EVALUATING THE ABCS OF SLEEPING MOBILE HEALTH SMARTPHONE
APPLICATION DESIGNED FOR PARENTS OF SCHOOL-AGE CHILDREN: AN
END-USER APPROACH TO DEVELOPMENT

By

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Dedication

To my husband Dejan Vidovic: Words cannot do justice the immeasurable support you have given me since we first met in 2010. You have had a front-row seat to the process of my educational career, and your belief in me has helped me reach this final stage. Your love, advice, and encouragement have been my anchor through the challenges and triumphs. Thank you for being my biggest cheerleader and best friend. I love you more than words can describe.

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Abstract

Insomnia symptoms are prevalent among school-age children, yet there are few accessible evidence-based treatment programs, and hence there is an "evidence-to-practice gap". This dissertation examines the development and evaluation of a smartphone application (mHealth "app"), the "*ABCs of SLEEPING*", taking a user-centered approach involving key end-users (parents and healthcare providers). The app provides sleep evaluation and recommendations to parents to help improve their children's sleep. Guided by Bowen et al.'s (2009) framework, a feasibility study (Study 1; $n = 23$), pilot randomized controlled trial (RCT) (Study 2; $n = 28$), and a barriers and facilitators to implementation study (Study 3; $n = 33$) were conducted. The feasibility study, which gathered feedback from parents who used the app, found evidence of acceptability (i.e., satisfaction/suitability) and preliminary effectiveness (i.e., improvement in sleep problems); however, fidelity was not as high as required (i.e., aim was for daily use). After modifying the intervention using end-user feedback (e.g., incorporating reminders into the app), a pilot RCT was conducted. Recruitment data indicated a large-scale study would need to include 118 participants to be adequately powered. Improvements in parents' reports of their children's sleep habits/bedtime routines, insomnia severity, and behavioural functioning were found, although the effects were relatively small and did not normalize sleep behaviours. The study examining potential implementation used semi-structured interviews with end-users. Results indicated a high demand for an mHealth intervention, clear integration strategies for searching and finding this app, and provided data related to practicality of the use of the app (e.g., would be best used as a first-line/preventative intervention). All participants found the app appealing due to its credibility, appearance, and information/features, and reported that daily use of the app would be feasible. Barriers (e.g., busy schedules) and facilitators (e.g., credibility) to its use were identified. This dissertation research has prepared the *ABCs of SLEEPING* app for full-scale effectiveness testing and results suggest a focus on improving sleep health rather than taking an insomnia sleep disorder lens. Given promising results from these three studies, the app has potential to close the "evidence-to-practice gap" and as such, improve school-aged children's overall sleep health.

List of Abbreviations and Symbols Used

ω^2 = Omega

κ = Kappa

α = Alpha

AARP = Abbreviated Acceptability Ratings Profile

ADHD = Attention-Deficit / Hyperactivity Disorder

APA = American Psychiatric Association

AASM = American Academy of Sleep Medicine

ANCOVA = Analysis of covariance

ANOVA = Analysis of variance

ASD = Autism Spectrum Disorder

App = smartphone application

AQ = Acceptability Questionnaire

BRQ = Bedtime Routines Questionnaire

BRQ WD = Bedtime Routines Questionnaire Weekday

BRQ WE = Bedtime Routines Questionnaire Weekend

CSHQ = Children's Sleep Habits Questionnaire

CFIR = Consolidated Framework for Implementation Research

d_z = Cohen's d

DSM-V-TR = Diagnostic Statistical Manual of Mental Disorders – Fifth Edition – Text

Revision

DQ = Demographic Questionnaire

EQ = Eligibility Questionnaire

eHealth = Electronic health

FDA = Food and drug administration

FS = Fidelity Survey

HCP(s) = healthcare provider(s)

ICSD-III-TR = International Classification of Sleep Disorders – Third Edition – Text
Revision

IOF = Implementation Outcome Framework

M = mean

mHealth = mobile health

N/n = sample size / sub-sample size

NDD(s) = neurodevelopmental disorder(s)

PDF = Portable document file

PISI = Pediatric Insomnia Severity Index

RCT = randomized controlled trial

SEF = Sleep efficiency

SES = Socioeconomic status

SD = Standard deviation

SLD = Sleep diary

SOL = sleep onset latency

SDQ = Strengths and Difficulties Questionnaire

SPSS = Statistical Package for Social Sciences

TD = typically developing

TDF = Theoretical Domains Framework

PhD = Doctor of Philosophy

REDCap = Research Electronic Data Capture

RE-AIM = Reach, Effectiveness, Adoption, Implementation, and Maintenance

Framework

Acknowledgements

Chapter 1: Introduction

This dissertation consists of three empirical studies, with the overarching goal of furthering the development and evaluation of the parent-implemented sleep smartphone application ("app") entitled the *ABCs of SLEEPING*. This research program was guided by Bowen et al.'s (2009) comprehensive feasibility framework. An evidence-based accessible app has the potential to enhance access to interventions aimed at improving sleep in elementary-school-age children (6 to 12 years). In Study 1 (Chapter 2), the acceptability, fidelity, and preliminary effectiveness of the *ABCs of SLEEPING* app was examined through a feasibility study following parents' one-month use of the intervention. Study 2 (Chapter 3) is a pilot randomized controlled trial (RCT), which was conducted to provide critical information to plan a future full-scale RCT and examined preliminary effectiveness using RCT methodology and employing both subjective and objective sleep measures. Finally, in Study 3 (Chapter 4), I evaluated barriers and facilitators to the potential implementation of the *ABCs of SLEEPING* app by exploring its demand, integration, and practicality using qualitative perspectives from end-users (i.e., parents and healthcare providers [HCPs]). In Chapter 5 the theoretical considerations and clinical implications, strengths and limitations, future directions, and conclusions derived from research in this dissertation are discussed.

The current chapter provides background information and context for the research presented within this dissertation. First, I discuss sleep disorders with a focus on insomnia in school-age children. Specifically, I focus on the prevalence, etiology, and impact of sleep disorders in this age group. Following this, I outline the evidence-based four-step model for the treatment of insomnia. Third, an overview of barriers and facilitators to treatment

is provided, followed by a review of digital interventions and mobile health (mHealth). Fourth, an overview of implementation research is provided followed by a detailed description of the *ABCs of SLEEPING* app and its development. Next, the theory and guiding framework of this dissertation are described. To conclude this chapter, the current dissertation's overarching objectives are outlined.

Sleep Disorders: Insomnia

The diagnostic criteria for sleep disorders are described within two manuals, one of which focuses on psychiatric disorders (i.e., the Diagnostic and Statistical Manual of Mental Disorders – Fifth Edition Text Revision [DSM-V-TR]; American Psychiatric Association [APA], 2022), and another that is specifically focused on sleep disorders (i.e., International Classification of Sleep Disorders – Third Edition, Text Revision [ICSD-III-TR], American Academy of Sleep Medicine [ASSM], 2023). All sleep disorders covered by these manuals involve symptoms related to difficulties with sleep quality, timing, and amount resulting in daytime impairment with the most prevalent sleep disorder being insomnia. Both sets of diagnostic criteria for insomnia describe it as characterized by difficulties with sleep quality or quantity due to one or more of the following symptoms: difficulties initiating and/or maintaining sleep, and/or early morning awakenings with an inability to return to sleep. According to the DSM-V-TR specifically, for a diagnosis to be made, these symptoms must cause significant distress or impairment, persist for at least three months, occur at least three nights per week, and not be attributable to other disorders, medical conditions, or substances (APA, 2022).

Prevalence rates of insomnia for school-age children have been investigated in several community and clinical samples with estimates ranging from 20 to 40% (Dewald-

Kaufmann et al., 2019; Calhoun et al., 2014; Singareddy et al., 2009; Liu et al., 2000; Owens et al., 2000; Sadeh et al., 2000; Stores, 1996). Furthermore, approximately one out of five school-aged children will experience chronic and clinically significant insomnia symptoms that result in daytime disturbances (Calhoun et al., 2014; APA, 2022). Prevalence rates have been noted to reach even higher levels depending on various demographic/environmental variables such as age, gender, sex, socioeconomic status (SES), ethnicity, and minority status, and biological ones such as hormonal changes and comorbid physical or mental health disorders (e.g., neurodevelopmental disorders [NDDs] such as Attention Deficit-Hyperactivity Disorder [ADHD] and Autism Spectrum Disorder [ASD] with prevalence rates as high as 86%; Robinson-Shelton & Malow, 2016; Sung et al., 2008), (Becker et al., 2015; Calhoun et al., 2014; Sadeh et al., 2011; Singareddy et al., 2009; Bruni et al., 2018).

Understanding the various factors influencing prevalence rates of insomnia can also provide insight into its etiology and maintenance in school-age children. There is not one universally accepted model to understand the etiology and maintenance of insomnia in any age group, but various models have been proposed. There is a cognitive model (Harvey, 2002), the three-p diathesis-stress model (Spielman et al., 1987), two-process model of sleep-wake regulation (Borbély, 1982), opponent-process model of sleep wake regulation (Edgar et al., 1993), and many more (Levenson et al., 2015). Some of these models focus more on the psychological and behavioural processes of insomnia (e.g., cognitive model, three-p), while others focus on biological, neurophysiological factors (e.g., two-process model, opponent-process model).

When examining what is known about the various pathways through which insomnia may be triggered and maintained, these theorized processes underscore the complexity of this sleep disorder. Levenson et al. (2015) proposed these models can be conceptualized together such that inherent vulnerabilities (e.g., family history, age, hormonal changes, lower SES) can result in neurophysiological hyperarousal and psychological and behavioural processes (e.g., compromised mental or physical health, rumination on sleep) that either individually or collectively increase the potential of developing insomnia and related negative impacts (e.g., poorer physical/mental health, daytime functioning). Insomnia may have a bidirectional relationship with these factors, variables, processes, or insomnia may be triggered by these or trigger the onset of some of these that further maintain the insomnia (e.g., ruminating on poor sleep leading to anxiety that further perpetuates insomnia symptoms; Harvey, 2002; Levenson et al., 2015). What is clear is that the degree to which an individual exhibits insomnia symptoms varies and stressors and personal factors, like age and sex, are influential.

The various ways in which onset can occur for school-age children underscores that insomnia is not a disorder that is experienced in isolation and research has demonstrated that there are various factors (social, psychological, behavioural, and biological) to consider altogether that are important to understand for the purposes of prevention and treatment (Meltzer & Montgomery-Downs, 2011; Levenson et al., 2015). Additionally, Falch-Madsen et al. (2021) discuss how defining insomnia etiology has its own challenges due to limitations of existing research (e.g., variability of diagnostic criteria used to define insomnia across studies, some research viewing insomnia as secondary to other medical or

mental health disorders, lack of longitudinal research, limitations with generalizing research findings to other populations, and variability of sleep measurement used).

This dissertation focuses on a school-age population due to the unique impact that insomnia begins to have on children once entering school. When starting school, increased cognitive, social, psychological, and behavioural demands are placed on children, which contributes to defining and evaluating the concept of "school readiness" to ensure children are prepared to make the transition to school (Peth-Pierce, 2000; Hair et al., 2006). For example, children starting school begin to experience increased academic, extra-curricular, and social demands and expectations. As children progress through elementary school, pubertal changes begin; for example, unique patterns of increased insomnia are observed in females experiencing pubertal changes approximately the ages of 11 and 12 years (Calhoun et al., 2014). These demands continue into adolescence underscoring the importance of early identification and treatment of sleep problems (Becker et al., 2015).

Insomnia symptoms have negative impacts on school-age children's mental health and behavioural functioning, such as internalizing (i.e., emotional) and externalizing (i.e., behavioural) problems; specifically internalizing problems such as anxiety, depression, withdrawal, suicidality, and substance use, and externalizing problems such as delinquent behaviour, defiance, and aggression (Calhoun et al., 2017; Armstrong et al., 2014; de Zambotti et al., 2018; Haynes et al., 2011). Additionally, Van Dyk et al. (2024) identified elevated scores on mental health screening indexes for youth seeking insomnia treatment, with affective problems being most elevated. In addition to these mental health and behavioural concerns, there are physical health consequences (e.g., gastrointestinal issues, obesity, headaches) and decreased health-related quality of life experienced by school-age

children with insomnia symptoms (Combs et al., 2016; Chaput et al., 2016; Nixon et al., 2008; Singareddy et al., 2009). If not treated, insomnia can progress into adolescence and adulthood and have further significant consequences for physical and mental health (Fricke-Oerkermann et al., 2007). Academic functioning is also negatively affected (e.g., poorer grades) by insomnia symptoms when controlling for age, sex, substance use, anxious/depressive symptoms, and SES (Dewald et al., 2010; Perfect et al., 2014; Zhang et al., 2022; Curcio et al., 2006). These negative impacts (e.g., anxiety, stress, fatigue, poorer quality of life) have also been observed in children who have subthreshold insomnia symptoms (Denis et al., 2020; Peersmann et al., 2022). Given the unique impact of insomnia within this age group, timely treatment following an evidence-based approach for insomnia symptoms in a school-age population is paramount.

