of the identified studies offered guidance on precisely when electronics should be shut off, there is a substantial and well-established body of evidence highlighting the relationship between negative sleep outcomes and electronics use during and after bedtime. Moreover, some of the findings – albeit more limited in scope – pointed to the potential importance of considering the impact that daytime use of electronics, and the content children are exposed to via electronic media have on their sleep.

***E: e**xercise and diet*

Current recommendation and rationale

It is recommended that children engage in physical activity on daily basis. This activity should not take place too close to bedtime (commonly defined as within 1–4 h of bedtime e.g., [58]) as it is important that they have the opportunity to relax and settle into a more restful state before bedtime to ease the transition to sleep. The content and timing of children's dietary intake may also be important. It is recommended that children limit or totally eliminate caffeine consumption (e.g., pop) and that they eat a healthy balanced diet. Finally, children should not be going to bed hungry, but they should not consume a large meal right before bedtime.

Evidence

As shown in Table 1, 12 articles were coded under exercise and diet. Eight (67%) articles identified an association between at least one sleep outcome and the importance of exercise or diet, while four (33%) did not provide any support for the current recommendations. Articles are further organized based on whether they address aspects related to physical activity or diet.

Physical activity. Six of the studies [21,26,37,41,50,59] addressed the relationship between physical activity and sleep outcomes. Contrary to what might be expected based on the recommendations, only one study [50] provided support for the notion that physical activity is beneficially related to sleep duration. As compared to children who slept for more than 9 h, a higher proportion of children who slept less than 9 h spent no time in physical activity. Two of the articles' [26,59] findings varied depending on which aspects of sleep and physical activity were examined. Specifically, one of the articles [26] found that participation in sports was associated with higher sleep efficiency, but also earlier weekday wake-up time. Contrary to recommendations to limit physical activity in the evening and encourage physical activity during the day, the second article [59] found that a) children who engaged in 30 min or more of physical activity in the evening had a shorter sleep onset latency, and b) higher overall levels of physical activity were associated with shorter sleep duration, regardless of whether the physical activity occurred during the day or night. The other three studies [21,37,41] also unexpectedly found that higher levels of physical activity were associated with shorter sleep duration, regardless of whether sleep duration was assessed via subjective reports or actigraphy. A number of plausible hypotheses have been put forth to explain these unexpected findings. For example, the relationship between physical activity and shortened sleep duration could result from scheduled physical activity adversely impacting bedtimes and/or wake-times [37]. Others have suggested that children's trait levels of activity, wherein children who are more physically active during the day are by nature more active at night thereby shortening sleep duration [59]. Alternatively, if physical activity improves sleep efficiency, children who engage in more physical activity may simply need less sleep. Regardless, the vast majority of the studies do not provide clear support for the current recommendations around exercise and sleep. While physical activity is certainly important for a number of health outcomes, the precise nature of the relationship between physical activity and sleep outcomes requires further exploration.

Diet. Five articles [19,43,60–62] addressed the relationship between diet and sleep outcomes. One of the articles [60] found no association between sleep outcomes and caffeine consumption or food intake. In contrast, consistent with the recommendation that children's caffeine consumption should be limited, two studies [19,43] provided support for the notion that caffeine consumption is associated with shortened sleep duration. In regard to the recommendation that children should not go to bed hungry, one study [62] found that amongst their sample of children, those that slept for the shortest amount of time had the lowest levels of intake of energy from fat, carbohydrates, and proteins associated with their evening meals. Consistent with these findings, the study also identified a relationship between longer sleep duration and higher levels of energy intake, particularly from carbohydrates, in the evening, but no relationship was identified between daily energy intake and sleep outcomes. Another study [61] examining the relationship between daily food intake and sleep provided some support for the recommendation that a healthy balanced diet is important to children's overall sleep. Specifically, the study [61] found that increased levels of daytime sleepiness and shorter sleep durations were associated with higher intake of energy-rich foods (e.g., candy and fast foods) and lower intake of nutrient-dense foods (e.g., vegetables). However, the association was weakened when physical activity level and screen time were controlled for. It is possible that in this study diets high in energy-rich foods served as a proxy for less healthy lifestyles that culminate in poorer sleep outcomes. We did not identify any studies that directly examined the impact of eating too close to bedtime. Cross-sectional studies provide some support for the recommendation that children should avoid caffeine, and that patterns of food intake are associated with sleep outcomes, but further research is needed to clarify the specific effects of the content and timing of food intake on sleep outcomes.