Treatment of Insomnia in School-aged Children

Evidence-based treatment for insomnia in school-aged children follows a stepped approach in which each step progresses toward more intensive intervention as needed (Rigney et al., 2023). Given that the etiology of insomnia involves social, psychological, and behavioural factors, effective treatment must address these factors. Below, the steps of evidence-based insomnia treatment for school-age children are outlined in the order sleep treatment should occur. This evidence-based model begins with addressing parental beliefs about sleep by providing sleep education, followed by implementing healthy sleep practices, specific behavioural strategies, and ending with incorporating pharmacological intervention if all other intervention strategies do not achieve adequate improvements.

Step 1: Parental Beliefs and Sleep Education

Parental beliefs about sleep are an important area of sleep treatment as (a) they can influence the use of sleep treatment strategies, and (b) have been demonstrated to be correlated with both parent and self-reported sleep problems for children (Ng et al., 2013; Gregory et al., 2009; McDowall et al., 2017). While the literature is lacking about the impact of misconceptions on sleep, research has evaluated the positive impact of sleep knowledge. According to a systematic review conducted by McDowall et al. (2017), parental sleep knowledge was generally poor, and parents demonstrating more sleep knowledge were more likely to report utilizing healthy sleep practices.

Overall, providing psychoeducation is a key part of sleep treatment, and an important first step for families to utilize when starting sleep treatment (Bourchtein et al., 2020; Bessey et al., 2013). Examples of misconceptions about sleep that have been identified are described in Table 1.1 below that was adapted from Robbins et al.'s (2019; 2022) tables.

Table 1.1.

Sleep Misconceptions According to Sleep Experts

Sleep Habits
• It is better to have a warmer bedroom than a cooler bedroom
• Boredom can make you sleepy even if you got adequate sleep before
• Watching television in bed is a good way to relax before sleep
• Exercising within four hours of bedtime will disturb your sleep
• Being able to sleep anytime, anywhere is a sign of a healthy sleep system
• In terms of your health, it does not matter what time of day you sleep
• Lying in bed with your eyes closed is almost as good as sleeping
• If you have difficulty falling asleep, it is best to stay in bed and try to fall back to sleep
• Loud snoring is mostly harmless
• Hitting snooze when you wake up is better than getting up when the alarm first goes off
• If you are having difficulties sleeping, taking a nap in the afternoon is a good way to get adequate sleep

Sleep Habits
• If you poorly sleep one night, it will disturb your sleep schedule for the whole week
• If you can get it, more sleep is always better
• Going to bed and waking up late on the weekends is no big deal as long as my child gets enough sleep during that time

Treatment and Medication
• Sleep training causes psychological harm, including reduced parent-child attachment
• It is better to take a sleeping pill/medication than having a poor night of sleep
• Medication is probably the only solution to sleeplessness
• Melatonin supplements are safe because they are natural
• Stimulants can counteract the negative effects from sleep deprivation

Knowledge about Sleep and Insomnia
• Heavy, loud snoring for my child means they are sleeping deeply
• A sound sleeper rarely moves at night
• During sleep, the brain is not active
• Remembering your dreams is a sign of a good night's sleep

Consequences of Insomnia on Daytime Functioning
• One night of sleep deprivation will have lasting negative health consequences
• Your brain and body can learn to function just as well with less sleep

Consequences of Insomnia: Negative Appraisals
•Falling asleep in class shows a lack of motivation
• Not being able to get up for school shows a lack of motivation
• It is better to stay up late studying for a test than it is to get sleep

Step 2: Healthy Sleep Practices

Healthy sleep practices (previously referred to as sleep hygiene) are the behaviours an individual engages in that promote sleep (Bessey et al., 2013). The *ABCs of SLEEPING* intervention name is a mnemonic that captures important healthy sleep practice areas that parent and caregivers can address to promote children's sleep with a 24-hour perspective, including: Age-appropriate Bedtimes and wakeup times with Consistency, Schedules and routines, Location, Exercise and diet, no Electronics in the bedroom or before bed, Positivity, Independence, and Needs met, equal Great sleep (Bessey et al., 2013).

Within the <u>A</u>ge-appropriate <u>B</u>edtimes and wakeup times with <u>C</u>onsistency area of the mnemonic, the focus is on a child's sleep and wake schedule, specifically with the consistency of adhering to the same bedtime and waketime each day (including weekends) allowing for age-appropriate amounts of sleep. The <u>S</u>chedules and routines component pertains to daytime routines and activities including morning routine (i.e., wake up, brush teeth, get dressed), daytime activities (school time, homework, or schoolwork), and evening routine (i.e., extra curriculars, reading, play time), and bedtime routine (i.e., brush teeth, bath time, pajamas, read story). Specific recommendations about timing of activities are underscored in this area such as keeping bedtime routines simple and efficient (15-30 minutes). <u>L</u>ocation describes where sleep occurs, specifically; the bedroom being free of distractions, loud noises, with an atmosphere promoting sleep (e.g., quiet, dark, uncluttered), and not associated with exciting and stimulating activities (e.g., play, screen time) or negative ones (e.g., time-outs). In addition to electronics being exciting and stimulating activities that you do not want to have associated with the bedtime, blue light is emitted from these screens that suppresses melatonin production. This impacts our internal clock signalling sleep, and as such, <u>E</u>lectronics not being in the bedroom or used before bed is another important area covered by the *ABCs of SLEEPING* mnemonic. For <u>E</u>xercise and diet, recommendations such as having at least one hour of physical activity, 30 minutes of which is recommended to be outside, and less than two hours of sedentary time are recommended (according to the Canadian 24-hour Movement Guide; Canadian Society for Exercise Physiology, 2019). To promote good sleep, it is recommended to not go to bed hungry and to consume a balanced diet avoiding foods such as those with high caffeine content. Further, the timing of these recommendations is covered (e.g., big meals

should be avoided within two hours of bedtime as digestion uses energy that the body needs to use to fall asleep). The Positivity component of the mnemonic emphasizes the importance of the child's living environment, specifically an open and positive environment and having a positive attitude toward sleep. Relaxation strategies (e.g., progression muscle relaxation, guided imagery, deep breathing) are recommended as is open communication about worries and validation. Challenging or exciting activities should be avoided prior to bedtime. If a child brings these up close to bedtime, strategies are recommended such as tabling a discussion for the next day while acknowledging its importance. Reinforcement of positive changes and improvements to sleep habits is also recommended. Promoting Independence involves recommendations about working towards sleeping independently through self-soothing, controlled comforting, and other behavioural approaches for those families that are working toward no longer co-sleeping or reducing night wakings. Meeting Needs describes the importance of checking in on a child's emotional (e.g., attention, support) and physiological needs (e.g., hunger, thirst) throughout the day to ensure they are being primed for optimal sleep. Last, when the family can identify areas to improve, and utilize the recommended healthy sleep practices, Great sleep can be accomplished.

Outcomes of RCTs have demonstrated the effectiveness of various sleep intervention programs that targeted sleep knowledge (Lin et al., 2018; Stremler et al., 2006; Wing et al., 2015; Wilson et al., 2014; Kempler et al., 2020) and healthy sleep practices (Lin et al., 2018; Wing et al., 2015; Tan et al., 2012). Results of these studies demonstrated improved sleep outcomes for groups that utilized the intervention such as sleep duration, quality, and/or insomnia symptoms (Stremler et al., 2006; Kempler et al., 2020; Wing et

al., 2015; Wilson et al., 2014; Tan et al., 2012), and daytime functioning (e.g., behavioural functioning, mental health, daytime sleepiness; Wing et al., 2015; Tan et al., 2012).

Step 3: Specific Behavioural Strategies

In addition to implementing healthy sleep practices, some parents will need to implement specific behavioural intervention strategies to achieve improved sleep for their children. For example, some parents' goals may be to reduce their children's number of night wakings or decrease their children's sleep onset latency for which strategies like bedtime fading with response cost can be helpful. Other examples of specific behavioural strategies include cognitive strategies (e.g., cognitive restructuring), use of rewards or reinforcement programs and consequences, relaxation training, and stimulus control (Zhou & Owens, 2016). Table 1.2 lists and describes examples of key strategies commonly used in the treatment of pediatric insomnia.

Table 1.2.

Examples of Specific Behavioural Strategies for School-age Children

Behavioural Strategy	Description
Bedtime fading (Schreck, 2022)	Improves a child's sleep onset by gradually adjusting their bedtime to match when the child naturally falls asleep, then slowly moving it earlier in small increments. The first step is identifying current sleep onset time, and the next step is to set bedtime to be 15-20 minutes earlier once success with the new bedtime is established until the desired bedtime is reached. If specific rules are implemented, this method would be considered bedtime fading with response cost (e.g., having child get out of bed if not falling asleep within a specific allotted time such as 20 minutes).

Behavioural Strategy	Description
Controlled comforting (graduated extinction; Hannon & Hiscock, 2015)	Involves a parent putting their child to bed then leaving the bedroom only to check on their child at preset time intervals (e.g., starting at 2-minute intervals and then increasing interval by 2 minutes at each check). The process continues until the child falls asleep independently.
Camping out (Hannon & Hiscock, 2015)	Parents place a chair beside their child's bed. Parents will sit and stay at this chair until their child is asleep (without interacting with the child). The next steps involve gradually moving their chair away from the child within a period of approximately 1 to 3 weeks.
Cognitive restructuring (Rossman, 2019)	Rooted in Cognitive Behavioural Therapy (CBT), cognitive restructuring targets thoughts in order to influence behaviour and feelings (emotions, physical sensations). Challenging beliefs and thoughts about sleep that are not conducive to sleep, such as anxiety about sleep, can help address insomnia symptoms (e.g., balancing thoughts/beliefs by identifying evidence for and against thoughts/beliefs)
Relaxation training (Rossman, 2019)	These are strategies to promote sleep that can consist of mindfulness activities (i.e., bringing yourself to the present moment) and reducing sympathetic nervous system activity (e.g., deep breathing, guided imagery)
Stimulus control (Rossman, 2019)	Involves enhancing sleep associations with the bed and bedroom environment by following specific rules consistently so that the bed is only used for sleeping and not for other activities (e.g., playing, time-out)
Reinforcement and consequences (McLay & Lang, 2022)	Reinforcement and consequences can be implemented when using any of the above approaches for sleep, or to promote engagement in healthy sleep practices. Reinforcement can involve gaining praise and reward (e.g., stickers, screen time, quality time), and consequence can involve losing privileges (e.g., losing screen time)

Step 4: Pharmacological Intervention and Behavioural Strategies

For the majority of children, it has been demonstrated that pharmacological treatment is not required to treat sleep problems (Mack & Rybarczyk, 2011; Riemann &

Perlis, 2009). For example, a review examining pharmacological versus nonpharmacological behavioural treatment demonstrated comparable effect sizes post treatment with only behavioural approaches maintaining therapeutic benefits long-term (Riemann & Perlis, 2009). This consideration is especially important for pediatric populations as pharmacological treatments are not yet well understood or officially approved for use by the American Food and Drug Administration (FDA) (Mindell et al., 2006; Pelayo & Dubik, 2008; Lunsford-Avery et al., 2020; Bock et al., 2016). Specifically, there are currently no medications that are FDA approved for pediatric insomnia treatment use and more research on their safety, tolerability, and efficacy are required (Lunsford-Avery et al., 2020; Bock et al., 2016; Mindell et al., 2006; Pelayo & Dubik, 2008).

Pharmacological treatment of children's sleep problems is only recommended in conjunction with behavioural strategies that alone are not achieving adequate improvements (Rigney et al., 2018). A recent comprehensive literature review of 22 RCTs examined the effectiveness of medications for insomnia in both TD children and children diagnosed with a NDD such as ADHD and/or ASD (McDonagh et al., 2019). Findings detailed trials for zolpidem and eszopiclone which did not demonstrate improvements in sleep for children with ADHD, but did have adverse effects (e.g., dizziness, hallucinations, enuresis). Diphenhydramine demonstrated minor improvements in sleep after one-week. Melatonin was most researched (19 studies) and demonstrated improvements in sleep latency, duration, and wake times, but did not reduce night wakings and had some adverse effects (e.g., dizziness, enuresis, daytime drowsiness) (McDonagh et al., 2019).

Owens et al. (2010) surveyed 1,273 physicians to examine their prescribing patterns for medications used to treat sleep problems in children. In this sample, 96% of physicians

prescribed pharmacotherapy (e.g., alpha agonists, Trazodone) and 88% prescribed over-the-counter medication (e.g., melatonin) for pediatric insomnia. Examples of commonly used medications include over-the-counter (e.g., antihistamines, melatonin) or prescription (e.g., Trazodone) (Boafo et al., 2020; Bock et al., 2016). Bock et al. (2016) provide an extensive list of over-the-counter and prescription medications that are commonly prescribed to pediatric populations within Ontario, Canada, summarized in Table 1.3 below.

Table 1.3.

Sleep Promoting Over-the-counter and Prescription Medications Prescribed to Pediatric Populations

Medications Prescribed to School-age Children	
Over-the-counter (% prescribed to ages 6 to 12)	Prescription (% prescribed to ages 6 to 12)
- Melatonin (48%) - Antihistamine (26%) - Pain reliever/antihistamine combination (18%) - Herbal preparations (13%)	- Antidepressants (18%) - Benzodiazepines (16%) - Antipsychotics (23%) - Alpha agonists (26%) - Prescription antihistamines (11%) - Chloral hydrate (5%) - Non-benzodiazepines (e.g., zopiclone, zolpidem) (2%) - Barbiturates (2%)

Note. Percentages are based on a community sample of 67 HCPs licensed in Ontario, Canada. Anticonvulsants were included in Bock et al.'s (2016) paper in their Table 2, however were not included in the current table given that 0% of all age groups, including school-age children, were prescribed these.

Evidence-to-Practice Gap

Despite insomnia being the most prevalent sleep disorder among children, there continues to be a concerning evidence-to-practice gap that requires addressing (Byars &

Simon, 2014; Reynolds et al., 2023). Specifically, the treatment trajectory for school-age children's insomnia does not typically follow a stepped approach; for example, pharmacological intervention is often prescribed first from primary-care physicians as opposed to nonpharmacological treatment, which is the recommended first treatment (Bock et al., 2016). Specifically, over two-thirds of Ontario physicians surveyed by Bock et al. (2016) reported prescribing pharmacological treatment for insomnia prior to recommending earlier steps of sleep treatment (i.e., sleep knowledge, healthy sleep practices, behavioural interventions) being utilized without pharmacotherapy. It has been posited that this inappropriate treatment recommendation is due to a lack of familiarity with behavioural interventions, and that medication is seen as less costly in terms of time and finances (Mack & Rybarczyk, 2011; Edinger & Sampson, 2003). This viewpoint is well supported by research with HCPs in Canada and worldwide, who report minimal training in sleep medicine and less than ideal clinical sleep knowledge (Boerner et al., 2015; Sullivan & Cao, 2021; Zhou et al., 2021; Kovacic et al., 2002; Saleem et al., 2017). Given that majority of HCPs report limited training in sleep, demand is high for evidence-based insomnia treatment for children, a situation that is further complicated by additional barriers to treatment.

Barriers and Facilitators to Treatment

Despite strong evidence of the therapeutic effects of behavioural treatments for insomnia, parents struggle to access and implement these interventions due to a range of treatment barriers. Barriers to treatment are defined as any factor that interferes or complicates receiving timely and evidence-based care. A number of barriers experienced by parents have been identified to accessing behavioural treatment for insomnia such as

literacy, cost (time and financial), transportation, geographical location, busy schedules/time demands, beliefs or misconceptions about sleep and treatment (e.g., insomnia perceived as benign), psychosocial factors (e.g., increased stress, marital problems, parental/caregiver mental health), and lack of available programs or awareness of them, and HCPs reporting a lack of training to treat insomnia using behavioural strategies (Tan-MacNeill et al., 2020; Billings et al., 2021; Paterson et al., 2019; Roberts & Ulmer, 2024; Stinson et al., 2006; Boerner et al., 2015). Additional distinct barriers that have been identified that may be experienced by socially disadvantaged groups that occur on an individual level (e.g., language and cultural barriers, lack of sleep-specific resources, perceived discrimination, beliefs about sleep and health), neighborhood level (e.g., proximity to green spaces, light and noise pollution, neighbor cohesion and safety), and broader sociocultural level (e.g., remote or rural locations, transportation barriers, segregation and redlining, lack of insurance coverage and lack of funds) (Billings et al., 2021).

Conversely, facilitators are those factors that enhance and promote accessibility or treatment fidelity. Although not at as extensively researched as treatment barriers, a number of facilitators have been identified that promote parental engagement in treatment such as positive beliefs and attitudes about sleep treatment, intervention-specific reasons (i.e., support/features, intervention providing a sense of connection, content, treatment modality and its functionality, having tailored content), trust and sense of security, and parent self-efficacy (Tan-MacNeill et al., 2020; Cheng et al., 2023; Chan et al., 2017; Grivell et al., 2022; Sandlund et al., 2018).

Internet-Delivered Interventions and Mobile Health (mHealth)

Lack of access to insomnia treatment is a chronic and concerning issue. A popular solution proposed across various research studies examining barriers is eHealth (i.e., intervention delivered via digital technologies such as websites, video-conferencing, mHealth; Lah & Cao, 2024; Santarossa et al., 2018; Buckman et al., 2021; Kreps & Neuhauser, 2010; Tan-MacNeill et al., 2020; Billings et al., 2021). According to Statistics Canada (2022), 95% of Canadians 15 years and older have access to the internet and since 2020, approximately 85% have access to a smartphone for personal use (Statistics Canada, 2021). Given these high rates of internet and smartphone use, behavioural intervention for insomnia delivered through the internet is a viable and promising way to bridge the evidence-to-practice gap (Carmona et al., 2021; Cliffe et al., 2020; Tan-MacNeill et al., 2023; Tan-MacNeill et al., 2020). Recent reviews conducted between 2018 and 2022 identified moderate to large effect sizes via RCTs for most sleep outcomes for youth following use of eHealth insomnia interventions; however, most available eHealth programs are for infants and adolescents (Tougas et al., 2023; Werner-Seidler et al., 2018; McLay et al., 2020; Zhu et al., 2022).

A mode of intervention delivery that has gained popularity is mHealth, which is accessed using a smartphone via their respective smartphone app store (e.g., App Store, Google Play) (Fedele et al., 2017; Budhi et al., 2013). More recently, interest has been increasing in the development of mHealth sleep interventions. For example, an mHealth intervention ("Nenne Navi"), developed by pediatric sleep experts at Osaka University Hospital, has undergone usability and effectiveness testing and demonstrated promising results for parents of babies (mean age of 19.5 months) (Yoshizaki et al., 2020; Yoshizaki

et al., 2023). Additionally, in adolescents, Quante et al. (2019) examined qualitatively the acceptability of two commercially available apps (mysleepbot; https://mysleepbot.com/; sleeptime: https://azumio.com) with positive results indicating acceptability of the intervention and perceived health benefits (e.g., physical health). Only one parent-implemented mHealth intervention for school-age children has been identified in the literature, although it is not in the format of a smartphone app. The program was developed by Mitchell et al. (2021) who examined the use of sleep health promoting messages sent via text message from a health promotion website platform (Way to Health, University of Pennsylvania) to the smartphones of the parents of school-aged children and demonstrated high acceptability but low fidelity in the use of strategies received. The intervention increased sleep duration as intended (Mitchell et al., 2021; 2023).

To date there are no mHealth resources in the form of a smartphone app for parents to use to help their school-aged children sleep better and for HCPs to recommend for school-aged children's sleep that provide evidence-based healthy sleep practice recommendations. Overall, those mHealth interventions that have been developed and tested among other age groups demonstrate promising results such as evidence of effectiveness and high acceptability among end-users (Zhu et al., 2022; Yoshizaki et al., 2020; Yoshizaki et al., 2023; Quante et al., 2019; Mitchell et al., 2021; 2023).

Evidence-to-Practice Gap: Implementation Research

Although eHealth and mHealth are well-supported solutions to treatment accessibility barriers, there are also implementation issues to consider when such interventions are disseminated. Implementation research is a research area focused on studying the process of translating evidence-based research knowledge into practice (e.g.,

dissemination of interventions, programs, guidelines) by identifying factors (barriers and facilitators) impacting uptake (Landsverk et al., 2012; Bauer & Kirchner, 2020; Luther et al., 2022). Barriers and facilitators to uptake are captured by a number of implementation frameworks such as the Theoretical Domains Framework (TDF; Atkins et al., 2017), Reach, Effectiveness, Adoption, Implementation, and Maintenance framework (RE-AIM; Glasgow et al., 2001), Implementation Outcomes Framework (IOF; Procter et al., 2011), and the Consolidated Framework for Implementation Research (CFIR; Damschroder et al., 2022). While there are key differences among these frameworks, all acknowledge the complexity and variability of what occurs beyond the research context that can make implementing evidence-based interventions difficult.

As discussed above, many barriers need to be addressed to successfully implement the *ABCs of SLEEPING* intervention. For example, HCPs do not currently approach sleep intervention for insomnia in a stepped approach and report a lack of knowledge and training in pediatric sleep. Moreover, parents report difficulty accessing insomnia evidence-based treatments/services (Newton et al., 2021). While evidence-based mHealth and eHealth may provide a solution to this evidence-to-practice gap, examining implementation is an important step to ensuring the success of these interventions once released to the public.

Addressing the Evidence-to-Practice Gap: The *ABCs of SLEEPING* app for School-Aged Children

The *ABCs of SLEEPING* intervention provides accessible treatment for school-age children whose parents would benefit from learning about and incorporating healthy sleep practices to address pediatric insomnia symptoms (Allen et al., 2016; Howlett et al., 2020; Jemcov et al., 2021). This section provides an overview of the *ABCs of SLEEPING*

app, including visuals of each component (check-in, sleep report, and sleep tips). The homepage of the *ABC of SLEEPING* app provides tabs for the intervention's three components, a to-do list, and "about the program" (see Figure 1.1 for a visual of the homepage and "about the program" tab).

Figure 1.1.

The ABCs of SLEEPING Homepage and "About the Sleep Program" Tab
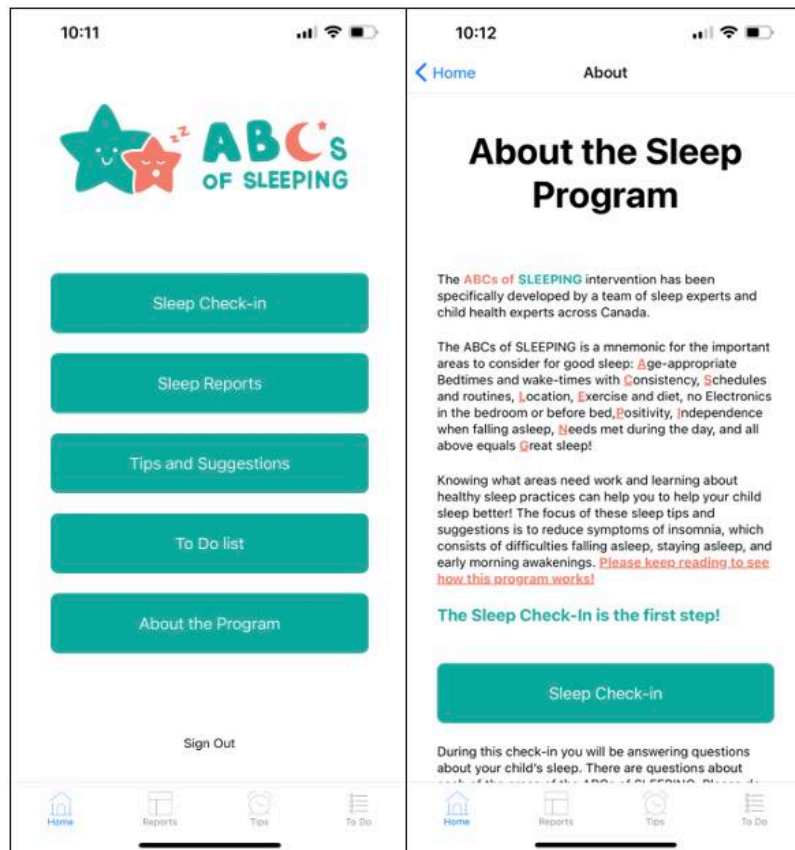
The *ABCs of SLEEPING* intervention has three components. Below, Figure 1.2 displays the first; the 'sleep check-in' (previously termed the *ABCs of SLEEPING* questionnaire) that parent users are instructed to complete first. The *ABCs of SLEEPING* check-in uses the *ABCs of SLEEPING* mnemonic to assess parent users and their

child(ren)'s current use of healthy sleep practices to promote health sleep habits for their child(ren).

Figure 1.2.