***P: p**ositivity and relaxation*

Current recommendation and rationale

Positivity surrounding sleep is generally considered an important component of healthy sleep practices. Parents should have a positive attitude towards sleep and the atmosphere in the child's living environment should be positive, in order to encourage a positive mood in the child. It is also important that the child is relaxed and calm before bed. Engaging in fun, exciting, or frustrating activities before bed is not recommended as it may interfere with the child's ability to achieve a positive, calm, relaxed state and consequently impede the transition to sleep process.

Evidence

As shown in Table 1, 26 articles were coded under positivity and relaxation. All 26 (100%) of articles identified an association between at least one sleep outcome and aspects relating to the importance of positivity and relaxation. Articles are further

organized based on whether they addressed aspects related to relaxation, parenting, or the child's broader emotional environment.

Relaxation. Four articles [28,63–65] were coded under relaxation. Two of the articles [63,64] provided support for the recommendation that children should be calm and relaxed at bedtime. The articles indicated that children with higher levels of pre-sleep arousal [64] (e.g., perspiration, or worrying a lot at bedtime) or increased excitement around bedtime [63] experienced more sleep problems, as indexed by both parent and child reports. Two of the articles [28,65] focused more explicitly on before bed activities. Consistent with the recommendations both articles found that children engaged in more active before bed activities (e.g., engaging in active play) displayed more subjective sleep problems.

Parenting. Twelve articles [6,25,34,37,45,65–71] were coded under parenting. One article [65] that directly addressed parents' sleep-related attitudes corroborated the importance of parents having a positive attitude towards sleep. Findings suggested that mothers with more problematic attitudes towards sleep (e.g., mothers that reported more feelings of helplessness and incompetence in the face of sleep problems) engaged in poorer sleep practices (e.g., active before bedtime activities), and had children with more subjective sleep problems. Ten other studies [6,25,34,37,45,66–71] provided at least partial evidence for the relationship between broader indices of parental functioning (e.g., parenting stress, parental warmth, encouragement of maturity, maternal sensitivity, etc.) and sleep outcomes. In general, findings from the studies provided evidence to suggest that higher parental functioning was associated with better sleep outcomes. For example, indices of higher parental functioning (e.g., less parenting stress, more parental warmth, more consistent and authoritative parenting, less hostile parenting) were associated with better sleep consolidation across time [67,70], fewer subjective sleep problems [6,25,68,71], and increased sleep duration [37]. In contrast, only one study [66] found no association between aspects of parental functioning (e.g., parental warmth and parental monitoring) and sleep. The majority of findings from these studies highlight the importance of considering whether parental attitudes regarding sleep or broader aspects of parental functioning are playing a role in maintaining or exacerbating sleep problems.

Emotional environment. Twelve articles [7,37,66,68,71–77] addressing aspects of family psychosocial functioning were coded under emotional environment. All studies provided at least some evidence to support the notion that aspects of children's emotional environment (e.g., the level of family stress, family conflict, family emotional well-being) either directly or indirectly impacts their sleep. Five studies [37,66,72,75,76] identified adverse associations between broad indices of family stress and various sleep outcomes (e.g., sleep quality, sleep problems, sleep disruptions), regardless of whether sleep was assessed subjectively [37,66,72,75] or via actigraphy [76]. Five of the studies [6,37,71,73,74] examined the relationship between sleep and indices of family conflict. Where significant relationships were identified, they invariably indicated that higher levels of family conflict were adversely associated with sleep. Children exposed to higher levels of conflict in their home environment displayed poorer objective sleep outcomes [73,74] (e.g., sleep duration, sleep efficiency, night time activity), more subjective sleep disruptions two years later [6], and more subjective sleep problems three years later [71]. One study [47] included family instability as one component of an overall indicator of chaotic living conditions (i.e., a cumulative index of levels of residential noise, crowding, and family instability). Results indicated that chaotic living conditions were adversely associated with subjective reports of sleep problems, though due to the reliance on the cumulative index the unique association between family instability and sleep outcomes was not clear. Three of the studies [68,73,77] addressed the relation between parent emotional well-being (i.e., levels of depressive symptoms) and children's sleep. Across both cross-sectional [68,73] and longitudinal [77] studies, higher levels of parental depressive symptoms were associated with higher levels of objective and subjective sleep problems. Consistent with the recommendation that child's living environments should be positive, findings largely indicated that children's sleep was adversely related to indices of higher negativity in their emotional environments. Note that the relationship between children's emotional environments and their sleep is more complicated than can be adequately captured in this review. For example, some findings suggest that impact of emotional environments on sleep is indirect, operating through the impact of emotional environments on parenting strategies [68,71,73]. Other studies suggest that the relationship between children's emotional environment and sleep is reciprocal [7,72]. In summary, although clinically and empirically complex, findings from across studies underscore the importance of considering children's sleep problems within their broader emotional environment.