The ABCs of SLEEPING Check-in
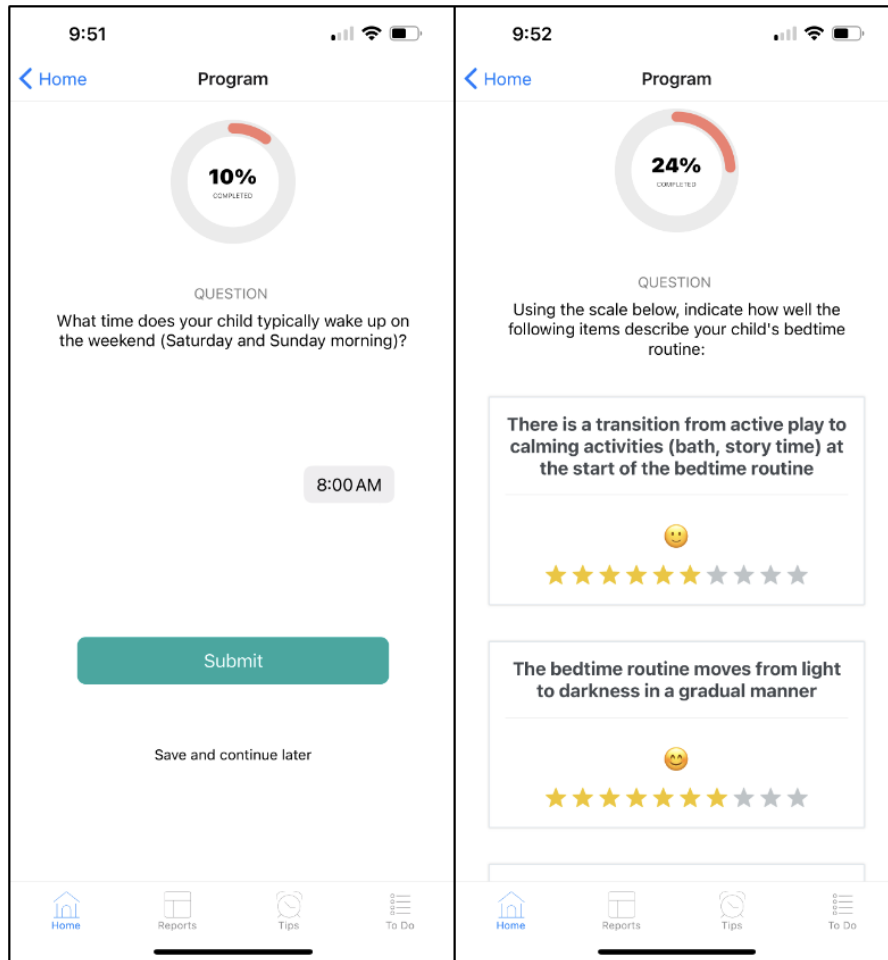
Upon completing the check-in, a 'sleep report' (component 2) and 'sleep tips' (component 3) are automatically produced. The sleep report provides families with positive and constructive feedback using a star system, with three stars indicating the healthy sleep practice area to be well implemented (no changes required), two stars indicating the healthy sleep practice area to be of moderate priority (consider making changes), and one star

indicating the area to be high priority for changes to support healthy sleep practices (see Figure 1.3 for a visual of the sleep report).

Figure 1.3.

The ABCs of SLEEPING Sleep Report
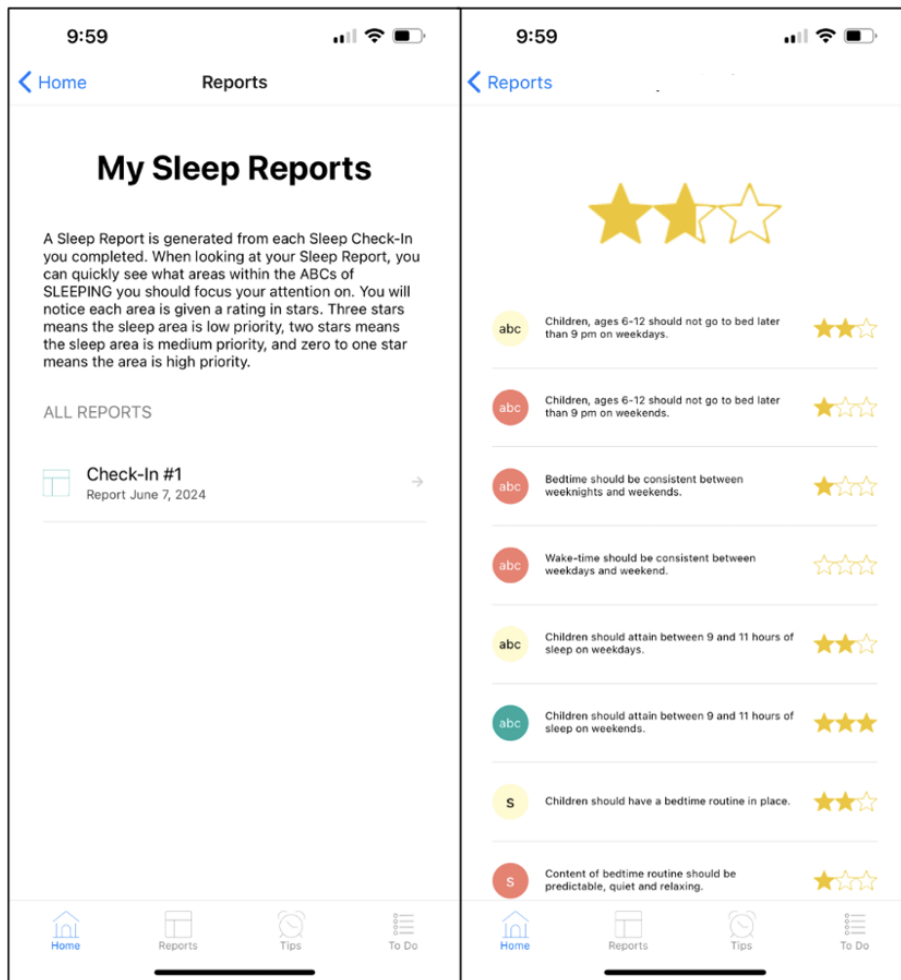
The sleep tips provide parents with recommendations on how to address those healthy sleep practice areas that were identified in the sleep report. The sleep tips are organized based on the *ABCs of SLEEPING* mnemonic. Note that stars and colours are used to indicate levels of priority in the sleep report and sleep tips, respectively. Green and three stars indicate the healthy sleep practice area does not need to be addressed (low

priority). Yellow and two stars indicate moderate changes may need to be made (medium priority). Red and one star indicate changes should be made in the healthy sleep practice area (high priority). Parents can tap on these letters (representing the healthy sleep practice area) to gain access to the sleep tips. See Figure 1.4 below for a visual of the sleep tips.

Figure 1.4.

The ABCs of SLEEPING Sleep Tips
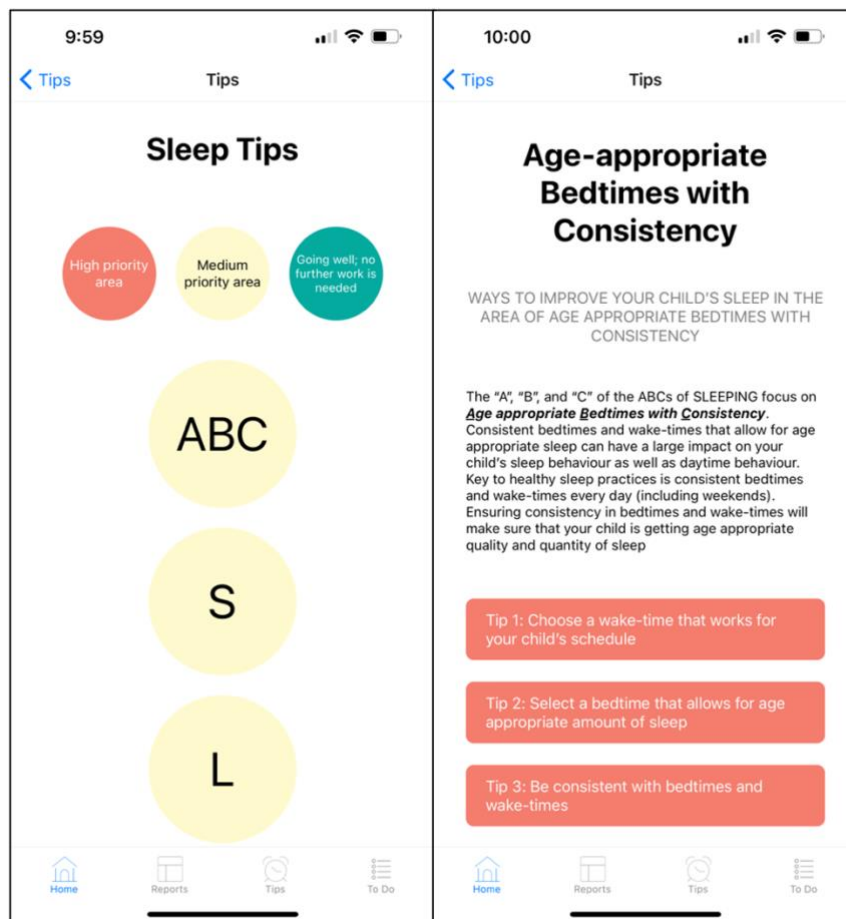
The Development of the *ABCs of SLEEPING* Intervention

Although *ABCs of SLEEPING* is currently in the format of a smartphone app, its conception followed a series of steps informed by an empirical approach. Figure 1.5 provide an overview of the timeline for the *ABCs of SLEEPING* foundational research

studies informing its development and evaluation (creation of the mnemonic for clinical use, systematic review, and usability study) and the modifications that occurred from 2013 to 2020. This research is also described below.

ABCs of SLEEPING Mnemonic. Bessey et al. (2013) examined differences in healthy sleep practices between TD children and those diagnosed with ADHD. The mnemonic was described to cover and organize healthy sleep practice concepts within a 24-hour perspective (i.e., considering sleep to be impacted by what happens at bedtime and throughout the child's day). This research highlighted a possibility of using the mnemonic clinically. As such recommendations were generated in each healthy sleep practice area and these recommendations were evaluated in a Systematic Review.

The Systematic Review of the ABCs of SLEEPING. To explore the clinical use of the mnemonic, recommendations were developed for each area of the mnemonic. These recommendations were formally evaluated for their empirical evidence. A systematic review of 77 research articles was conducted by Allen et al. (2016) to examine the evidence for each area covered in the *ABCs of SLEEPING* mnemonic. Level of support was defined based on the total number of research studies supporting the area as well as based on the methodology used (e.g., strengths or limitations relating to experimental control) and whether there was presence of contradicting findings between the research reviewed. The levels of empirical support were developed by the researchers. Strong support was defined as at least three well-designed studies. For moderate support, at least three studies were identified but some being cross-sectional or longitudinal. Limited support was less than three studies using this methodology. For strong, moderate, and limited support, no research findings could contradict each other. Equivocal support was the presence of any

contradicting evidence regardless of the number of articles identified or methodology used. Insufficient evidence was defined as no articles providing results to support the healthy sleep practice area while non-supportive were those areas that had majority of articles being contradictory or no results to support.

The results of Allen et al. (2016) review were that most of the *ABCs of SLEEPING* mnemonic areas had strong to moderate support. A minority of recommendations within any area having limited, equivocal, or insufficient support. Only one recommendation under "Exercise and diet" (i.e., avoiding exercise close to bedtime) was found to have non-support. Overall, the results empirically supported clinical use of the *ABCs of SLEEPING* mnemonic.

The ABCs of SLEEPING Usability Study. Following the systematic review, an intervention with three components was developed. These components were termed the "*ABCs of SLEEPING* questionnaire" (now termed "sleep check-in"), "sleep report card" (now termed "sleep report"), and "recommendation handouts" (now termed "sleep tips"). The sleep check-in was developed to be an online questionnaire administered via Opinio, a secure web-based survey system, and responses were manually scored to produce a sleep report provided as a portable document format (PDF) via email to parents. Handouts for all areas, unless no concerns were identified, were also provided to parents as PDFs via email. The usability study utilized the honeycomb user experience framework (Morville & Sullenger, 2010). This is a framework that outlines six usability constructs (i.e., usefulness, usability, desirability, valuableness, accessibility, and credibility) that contribute to overall user experience. These six usability areas were evaluated via a Usability Feedback Questionnaire that collected quantitative and qualitative feedback with twenty-two parents

of children between the ages of 1-12 years with at least one behaviourally based sleep problem. Results revealed parents to consider the *ABCs of SLEEPING* intervention as highly usable, desirable, accessible, and credible (Howlett et al., 2020). Feedback for modifications were provided by both parents and from eight HCPs as well (please see Table 1.3). The most substantial change was adapting the intervention to an mHealth format (i.e., smartphone app) in order to integrate all three components. The mHealth format was chosen given the emerging strong evidence of the effectiveness of mHealth programs (Yoshizaki et al., 2020; Yoshizaki et al., 2023; Quante et al., 2020; Mitchell et al., 2021).

Table 1.4.

End-user Feedback Informing ABCs of SLEEPING Modifications

Usability Study Feedback		Modifications
Parent	HCP	
• Centralize the sleep check in, report, and tips • Need to know what sleep tip areas to prioritize • Reduce amount of information as overwhelming • Include more age-specific information • Include more information about night wakings • Include areas for parents to write comments • Enhance visual by adding more colour • Make more personalized • Include "frequently asked questions"	• Add feature to receive data from check-in that parent sends to inform assessment and treatment planning • Consider how some families may need more support than what can be provided through an app	• All components of intervention (sleep check-in, report, and tips) centralized into a smartphone application • Healthy sleep practice areas were colour coded and a star-system implemented into sleep report to let parents know what sleep tip areas to prioritize • Sleep tips edited to be more concise and age-specific (i.e., school-age children) • Open textbox fields included in sleep check-in • Night waking information included • Intervention modified to have more colour • An "about the program" tab included

Figure 1.5.

Intervention Development Timeline

2013 ─── 2020

Bessey et al. (2013)
ABCs of SLEEPING menmonic created for clinical use

Allen et al. (2016)
Systematic review completed. Evidence for *ABCs of SLEEPING* healthy sleep practice areas established.

Howlett et al. (2019)
Usability study completed. See figure notes for results. Feedback collected from end-users to inform modifications.

2014-2016
Idea to create an intervention. Next step identified: evaluate level of evidence for each area of the mnemonic.

2016-2019
The *ABCs of SLEEPING* intervention created to have three components: questionnaire, sleep report, recommendation handouts. Next step identified: collect end-user feedback.

2019-2020
Feedback used from usability study to adapt the *ABCs of SLEEPING* intervention. Modified based on feedback (e.g., adapted to a smartphone app; see table 1.4 for further feedback and modification details).

The ABCs of SLEEPING Development Timeline

Note. For results of the research outlined in this timeline, please refer to each study's sub-heading above within this section of Chapter 1.

User-centered Theory

The development of the *ABCs of SLEEPING* app has followed an approach informed by user-centered theory. User-centered theory postulates that including end-users in the development and evaluation of a program or intervention translates to positive impacts (e.g., well-received, achieve intended outcomes) to those it is intended for (i.e.,

end-users; Still & Crane, 2017; Pratt & Nunes, 2012). A user-centered approach has been highlighted as especially important in research evaluating and developing digital programs and interventions (e.g., mHealth, internet-based interventions) given the remote delivery of information via these methods (Zhai et al., 2023). The goal of digital programs and interventions is to suit various contexts and situations, and engaging end-users in development and evaluation through a user-centered approach is theorized to accomplish this goal (Zhai et al., 2023; Still & Crane, 2017).

The research to be described in this dissertation incorporates a user-centered approach, and thus it is likely that involving end-users would translate to the *ABCs of SLEEPING* app being more acceptable among end-users, participants showing higher fidelity to the intervention improving intended sleep outcomes (i.e., use of and higher consistency of using healthy sleep practices, and improved sleep which was examined in a limited way with a pilot RCT in Chapter 3). It is likely that understanding the demand (i.e., who is the intervention intended for, is there a perceived need for it), integration (i.e., how is an intervention like this searched for and used), and practicality (i.e., barriers and facilitators) from end-users would enhance the uptake of the intervention when released to the public.

Feasibility Framework

Given that this dissertation is guided by a framework for feasibility and pilot study data, it is important to provide clear definitions of each. As discussed by Whitehead et al. (2014), feasibility studies are a broader term for preliminary research whereas pilot RCT studies are intended to utilize intended methodology (i.e., RCT methodology). Leon et al. (2011) defined pilot studies as small-scale trials of methodology intended for a future full-

scale trial. Moreover, a pilot study can examine feasibility data such as recruitment potential and participant retention (i.e., retention and dropout rates) with which sample size estimates may be made (Leon et al., 2011; Whitehead et al., 2014). Only the results of full-scale RCTs may be used to influence future clinical practices as feasibility and pilot studies are not intended to establish treatment effectiveness but may, with caution, examine effectiveness in a limited manner (e.g., preliminary effectiveness).

To prepare the *ABCs of SLEEPING* app for a full-scale RCT, the current dissertation is guided by the feasibility framework of Bowen et al. (2009). This comprehensive framework provides researchers with important potential areas of feasibility to explore, including three design options for a feasibility and/or pilot study to evaluate an intervention prior to a full-scale RCT. The design options are (1) 'can it work?' (e.g., is there evidence that the intervention might work with the intended population?), (2) 'does it work?' (e.g., is there evidence that the intervention might be efficacious or effective under ideal or actual conditions compared to other practices such as usual care?), and (3) 'will it work?' (e.g., will the intervention work in real-life contexts with those populations that might adopt the intervention as practice?).

Within these design options, Bowen et al. (2009) outlines various areas of feasibility that can be explored such as acceptability (e.g., satisfaction ratings with intervention), demand (e.g., need for, and/or degree to which the target population would want/use the intervention), fidelity[1] (e.g., is the intervention being used as the researchers

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[1] Bowen et al. (2009) use the terms "implementation" instead of fidelity and "limited efficacy or effectiveness" instead of preliminary effectiveness. I use the latter terms in this dissertation and will explain the reasoning for this in the subsequent paragraph.

intended), practicality (e.g., barriers or facilitators to using the intervention), integration (e.g., how an intervention can be searched for or used), preliminary effectiveness (e.g., examining pre/post changes with limited methodology such as lower statistical power, convenience sample), adaptation (e.g., examining the process of changing the content of the intervention for a new context such as a different format, media, or population), and expansion (e.g., examining the potential success of an already successful intervention with a different population or setting). We utilized each design option and explored all areas of feasibility outlined, except adaptation and expansion. Study 1 explores acceptability, fidelity, and preliminary effectiveness of the initial *ABCs of SLEEPING* app, Study 2 examines preliminary effectiveness of the revised program using pilot RCT methodology, and Study 3 examines demand, integration, and practicality. Familiarity (i.e., an individual's familiarity with a given intervention or its format) is an additional area, not covered by Bowen et al. (2009), explored in Study 3. Overall, this framework allows for a comprehensive evaluation of an intervention that involves end-users (i.e., parents and HCPs).

It is important to note that within the Bowen et al. (2009) framework preliminary effectiveness is one area that can be explored, and it does not equate to well-powered hypothesis testing given limitations (e.g., underpowered analysis, convenience sample, shorter follow-up period). Additionally, in this dissertation different terminology than Bowen is used to better capture what was measured. Specifically, Bowen et al.'s (2009) framework refers to implementation as an area that can be explored, but we refer to this area as fidelity given its definition (i.e., degree to which the intervention is utilized as intended). We also will use the term "preliminary effectiveness" as our evaluations of the

intervention measure effects under less-than-ideal conditions (e.g., small sample size) and provide results to examine for evidence of intended effects of the intervention (Gartlehner et al., 2006). Last, we focus on effectiveness rather than efficacy. Effectiveness and efficacy exist on a spectrum where increased control translates closer to efficacy (Gartlehner et al., 2006). Given the nature of feasibility and pilot research, effectiveness is considered the more appropriate terminology.

Dissertation Objectives

The aim of this dissertation was to further the development and evaluation of the *ABCs of SLEEPING* mHealth intervention taking a user-centered approach. The specific objectives were to (a) to evaluate the acceptability, fidelity, and preliminary effectiveness of the *ABCs of SLEEPING* intervention qualitatively and quantitatively, (b) conduct a pilot RCT study to inform a future full-scale RCT and to evaluate preliminary effectiveness with increased methodological rigour, and (c) examine barriers and facilitators to potential implementation by evaluating the areas of familiarity, demand, integration, and practicality from the perspective of end-users (i.e., parents and HCPs) who have experience with the *ABCs of SLEEPING* intervention. These goals were achieved via three research studies, described in Chapters 2 to 4. Chapter 2 (Study 1) provides the first manuscript for the feasibility study. Chapter 3 (Study 2) provides the second manuscript for the pilot RCT study, and Chapter 4 (Study 3) provides the third manuscript for the study examining barriers and facilitators to potential implementation. Last, Chapter 5 includes a general discussion of the findings from the three studies, theoretical considerations, clinical implications, strengths and limitations of the research, and future research directions.

Chapter 2: Evaluating the Feasibility of the ABCs of SLEEPING Mobile

Application: Exploring Fidelity, Acceptability, and Preliminary Effectiveness

The manuscript based on this feasibility study is presented below. Readers are advised that Anastasija Jemcov, under the supervision of Dr. Penny Corkum, was responsible for the research question, methodology, analysis, and all aspects of the writing process. The following manuscript was published in the Clinical Practice in Pediatric Psychology journal in 2021. Anastasija Jemcov received critical editorial feedback from her dissertation committee members (Dr. Isabel Smith and Dr. Sean MacKinnon).

Jemcov, A., Keys, E., & Corkum, P. (2021). Evaluating the feasibility of the *ABCs of SLEEPING* mobile application: Exploring implementation, acceptability, and limited efficacy. *Clinical Practice in Pediatric Psychology*, *9*(2), 180–191. https://doi.org/10.1037/cpp0000400

Abstract

Objective: Behaviourally based sleep problems are common among school-age children. Due to a number of barriers, few children receive evidence-based behavioural interventions for their sleep problems. The *ABCs of SLEEPING* intervention was developed to provide parents with individualized and prioritized sleep recommendations. **Method:** The current study assessed the feasibility of the intervention using a cohort pre-test post-test design. Acceptability was assessed by collecting parent ratings of satisfaction/suitability and qualitative feedback through open-ended questions. Fidelity was assessed weekly for four weeks to examine if the intervention was used as intended. Preliminary effectiveness was explored by assessing changes in children's sleep and bedtime behaviours using parent report. **Results:** Twenty-three Parents generally reported satisfaction with each of the three intervention components (check-in, sleep report, and tips) and suitability of the tips for their child's age and sleep problems. Descriptive statistics of the fidelity data revealed parents did not use the intervention as much as intended. Content analysis of the qualitative data indicated that some changes to the intervention are needed (e.g., reminders to use). Statistically significant evidence for preliminary effectiveness was found based on parent-reported questionnaires with moderate to large effect sizes, but sleep was not normalized. **Conclusion:** The results indicate that while the *ABCs of SLEEPING* intervention had a moderate level of feasibility, it is not yet ready for large-scale testing. Future research should focus on modifying the intervention to imbed features to enhance acceptability and support fidelity of the intervention. Once addressed, RCT methodology can be piloted ahead of full-scale testing.

Evaluating the Feasibility of the *ABCs of SLEEPING* Intervention: Exploring

Fidelity, Acceptability, and Preliminary Effectiveness

Sleep plays an important role in the development, health, and mental well-being of children (Dewald et al., 2010; Matricciani et al., 2019) and is necessary for optimizing performance on tasks requiring learning, cognition, and attention (Dewald et al., 2010; Gruber, 2013). For example, sleep restriction in school-age children (i.e., one hour less than the recommended nine hours of sleep) is associated with negative impacts on attention and regulation of behavior and emotion (Vriend et al., 2012). Fostering healthy sleep habits in children is important to promote sleep quality and quantity, which in turn will help to prevent negative daytime consequences and support optimal functioning (Allen et al., 2016).

Certain sleep practices have been consistently found to be associated with poor sleep including inconsistent bedtime routines, use of electronics close to bedtime, lack of independence at bedtime, and so forth (Hale & Guan, 2015; Mindell et al., 2009). These sleep practices contribute to sleep problems such as difficulty falling asleep, night awakenings, and early morning awakenings, and when sleep problems result in clinical impairment, the child qualifies for a diagnosis of insomnia (American Psychiatric Association [APA], 2022). The prevalence of insomnia symptoms within school-age children is high, with one out of five children from the general population experiencing insomnia symptoms (Calhoun et al., 2014). If left untreated, these symptoms can continue into adolescence and adulthood and have significant consequences for physical and mental health (Fricke-Oerkermann et al., 2007).

Rigney et al. (2018) described a four-step intervention model for sleep care. This model begins with less complicated interventions and moves toward more intensive interventions or ones with potential side-effects when the approaches implemented in earlier steps do not achieve adequate improvements (Korff & Tiemens, 2000). When following this model, sleep education is used first, which involves changing knowledge about sleep (e.g., addressing parental misinformation and inaccurate beliefs about sleep). The second step involves putting into place healthy sleep practices (e.g., not using electronics before bed). The third step is to implement specific behavioural sleep strategies such as reinforcement and graduated extinction. The strategies in the third step are typically delivered by parents after consultation with sleep and/or behavioural specialists. Only after the use of an intensive behavioural approach should medication be considered as the fourth and final step in the stepped care model.