I: independence when falling asleep

Current recommendation and rationale

Achieving independence in falling asleep is critical for the development of healthy sleep. Children need to learn to settle to sleep in their own beds without their parents, so that they do not become dependent on parental presence to fall asleep at bedtime or after night wakings. Indeed, this recommendation is so important that a major focus of behavioural sleep interventions is providing parents with skills and supports so that they can encourage independent sleep.

Evidence

As shown in Table 1, 17 articles were coded under independence when falling asleep. All 17 (100%) articles identified an association between at least one sleep outcome and aspects relating to the importance of independence when falling asleep.

Eight of these studies involved trials of behavioural sleep interventions [23,29,34,35,72,78–80]. The specific intervention methods (e.g., shaping protocols, graduated extinction protocols, etc.) varied across the studies, but each included components aimed at fostering children's ability to self-soothe and fall asleep independently (e.g., by decreasing the need for parental presence, discontinuing negative sleep associations, decreasing attention given to night wakings, etc.). All of the interventions led to clinically significant improvements in sleep outcomes. For example, children of families who participated in behaviourally based sleep interventions experienced reductions in bedtime resistance [29,80], improvements in sleep quality [78], and improvements in sleep duration [72], sleep onset [72], and night wakings [35,72,80]. Findings represented in this review are consistent with conclusions drawn from more formal systematic reviews of behavioural sleep interventions that include broader age ranges [81]. While these intervention studies do not directly address the degree of independence achieved following interventions, given that this is a major target of these interventions, they provide indirect support for the relevance of independence for healthy sleep outcomes.

Nine of the articles [19,22,48,82–87] used surveys to explore the relationship between sleep outcomes and practices relating to independence (e.g., co-sleeping, parental presence, etc.). Three of the articles [19,82,83] corroborated the importance of children learning

to settle to sleep in their own bed. For example, children who fell asleep in their bed had longer sleep durations [19,83] and less night wakings [82]. In contrast, children who were put to bed after they had fallen asleep had shorter sleep durations [83]. In addition, one of the articles [82] found children who were put to bed asleep were more likely to call out for their parents during the night and less likely to stay in their own bed throughout the night. The same three articles [19,82,83] in addition to one other [22] provided support for the importance of limiting parental presence at bedtime. Findings from across the studies suggested that parental presence at bedtime was associated with later bedtimes [22], shortened sleep durations [19,83], and increases in night wakings [19,82]. Five of the identified articles [48,84–87] specifically examined the relationship between co-sleeping and sleep outcomes. Consistent with the notion that independence when falling asleep sets the stage for healthy sleep outcomes, findings from four of the studies [84–87] suggested that reactive co-sleeping (i.e., a parent or child initiated strategy for managing night time awakenings), is adversely associated with a number of subjective and objective sleep outcomes (i.e., sleep onset, sleep efficiency). For example, in these studies co-sleeping was associated with increased night awakenings [84–87] and by definition, children being more likely to get out of their bed and go to their parents when they did wake up [87]. The final study [48] looked more generally at bedsharing. As compared to solitary sleepers, children who shared a bed with their parents had higher rates of daytime sleepiness and sleep-related anxiety, though no differences were observed in terms of sleep duration. It should be noted that varied definitions of co-sleeping (e.g., reactive vs. proactive) and cultural factors complicate the interpretation of the co-sleeping literature. Even amongst the few studies reviewed herein, findings varied depending on how co-sleeping was defined and what sleep outcomes were examined. Nevertheless, at minimum the literature reviewed points to the conclusion that reactive co-sleeping and parental presence are likely to be ineffective management strategies for dealing with sleep problems and achieving independent sleep.