Although sleep education and implementing healthy sleep practices would be considered the first steps for addressing behaviourally based sleep problems, there are barriers to using these interventions. While there is strong evidence for a range of behavioural strategies to help children sleep better, health care providers (HCPs) report a lack of training, knowledge, and time to provide evidence-based sleep care (Boerner et al., 2015). This is problematic as the majority of parents bring their concerns to frontline HCPs (e.g., family physician, pediatrician) when seeking intervention for their child's insomnia symptoms (Mack & Rybarczyk, 2011). Additionally, there is a scarcity of accessible behavioural sleep intervention programs for school-age children that exist for use by parents and HCPs, and to our knowledge there are no evidence-based mobile health (mHealth) intervention programs available in the format of a smartphone app for this age

group. Interventions using the mHealth format use smartphones to deliver treatment and have increased in popularity given their potential to address accessibility barriers (Kazdin & Blase, 2011). Of the available mHealth resources for sleep, those adapted for other age groups (e.g., infants, adolescents) have demonstrated promising acceptability and effectiveness results (Yoshizaki et al., 2020; Yoshizaki et al., 2023; Quante et al., 2020).

Unfortunately, first-line behavioural interventions to improve sleep are typically recommended alongside pharmacotherapy (e.g., sedative and hypnotic medications) despite the lack of evidence for efficacy, tolerability, and safety in this population (Owens et al., 2010; Owens & Mindell, 2011; Owens et al., 2003). Owens et al. (2010) reported that 96% of 1,273 physicians surveyed about their practice patterns with treating insomnia in school-age and adolescent children indicated that they prescribe pharmacotherapy (e.g., alpha agonists, Trazodone), and 88% recommended over-the-counter medication (e.g., melatonin) for insomnia in a typical month. There is a need for accessible sleep resources so that parents can directly access evidence-based interventions. Smartphone apps used to administer eHealth programs (i.e., using the internet to deliver interventions), and mHealth (i.e., mobile health programs and interventions delivered via smartphones) would provide this wide level of accessibility. These intervention programs would allow parents better access to evidence-based information about sleep (level one) and teach them to implement strategies that promote healthy sleep practices in their children (level two). Given the high prevalence of Internet use in North America (i.e., 94.6% of the population as of May 31, 2020; Internet World Stats, 2020), an online smartphone app would seem ideal to meet this evidence-to-practice gap. Moreover, the use of e/mHealth programs can help to offset access barriers in terms of time and financial burdens on families (Borrelli & Ritterband,

2015; Rigney et al., 2018). To ensure uptake and adherence to the program, the components of the intervention must be delivered in a manner that is easy for the parent to use. To address the above-noted needs, we created the *ABCs of SLEEPING* in a mobile app that provides intervention strategies at level one and level two of the stepped care model for treating pediatric insomnia.

To develop the *ABCs of SLEEPING* app, a usability study was conducted on a beta version to gather feedback from parents ($n = 22$) and HCPs ($n = 8$) (Howlett et al., 2020). Based on feedback by participants, this study found high quantitative ratings for the intervention's usability (user-friendliness, easy to navigate/understand), desirability (visually appealing, presented in a logical way), credibility (information trusted by user), and accessibility (easy to navigate/access). Participants generally provided positive qualitative feedback in terms of the intervention's usability, but some constructive feedback was also provided. The main constructive feedback included the need to further streamline the sleep tips so as not to overwhelm parents with information, to include more age/ developmentally specific information, and to host the intervention on an interactive online website rather than through the online survey site used in the usability testing of the beta version. Modifications based on the feedback gathered through the usability study were made (e.g., modifying the intervention to be specific to school-age children), and the intervention is now an automated intervention accessible as an app on smartphones/tablets through both the Apple and Android App Store (currently only available for research purposes).

The current study assessed the feasibility of the *ABCs of SLEEPING* in this new app-based format. Bowen et al. (2009) guidelines for a feasibility study was used as a framework for this study. These guidelines cover recommended samples sizes (small sample sizes being common in feasibility research) and also eight possible areas of focus, including: acceptability, demand, implementation (referred to as "fidelity" in this manuscript), practicality, adaptation, integration, expansion, and limited efficacy or effectiveness testing (referred to as preliminary effectiveness in this manuscript). Bowen et al. (2009) outlines different design options that combine selected areas of focus from these eight areas. The "does it work" design option was utilized to determine if the intervention is ready for testing in a full-scale RCT. As such, the areas of focus for the current feasibility study were acceptability, fidelity, and preliminary effectiveness. Acceptability examines how the users react to the intervention, specifically their satisfaction and whether they found the intervention to be suitable for their child. Fidelity examines whether the intervention can be implemented as indicated (i.e., daily use of healthy sleep practices). Last, preliminary effectiveness examines the effectiveness of the intervention in a limited way (limited resources: shorter follow-up periods, limited statistical power). Together, these areas provide insight into whether full scale RCT testing is justified. This research is also informed by user-centered theory, specifically, it is posited that collecting feedback from intended end-users of an intervention and using it to make modifications during development contributes to its enhanced positive impacts on those end-users such as it being successful in achieving intended outcomes (Still & Crane, 2017; Pratt & Nunes, 2012). We used a cohort, pre-test post-test design for this feasibility study. Acceptability was assessed by parents after using the intervention for one-month. Fidelity

was measured each week for one-month. Preliminary effectiveness involved the measurement of the child's sleep before the intervention (pre-test) and after one-month of the intervention (post-test). The first study objective was to evaluate the acceptability of the sleep intervention. It was hypothesized that participants would rate the intervention as acceptable as this would be consistent with positive feedback received during our usability study (Howlett et al., 2020). Our second objective was to evaluate fidelity by examining whether the intervention is being used as intended (i.e., daily use of healthy sleep practices). The focus on daily use is based on research literature demonstrating that increased fidelity of implementation is associated with better outcomes (Hiscock et al., 2019). Last, the third objective was to evaluate the preliminary effectiveness of the intervention by assessing change in the child's sleep (pre-test vs. post-test). It was hypothesized that parent participants would report improved sleep habits and insomnia severity for their child as this would be supported by the larger body of research demonstrating the effectiveness of psychoeducation and healthy sleep practices.

Method

Participants

The current study recruited 23 parents with children between the ages of 6 to 12 years through a multi-pronged recruitment strategy including social media (e.g., Facebook), contacting participants from our research lab's study contact list (i.e., participants that have indicated interest in future research), and community board advertisements (e.g., local health clinics). Eligibility criteria for the participating parents were: (a) resided in Canada, (b) had internet/computer access and an email account for the completion of online questionnaires, and (c) was comfortable reading and writing in

English. The participant's child needed to meet the following eligibility criteria: (a) was between the ages of 6 to 12 years, (b) did not have major mental or physical health conditions that substantially impacted daily functioning (i.e., child is ambulatory, living at home/not hospitalized, can complete developmentally appropriate daily activities as expected for their age), and (c) to have at least one of three insomnia symptoms (i.e., difficulty falling asleep, staying asleep, and/or early morning awakenings, but insomnia diagnosis not required) and no intrinsic sleep disorders (e.g., sleep apnea). Eligibility criteria were assessed with a questionnaire based on parent report (described below). Ethics approval for this study was obtained through the Research Ethics Board in a tertiary care pediatric health center (i.e., IWK Health Center Research Ethics Board [REB]; 1024953).

Measures[1]

Eligibility Questionnaire (EQ)

The 12-item EQ was designed by the researchers to evaluate the study's inclusion criteria (as described above) that was administered prior to being enrolled in the study. Participants provided "yes" or "no" responses to each item. This online questionnaire is fully automated with two outcomes: eligible or ineligible.

Demographic Questionnaire (DQ)

Participants completed the 29-item DQ during the pre-test period. Information was collected about the participant (relationship to the child, level of education) and their child (sex, ethnicity). Items were compiled from the Canadian National Longitudinal Survey of Children and Youth (2011), as well as the Canadian Census. This questionnaire allows us to make comparisons to the Canadian population in general.

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[1] For all Study 1 measures, please see Appendix A.

Acceptability Measures

Acceptability Questionnaire (AQ). The AQ is a nine-item questionnaire that was administered at the pre and post-test. It includes eight rating scale items (e.g., satisfaction ratings, intent to continue use, or suitability) and one open-ended qualitative item that assesses acceptability of the intervention. The AQ is author-made but based on Bowen et al. (2009) components to assess acceptability in a feasibility study and Tarnowski and Simonian (1992) Abbreviated Acceptability Ratings Profile (AARP). As such we have followed a similar format to the AARP but have adapted the items to make it directly applicable to our study. We did this by including our intervention components in the wording (questionnaire, sleep report, or sleep tips) and used wording from our feasibility framework (suitability, satisfaction) in our items. The AARP has been widely used and its psychometric properties have been tested across different types of interventions (Finn & Sladeczek, 2001). Following the structure of the AARP, all items on the AQ are on a 5- point Likert scale ranging from strongly disagree to strongly agree and the AARP and AQ have a score of 30 as a cut-off value for acceptability (Tarnowski et al., 1992). In order to group and describe our data, strongly agree and agree item responses were considered positive acceptance ratings, neutral responses were considered neutral acceptance ratings, and strongly disagree and disagree were considered negative acceptance ratings.

Fidelity Measures

Fidelity Survey (FS). The FS is an author-made three-item questionnaire (one rating scale item and two open-ended questions) that was administered to participants on a weekly basis during the one-month intervention phase between the pre and post-test

periods. The rating scale item assessed the frequency of use of sleep tips on a scale from 0 days to 7 days per week. The two open-ended questions asked participants for their opinions about fidelity. The first question asked what made the sleep tips easy to use, and the second question asked what made the sleep tips hard to use. The FS is based on Bowen et al. (2009) components to assess fidelity in a feasibility study.

Preliminary Effectiveness Measures

Children's Sleep Habits Questionnaire (CSHQ; Owens et al., 2000).

The CSHQ includes 45 items tapping into the frequency of the child engaging in certain sleep practices over the last typical week with a scale ranging from "Usually" (5 to 7 times a week, scored as 3) to "Rarely" (0 to 1 time per week, scored as 1). This questionnaire was designed as a sleep screening instrument for school-age children and yields a summative score, called the total sleep disturbance score, as well as scores across eight subscales (e.g., bedtime resistance, sleep onset delay, sleep duration, sleep anxiety, night wakings, parasomnias, sleep disordered breathing, and daytime sleepiness). Thirty-one select items are used to derive the total sleep disturbance score. A total sleep disturbance score of 41 is used as a cut-off to identify children with clinically significant sleep problems (Owens et al., 2000). In another study, Owens et al. (2000) demonstrated that the CSHQ cut-off score has good sensitivity (.80) and specificity (.72), with this score correctly identifying 80% of the clinical group in a sample. For the current study, we used the total sleep disturbance score (minus the Sleep Apnea subscale, resulting in minimum score of 33 and a maximum score of 99) at both pre and post-test as a measure of preliminary effectiveness.

Pediatric Insomnia Severity Index (PISI; Byars & Simon, 2014)

The PISI collects parental reported overall score at pre and post-test of their child's insomnia symptoms that is summed from the first five of seven-items relating to sleep onset and sleep maintenance problems, daytime sleepiness, and nocturnal sleep duration. The PISI has a scale ranging from 0 (i.e., "never") to 6 (i.e., "always"). The internal consistency between items measuring sleep onset problems (Cronbach's α = .92) and sleep maintenance problems (Cronbach's a = .72) is high in prior research (Byars & Simon, 2014).

Bedtime Routines Questionnaire (BRQ; Henderson & Jordan, 2010)

The BRQ was used to collect pre and post-test measures of bedtime routine consistency on weekdays and weekends. This 31-item questionnaire yields a final summative score for the consistency of child's weekday and weekend bedtime routines with higher scores indicating higher consistency of bedtime routines. The BRQ has a scale ranging from 1 (i.e., "almost never") to 5 (i.e., "nearly always") and was administered at the pre and post-test. Overall, the BRQ demonstrated solid factor structure and adequate internal consistency in previous research (.69–.90; Henderson & Jordan, 2010).

Procedure

Parents expressed interest in the study in response to recruitment materials (posters and social media advertisements) by contacting the researcher (AJ) via email. Next, parents were sent a link to the EQ to complete via email. Upon completing the EQ, parents who were eligible were provided with a link to an electronic consent form to review and sign. Participants who provided consent to participate in the study were contacted by telephone to give them an opportunity to ask questions about the study's requirements. At the same time, participants were sent a link to complete the DQ, CSHQ, PISI, and the BRQ, all of

which were administered via the secure online data collection tool REDCap (Research Electronic Data Capture; Harris et al., 2009; Harris et al., 2019). The pre-test period began once the parent received the link to the questionnaires.

Following the completion of all measures administered during the pre-test period, parents received log-in access to the *ABCs of SLEEPING* intervention and an email instructing them to use some or all of the sleep tips each night for one-month. Once logged into this intervention, parents were able to complete the *ABCs of SLEEPING* questionnaire, and then the sleep report card and the sleep tips specific to the child's sleep practices were automatically generated and made available to the parent. All sleep tips were accessible to the parent (with approximately three to four tips provided within each sleep area of the *ABCs of SLEEPING* mnemonic). Parents were instructed to use the sleep tips daily and were directed as to which ones to use based on the colour-coding system.

Parents were also asked to complete the FS once per week for the duration of the one-month study period. No additional measures were administered during this one-month period. After having access to the intervention for one-month, the post-test period began. A link to the post-test online questionnaires was sent to the participant's email. The results were used to measure changes in sleep practices (CSHQ, PISI, and BRQ) and to assess their acceptability ratings (AQ) for the intervention. When parents completed the study, they were thanked for their participation via email and received a $20 honorarium payment in the form of an Amazon.ca gift card.

The *ABCs of SLEEPING* Intervention

The mnemonic, "*ABCs of SLEEPING*", was developed to draw attention to the important factors that must be considered for healthy sleep practices for children: <u>A</u>ge-

appropriate <u>B</u>edtimes and wakeup times with <u>C</u>onsistency, <u>S</u>chedules and routines, <u>L</u>ocation, <u>E</u>xercise and diet, no <u>E</u>lectronics in the bedroom or before bed, <u>P</u>ositivity, <u>I</u>ndependence, and <u>N</u>eeds met, equal <u>G</u>reat sleep (Bessey et al., 2013). After the development of this mnemonic, Allen et al. (2016) conducted a review of the empirical evidence supporting each of the recommendations established by the mnemonic. They found strong support for many of the healthy sleep practice recommendations made through the *ABCs of SLEEPING* mnemonic.

Using this mnemonic as a foundation, an intervention was developed that includes three components. The first component is the *ABCs of SLEEPING* questionnaire (sleep check-in) that assesses the child's sleep practices using parent's responses to questions within each of the *ABCs of SLEEPING* healthy sleep practice areas. These responses algorithmically determine the feedback received on the second component, the sleep report card, which provides parents with feedback on each healthy sleep practice area. Feedback is provided based on a star system, with one star denoting the sleep practice area to be high priority (i.e., the healthy sleep practice recommendations are not being met), two stars denoting medium priority (i.e., the healthy sleep practice recommendations are not being fully met), and three stars denoting low priority (i.e., the healthy sleep practice recommendations are being fully met). The third component, the sleep tips, are organized using a colour-coded system for priority (i.e., red = high, yellow = medium; green = low). Priority is based on the star system described above, in combination with the robustness of the evidence for the healthy sleep recommendation. For example, if one star was received for both use of electronics at night and exercising before bed, use of electronics would be

prioritized over exercising before bed based on the strength of the extant literature for this recommendation.

Data Analyses

All data was analyzed using SPSS Version 25.0 (SPSS Inc., Chicago, IL). To analyze acceptability data (i.e., satisfaction, suitability ratings), descriptive statistics were used to determine the total acceptability score (means), and to determine parent agreement on items on the AQ (percent). Fidelity data (that is, frequency of using the sleep tips) were analyzed with descriptive statistics (i.e., means and standard deviations). Qualitative data was analyzed using content analysis to summarize the responses to the open-ended items in the fidelity and acceptability questionnaires. Participant's open-text responses were pooled from the FS and AQ feedback sections for analysis. The content analysis approach followed that of Erlingsson and Brysiewicz (2017) conventional content analysis. In this approach, data are broken down into codes in which labels are applied to participants' responses to provide a condensed meaning. These codes are then examined and grouped together based on meaning to form a category. A category is defined as a condensed factual representation of a collection of related codes. Parent responses were coded by Jemcov and Keys. Qualitative data was gathered from open-text responses provided on the AQ and FS. All preliminary effectiveness outcome data were analyzed using paired t-tests to examine mean differences between pre-test and post-test data. Cohen's d_z was utilized to examine effect sizes.

Results

Participant Characteristics

Table 2.1 displays the sample's demographic characteristics. Participating parents (n = 23) were mostly biological mothers with a high level of education. Participating children were mostly male, White, and had a mean age of 8.73 (range = 6–12 years). At the time of pre-test, the children on average had high scores on the Total Sleep Disturbance Scale of the CSHQ (M = 57.87, SD = 4.98), and all children in this sample met criteria for clinically significant sleep disturbances based on a cut-off of 41 (Owens et al., 2000).

Acceptability

Based on the total score on the AQ, it is not clear whether the mean score for the *ABCs of SLEEPING* (M = 28.96, SD = 5.43) reached the standard of acceptability based on the cut-off score of approximately 30 when examining the 95% confidence interval [26.62, 31.31] (Tarnowski et al., 1992). Parents endorsed satisfaction with all three components of the intervention. For satisfaction with the *ABCs of SLEEPING* questionnaire (i.e., sleep check-in), the majority of parents provided positive acceptance ratings (56.5%); however, a number of parents provided neutral (34.8%) or negative ratings (8.7%). Second, the sleep report card had positive acceptance ratings from half of parents (52.17%), with remaining parents reporting either neutral (26.1%) or negative ratings (21.7%). Third, satisfaction with the sleep tips had positive acceptance ratings from majority of parents (60.7%); with a number of parents provided neutral (26.1%) or negative ratings (13.0%).

In regard to suitability, the majority of parents provided positive ratings of suitability for the child's sleep problem (60.9%), with remaining parents indicating neutral

(30.4%) and negative ratings (8.7%). For sleep problem suitability, the majority of parents reported positive acceptance ratings based on child's age (60.9%), with remaining parents providing neutral ratings (26.1%), and negative ratings (13.0%).

Last, half of the parents in our sample provided positive ratings for the intervention being easy to use (52.2%), with remaining parents providing neutral (39.1%) and negative ratings (8.7%). The majority of parents indicated positive ratings for intending to continue using the sleep tips at this time (73.9%) with remaining parents proving neutral (17.4%) and negative ratings (8.7%). For intent to use six months from now with majority parents providing positive ratings (56.5%) with a number of parents providing neutral (21.7%) and negative ratings (21.7%).

Fidelity

Parents reported using the tips approximately the same number of days per week from week one ($M = 3.36$, $SD = 2.19$), to week two ($M = 3.04$, $SD = 2.23$), to week three ($M = 2.71$, $SD = 1.95$), and to week four ($M = 2.71$, $SD = 1.92$). Parents on average implemented the tips on three out of seven days each week. There was no significant difference between weeks one to four for sleep tip use, as determined by a repeated measures analysis of variance (ANOVA) test using a Greenhouse-Geisser correction to account for violations of sphericity, ($F(3, 2.43) = 1.83$, $p = .34$).

Qualitative Data

Qualitative feedback about the app was coded into six categories. Two categories consisted of positive feedback about the app. The first category was that the *ABCs of SLEEPING* has helpful sleep information, with parents reporting information was easy to understand (47%), that there were appropriate recommendations (30%), and that the app

reinforces good sleep habits (22%). The second category was that parents were satisfied with the intervention delivery and included comments from parents reporting the app being easy to use (52%), well organized (39%), and that parents liked the modality (i.e., app-based format; 35%).

There were three categories that offered constructive feedback about the app. The first category was that the sleep tips component of the app needed further refinement with parents reporting that the sleep tips were not always appropriate for the age of their child (39%), the tips needed to be more specific (35%), the tips were hard to implement (17%), and there was too much to implement (17%). The second category was that additional app development was needed to move backward and forward in the app (74%) and the need to include reminders (17%). Last, the third category was modifications to work with family's schedules as parents reported busy schedules that created time constraints (43%). Parents also provided general comments (neither constructive nor positive) regarding what impacted their sleep tips use such as major family events (e.g., death of a family member; 13%) and environmental disruptions (e.g., home renovations; 9%) that were grouped under extenuating circumstances impacting sleep tip use. Constructive feedback was used to pull recommendations for modifications (please see Table 1.4 in chapter 1 of this dissertation).

Preliminary Effectiveness

All quantitative data including effect sizes are displayed in Table 2.2. On the CSHQ, there was a statistically significant difference ($p = .012$; $d_z = 0.57$; moderate effect size) from the pre-test ($M = 54.48$, $SD = 4.93$) to post-test period ($M = 52.17$, $SD = 5.40$), indicating preliminary effectiveness. However, it should be noted that the post-test mean score is still well above the cut-off score of 41 for clinically significant sleep disturbance

based on the CSHQ. In terms of the specific subscales of the CSHQ that directly relate to insomnia, the night wakings subscale was significant ($t(22) = 3.53$, $p = .002$; $d_z = 0.73$). The daytime sleepiness ($t(22) = 1.94$, $p = .065$; $d_z = 0.41$), and the sleep duration sub-scales ($t(22) = 1.80$, $p = .086$; $d_z = -0.38$) were not significant. There were no significant changes for bedtime resistance ($t(22) = .24$, $p = .812$; $d_z = -0.05$) or the sleep onset delay ($t(22) = 1.54$, $p = .137$; $d_z = -0.32$) subscales. For the PISI, parents reported that their child's insomnia severity was significantly improved ($p = <.001$; $d_z = 0.97$; large effect size) at the post-test ($M = 9.65$, $SD = 4.18$) when compared with the pre-test ($M = 14.39$, $SD = 5.71$). However, the post-test mean is still within range of a clinically significant insomnia diagnosis (Byars et al., 2017). For the BRQ (weekday consistency), there was a statistically significant difference ($p = .023$; $d_z = -0.51$; moderate effect size) between the pre- test ($M = 20.21$, $SD = 3.45$) and post-test period (M = 22.69, $SD = 2.69$). The same was true for the weekend consistency with there being a statistically significant difference ($p = .005$; $d_z = -0.66$; moderate effect size) between the pre-test ($M = 17.82$, $SD = 3.95$) and post-test period ($M = 20.30$, $SD = 3.67$). Although this difference is statistically significant, strong conclusions cannot be made given the lack of normalization of these sleep variables and due to our small sample size (Henderson & Jordan, 2010).

Discussion

The purpose of the study was to assess the feasibility of the *ABCs of SLEEPING* intervention for parents to use to help their children aged 6 to 12 years to improve their insomnia symptoms. Using Bowen et al. (2009) "does it work" design option for feasibility studies, the areas of focus for the current study were to evaluate the app's feasibility (i.e., acceptability, fidelity, and preliminary effectiveness). Together, these areas provide insight

into whether full scale RCT testing is justified. Our findings demonstrated that overall, parents rated the intervention as acceptable. At the individual item level, over half of parents provided positive acceptability ratings across all items, but more than 15% of parents provided negative acceptability ratings for two items (i.e., sleep report card and intent to use the intervention in 6 months). Qualitative feedback about the intervention identified both positive (i.e., sleep information, delivery modality) and negative (i.e., need for more age-specific sleep information and more app features such as daily reminders) aspects. The intervention was used less frequently than the requested nightly use of the sleep tips. Preliminary effectiveness demonstrated improved sleep practices based on parent-report measures, although sleep problems were not normalized. Based on the feasibility data, some modifications are needed before full-scale RCT testing.

The first research question was to evaluate the acceptability of the sleep intervention. The hypothesis of positive acceptability ratings was partially confirmed. It was not clear whether the overall acceptability rating reached the standard (i.e., cut-off score of 30; Tarnowski et al., 1992). On individual items, the majority of parents provided positive acceptance ratings (ranging from 52.2% to 73.9%), many provided neutral (ranging from 17.4% to 34.8%) and some provided negative acceptance ratings (ranging from 8.7 to 21.7%). Two items were rated negatively by more than 15% of the sample (i.e., the report card component and their intention to continue to use the intervention in six months' time). The qualitative feedback was consistent with quantitative ratings and provided further elaboration for these ratings. The main positive feedback was that the parents liked the app as an intervention delivery method and that it provided helpful information. Constructive feedback included the need to further refine the sleep tips, in

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particular, to provide more age-specific interventions. Parents also commented on how difficult daily use was given their busy schedules.

The second research question was to evaluate fidelity by examining whether the intervention was being used as intended (i.e., daily use of healthy sleep practices). Contrary to our hypothesis, parents did not use the sleep tips daily as requested, but rather they used the sleep tips, on average, three out of seven nights. To maximize effectiveness, these strategies need to be used consistently across time (Allen et al., 2016; Howlett et al., 2020). The qualitative feedback indicated that the parents had difficulty remembering to use the app and sleep tips. It may be that the app could be improved by providing parents daily reminders to use the strategies. Also, using strategies based on motivational interviewing literature (e.g., providing feedback on progress) may help to improve fidelity (Draxten et al., 2016).