N: n*eeds met during the day*

Current recommendations and rationale

Children's emotional (e.g., secure attachments to caregivers and general emotional well-being) and physiological needs (i.e., thirst, hunger, etc.) should be met during the day.

Evidence

As shown in Table 1, 14 articles were coded under needs met during the day. Of note, we were not able to identify any studies that directly measured children's physiological needs and related this to sleep. All 14 (100%) of articles identified an association between at least one sleep outcome and aspects relating to children's emotional needs. Articles were further organized based on whether they addressed security in family relationships, or emotional wellbeing.

Security in family relationships. Five studies [88–92] examined the relationship between the children's security in their family relationships (i.e., child-mother, child-father, and child-parental relationship) and sleep outcomes. Two studies [91,92] provided mixed support for the notion that security in family relationships may impact children's sleep. Both studies identified associations between child-mother attachment style (i.e., secure vs. insecure attachment style) and maternal reports of sleep outcomes, but not sleep outcomes derived from actigraphy. However, the findings were not entirely consistent across studies. One of the studies [91] found that insecure attachment styles at 18 mo were associated with longer night wakings 6-mo later. In contrast, the other study [92] identified no concurrent associations between night wakings and attachment style. However, they did identify an association between mothers' ratings of the level of difficulty children had falling asleep and attachment styles, wherein children with a secure but dependent attachment styles seemed to have the most difficulty falling asleep. The authors of the study noted that this finding seems to make intuitive sense given that children with a secure but dependent attachment style are characterized by their tendency to display high levels of separation distress, and seek proximity to their attachment figures. The three other articles [88–90] consisted of two cross-sectional and one longitudinal study conducted by the same research group. Findings from across these three studies indicated that higher levels of insecurity across family relationships were adversely related to sleep duration and sleep quality. Findings from the longitudinal study [90] further indicated that children's levels of security in their family relationships predicted sleep problems two years later, even when controlling for baseline levels of sleep problems. In sum, both cross-sectional and longitudinal research support the relationship between at least some sleep outcomes and security in family relationships.

Emotional well-being. Eight studies [20,84,93–98] addressed the relationship between aspects of children's emotional well-being (e.g., internalizing symptoms, loneliness, optimism, self-acceptance, self-esteem) and sleep outcomes. All eight studies corroborated the notion that sleep and emotional well-being are linked. In general, indices of poorer emotional well-being (e.g., higher levels of internalizing symptoms, loneliness, more self-critical attitudes) were associated with poorer sleep outcomes, whereas indices of better emotional well-being (e.g., higher levels of optimism, lower levels of pessimism, self-esteem, self-acceptance) were associated with more positive sleep outcomes. Findings identified in this clinical review highlight the importance of emotional well-being for healthy sleep. Clinicians need to be aware of this connection, and consider how a child's emotional needs may be contributing to or complicating sleep problems. If factors related to children's emotional well-being (e.g., mental health problems) appear to be playing a central role in maintaining or exacerbating sleep problems, appropriate supports should be put in place (e.g., referrals to mental health specialists where needed).

G: g*reat sleep*

This review used the ABCs of SLEEPING mnemonic as an organizing framework for examining the empirical evidence underlying common pediatric sleep recommendations. To our knowledge, this is the first comprehensive review of the full range of sleep practices commonly targeted by these recommendations. With the exception of guidelines around exercise/diet and location, at least some of the recommendations within each other area captured by the ABCs of SLEEPING mnemonic were based on moderate levels of empirical support, with some recommendations backed by strong levels of support. However, it is equally important to note that not all recommendations within and across areas captured by the ABCs of SLEEPING mnemonic have equivalent support. Clinicians need to be mindful of the level of support behind these common pediatric sleep recommendations and adjust their practice accordingly. Such adjustments may involve focussing in on recommendations with greater levels of empirical support, and tempering recommendations with more limited support. The importance of ensuring that other activities are not interfering or competing with children's ability to maintain a consistent sleep schedule and as such can obtain adequate sleep emerged as a common theme across different practices examined (e.g., electronics and daytime activities). It was clear that consistent bedtimes and wake-times,

calming bedtime routines, limiting electronics at bedtime, and going to sleep independently in a positive and low stress environment are key to good sleep.

Limitations

Our approach to this article allowed us to meet our goal of providing a broad and comprehensive overview and evaluation of the empirical evidence behind common pediatric sleep recommendations; however, there are inherent challenges to interpreting such a varied literature. For example, included articles varied in methodology, sleep outcomes measures, and how directly they spoke to a given recommendation. As a result, our interpretations where limited to a basic determination of whether or not findings provided support, partial/mixed support, or no support for the importance of the recommendations captured by the ABCs of SLEEPING mnemonic. The varied nature of the studies also necessitated the development and use of a study-specific classification system for rating levels of empirical support. Applying this classification system allowed us to provide a basic overview that succinctly summarizes our conclusions regarding the level of support behind the recommendations captured by the ABCs of SLEEPING mnemonic (see Table 3); however, due to the study-specific nature of our classification system our ratings need to be interpreted within the context and limitations inherent to the current review. That is, the ratings are limited in their generalizability beyond this study and are not readily comparable with ratings derived from other systems designed for rating the strength of a body of evidence. In addition, while the decision to organize the review around the ABCs of SLEEPING mnemonic should enhance the clinical utility of the review, there are limitations associated with taking such a structural approach to the review. For example, coding was not mutually exclusive, resulting in some studies being used to lend support for multiple recommendations, which could inflate the apparent level of support for common pediatric sleep recommendations in general. Certainly, there is more work to be done to further clarify and quantify (e.g., via effect sizes) the impact of common pediatric sleep recommendations.

Nevertheless, the review met the goal of providing a basic overview of the evidence and identified some important limitations of the current body of research. In particular, most studies (62% of the current studies reviewed) used cross-sectional research designs with very few longitudinal studies (17%) or clinical intervention trials (21%). This means that most of the evidence to date is correlational and does not imply causation. Moreover, the majority (~80%) of studies used only subjective measures of sleep, rather than objective measures. Of the 66 articles that included self and parent-reports of sleep, almost half (48%) used questionnaires that were either developed or modified for the purposes of the study, and only 11 articles (17%) used questionnaires that are considered to be well-established [99]. There was variability in the amount of research conducted for each of the healthy sleep practice variables (see Table 2 for overview), with the greatest amount focused on **p**ositivity (34% of studies included in this review), and the least about the ABCs (9% of studies) and **l**ocation (13% of studies). The number of studies also varied by age range, with fewer than expected studies focused on infants in terms of **l**ocation, **e**xercise & diet, **p**ositivity, and **n**eeds met during the day. For toddlers, there was less than expected research on **e**xercise and diet, for preschoolers there was less research on **n**eeds met during the day, and for middle school-aged children there was less research on Independent sleeping. Some specific research areas that are lacking are: 1) the relationship between consistent sleep schedules and good sleep, 2) the impact of bedtime routines for school-aged children, 3) the need to limit electronics for a certain duration before bedtime, 4) the impact of eating close to bedtime, 5) the role of meeting physiological needs for good sleep.

Conclusion

A growing body of research provides at least preliminary support for the majority of recommendations that are commonly made to families regarding healthy sleep practices. However, the level of support identified was not equivalent for all recommendations. Rather the level of support varied for recommendations within and across the different areas of sleep practices outlined by the ABCs of SLEEPING mnemonic. More robust investigations are needed to better understand the extent to which each of the sleep practices examined in this review contributes to the onset and maintenance of children's sleep problems.

Practice points

1) Clinicians can use the ABCs of SLEEPING mnemonic in tandem with the findings in this review, to guide their recommendations and treatment planning.
2) The ABCs of SLEEPING mnemonic captures a broad range of sleep practices. Parents and children will likely be more successful if only a few things are targeted at once. Clinicians are encouraged to prioritize sleep practice recommendations with stronger empirical support, and temper recommendations for sleep practices with more limited support (see Table 3).
3) If factors related to **p**ositivity (i.e., the **p** of the ABCs of SLEEPING) or **n**eeds met during the day (i.e., the **n** of the ABCs of SLEEPING) are thought to be contributing to children's sleep problems, appropriate supports (e.g., a referral to a specialist with expertise in the area of concern) should be put in place.

Research agenda

1) Clarify the causal relationships between sleep practices captured by the ABCs of SLEEPING mnemonic and sleep outcomes.
2) While the challenges of defining optimal sleep have been well articulated [24], researchers should make use of well-established measures, wherever possible objective measures, of sleep and report on all sleep outcomes assessed.

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Conflicts of interest

None to declare.

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