The third research question was to evaluate the preliminary effectiveness of the intervention by assessing change in the child's sleep over a one-month period. As hypothesized, preliminary effectiveness data was demonstrated by improvements in parent ratings from pre to post-test on their child's sleep behavior (CSHQ) and insomnia symptom severity (PISI), as well as daily sleep routines on weekdays and weekends (BRQ). These results should be interpreted with caution given the lack of experimental control (no control group), and small mean differences (even though statistically significant). Moreover, despite the changes in the children's sleep, they continued to have clinically significant symptoms. However, it may also be that the more clinically significant results would have been found if the post-test was after a longer period of time given that it takes time to change sleep quality and quantity.

There are a number of clinical implications from this study. First, we have collected user feedback to make modifications to the *ABCs of SLEEPING* intervention. By making these modifications we may increase the acceptability, fidelity, and effectiveness of the intervention. As such, we are furthering the development of an intervention that could result in a highly accessible mobile app intervention providing psychoeducation about sleep and recommendations for healthy sleep habits (level one and two of the stepped care model; Rigney et al., 2018). HCPs could use the *ABCs of SLEEPING* as a resource to provide to parents to implement independently or to be supported by the HCP while implementing. Second, this research highlights the importance of a user-centered design when developing interventions and incorporating support into the intervention (Jokela et al., 2003).

This research should be interpreted in light of limitations. First, we only used subjective measures of sleep (i.e., parent-report questionnaires) and usage (i.e., self-report of fidelity), which may provide biased ratings (Nixon et al., 2008; Owens et al., 2000). Second, the follow-up period was short (one-month) and it may take more time for parents to implement the healthy sleep practice recommendations and for children's sleep to change (Howlett et al., 2020). Third, given that the sample size was small for statistical analysis, we could only test preliminary effectiveness. To establish more accurate evidence of the app's effectiveness, a more rigorous methodology would be required (e.g., RCT, controlling for medication use, etc.). Fourth, we did not objectively measure parental usage of the app. As such, we were unable to describe the frequency with which parents accessed the app. Fifth, it is not clear whether parents understood to use the strategies from the sleep tips daily as opposed to the app itself (i.e., opening the app each day which was not what

was expected). Participants were instructed to "use the information from the sleep tips" however we did not explicitly clarify that this did not require re-accessing the app. Sixth, the majority of parents in our sample were primarily of a White ethnicity and with a high level of education. As such, this study may not generalize well to families with demographics not represented in this study's sample. Additionally, while there is a high rate of individuals with Internet access (i.e., 94.6% of the population as of May 31, 2020; Internet World Stats, 2020), there are still 5% of individuals who may experience difficulty accessing the *ABCs of SLEEPING* intervention. Last, while we targeted increasing sleep knowledge and healthy sleep practices, it needs to be acknowledged that these are not always related. Improvements in healthy sleep practices can be observed without improvements in sleep knowledge (Wilson et al., 2014). This highlights that while the model for the delivery of evidence-based intervention for insomnia is presented in a linear fashion in a stepped care model (i.e., starting with less intense to more intense intervention), this sequence of steps is not always needed to observe behavioural change.

Our future research will focus on further developing the *ABCs of SLEEPING* intervention. Parents noted the need for this sleep information and approved of the mobile app delivery method. First, we will address improving the acceptability of our intervention by incorporating changes based on the constructive qualitative feedback that we received (e.g., streamlining the intervention for specific ages). Second, using our fidelity data we will modify the app program to provide parents with more support (e.g., including an option for reminders to be set, providing feedback on progress). Additionally, for future research we will include an objective measure of parental use of the app (i.e., how many times a day the app was used). After addressing the feedback provided in this feasibility study, the

ABCs of SLEEPING intervention should be evaluated for its effectiveness using full-scale RCT testing and collecting information about sleep using both subjective and objective measures. Future research should also focus efforts on developing accessible smartphone apps for additional age groups with high prevalence of insomnia symptoms (e.g., adolescents) and for parents of children with neurodevelopmental disorders (NDDs).

Developing an acceptable and effective mobile app intervention will allow for increased accessibility for parents of children with insomnia/insomnia symptoms and will help to fill the gap for treatments at levels one and two of the stepped care model for sleep intervention. When achieved, the *ABCs of SLEEPING* intervention has strong potential to be an accessible and useful resource for both HCPs and parents to use for the treatment of insomnia symptoms in children. This research can also be used more generally, such as when building smartphone applications for concerns other than sleep.

Table 2.1.

Participant Demographic Characteristics (N = 23)

Variables	N (%)
Parent relation to child	
Biological Mother	22 (95.7)
Biological Father	1 (4.3)
Parent level of education	
Some or Completed Trade School	4 (17.3)
Undergraduate Degree	11 (47.8)
Graduate or Professional Degree	8 (34.7)
Child ethnicity	
White	17 (73.9)
Non-White	5 (21.6)
Child sex	
Female	9 (39.1)
Male	14 (60.9)

Table 2.2.

Preliminary-Efficacy Data based on Parent-Report Measures

	Pre-test M (SD)	Post-test M (SD)	M difference (SD)	95% CI of M difference	t	p	Effect size Cohen's d_z
Subjective (Questionnaires)							
CSHQ	54.48 (4.93)	52.17 (5.40)	2.30 (4.04)	[0.557, 4.050]	2.74	.012	0.57
PISI	14.39 (5.71)	9.65 (4.18)	4.74 (4.86)	[2.635, 6.842]	4.67	<.001	0.97
BRQ Weekdays	20.21 (3.45)	22.69 (2.85)	-1.48 (2.90)	[-2.734, -0.221]	-2.44	.023	-0.51
BRQ Weekends	17.82 (3.95)	20.30 (3.67)	-2.48 (3.76)	[-4.106, -0.850]	-3.16	.005	-0.66

Note. CSHQ=Child Sleep Habits Questionnaire, PISI=Pediatric Insomnia Severity Index; BRQ=Bedtime Routines Questionnaire)

Higher scores on the CSHQ, and PISI questionnaires indicate more problematic sleep behaviour/insomnia severity, but for BRQ weekdays and weekends, higher score indicates less problematic sleep behaviour (i.e., increased bedtime routine consistency).

Cohen's d_z effect size interpretation: 0.2 = small effect, 0.5 = moderate effect, and 0.8 = large effect.

Chapter 3: A Pilot Randomized Control Trial of the *ABCs of SLEEPING* mHealth Intervention for Parents of School-aged Children with Insomnia Symptoms

The manuscript based on this pilot randomized controlled trial (RCT) study is presented below. Readers are advised that Anastasija Jemcov, under the supervision of Dr. Penny Corkum, was responsible for the research question, methodology, analysis, and all aspects of the writing process. She received critical editorial feedback from her dissertation committee members (Dr. Isabel Smith and Dr. Sean MacKinnon). A version of the following manuscript is currently being prepared for submission.

Jemcov, A., Mackinnon, S. P., Smith, I. M., & Corkum, P. (2024). A Pilot Randomized Control Trial of the *ABCs of SLEEPING* mHealth Intervention for Parents of School-age Children with Insomnia Symptoms. [Manuscript in preparation]. Department of Psychology, Dalhousie University.

Abstract

Sleep is important for overall functioning; thus, parents should have access to effective sleep intervention for their children's insomnia. Mobile health interventions (mHealth) are increasingly popular partly due to their accessibility. Currently, no evidence-based sleep intervention apps are available for parents and their school-age children. Our research team developed the *ABCs of SLEEPING* intervention to address this gap. The current study used a modified version based on feedback from a feasibility study which found reasonable acceptability and promising preliminary effectiveness but lower fidelity than expected (i.e., not daily use). The current study examined preliminary effectiveness using randomized controlled trial (RCT) methodology for subjective (sleep habits, insomnia severity, behavioural functioning) and objective sleep variables, and examined recruitment data to inform practices for a future RCT. Participants were 28 parents of typically developing children with parent-reported sleep problems, randomized to a treatment or control group. Recruitment rate was 70%, dropout rate was 30%, and estimated sample size for an RCT was 118. Data were analyzed using descriptive statistics and analysis of covariance (ANCOVA). Results demonstrated a small effect of the intervention improving sleep habits, daytime functioning, and insomnia severity, and no statistically significant effect for objectively measured sleep. These results can be used to modify the intervention and to prepare for a large-scale effectiveness study. As an accessible mHealth intervention for parents of school-aged children with insomnia, the *ABCs of SLEEPING* app has the potential to address an existing treatment gap.

A Pilot Randomized Control Trial of the *ABCs of SLEEPING* mHealth Intervention

for Parents of School-aged Children with Insomnia Symptoms

Sleep is essential for the growth and development of children. Unfortunately, sleep problems are highly prevalent among school-age children in Canada, with one out of five children in the general population experiencing a significant sleep problem (Calhoun et al., 2014). The most common sleep problems experienced by school-age children are difficulties falling/staying asleep and early morning awakenings. When these symptoms are chronic and cause clinically significant distress, they are grouped as insomnia. Insomnia symptoms are associated with increased behavioural difficulties, emotional dysregulation, and poorer academic performance (Chaput et al., 2016; Calhoun et al., 2017). Given the negative consequences of insomnia symptoms, it is important that children experiencing them receive timely and effective sleep intervention.

There are a range of sleep interventions including sleep psychoeducation (i.e., teaching sleep knowledge to children and their parents/caregivers and addressing misinformation), making changes to sleep habits (e.g., removing electronics from bedroom, timing of sleep/wake times, location of sleep), using specific behavioural interventions (e.g., bedtime fading), and sleep medication (e.g., non-prescription like antihistamines and melatonin, and prescription medications such as alpha-receptor agonists; Thomas et al., 2014). Each of these interventions has their place within a stepped approach to sleep treatment (Rigney et al., 2023). Specifically, less intensive and more economical approaches (sleep education, changing sleep habits) should be tried first with those that are more intensive and costly (e.g., sleep programs with specific behavioural interventions like bedtime fading) implemented if needed. If these sleep education and behavioural interventions are tried without adequate improvements to sleep problems, only then should

medication be trialed in combination with behavioural strategies. This is because medication alone does not improve sleep problems over the long term, as its impacts tend to be short lived (Mack & Rybarczyk, 2011; Riemann & Perlis, 2009). Moreover, evidence for safety and tolerability of medications in children is limited and their use to treat pediatric sleep problems is not approved by the American Food and Drug Administration (FDA) (Mindell et al., 2006; Pelayo & Dubik, 2008; Lunsford-Avery et al., 2020; Bock et al., 2016). These approaches to sleep treatment are organized in a stepped care model. Specifically, step one would be teaching sleep information, addressing inaccurate information and parental beliefs about sleep. Step two would be making changes to sleep habits (previously referred to as sleep hygiene). Behavioural interventions (e.g., cognitive behavioural therapy focused on insomnia) are step three. Last, step four is non-prescription medications such as antihistamines and prescription medications such as trazodone.

A large issue in delivering sleep treatment has been accessibility barriers. A myriad of studies demonstrate that costs (time and financial), transportation, geographical location, busy schedules/time demands, psychosocial factors (e.g., parental stress), and lack of available programs and interventions or awareness of them, and healthcare providers (HCPs) lacking training to treat insomnia are all influential barriers to receiving and engaging with sleep treatment (Tan-MacNeill et al., 2020; Billings et al., 2021; Paterson et al., 2019; Roberts & Ulmer, 2024; Stinson et al., 2006; Boerner et al., 2015). Historically, there have been efforts toward making interventions more accessible via alternative electronic forms of delivering care (e.g., video-conferencing, internet, and website interventions; Corkum et al., 2018; Tan-MacNeill et al., 2020; Wosik et al., 2020; Santarossa et al., 2018; Buckman et al., 2021; Kreps & Neuhauser, 2010). Smartphone applications ("apps") are a newer form of intervention delivery, often referred to as mobile

health (mHealth; Marcolino et al., 2018). Although there are currently no empirically supported smartphone apps addressing insomnia for school-age children, studies have demonstrated the acceptability and effectiveness of smartphone apps changing sleep outcomes in infants, adolescents, and adults (Yoshizaki et al., 2020; Yoshizaki et al., 2023; Quante et al., 2020; Rayward et al., 2020). Apps can provide a convenient and flexible way for people to access mental health resources and support. This is particularly important for individuals who may have limited access to traditional face-to-face treatment due to geographical and financial barriers. mHealth interventions have the potential to improve treatment access for Canadians who have a smartphone (i.e., approximately 85% have access for personal use; Statistics Canada, 2021).

To address this resource gap, our research team has developed a smartphone app, the "*ABCs of SLEEPING*". This intervention was developed to provide parents and their school-age children (6 to 12 years) with evidence-based knowledge and recommendations to improve their children's sleep habits and insomnia symptoms. The *ABCs of SLEEPING* is a mnemonic that draws attention to the important factors that must be considered for healthy sleep practices for children: Age-appropriate Bedtimes and wakeup times with Consistency, Schedules and routines, Location, Exercise and diet, no Electronics in the bedroom or before bed, Positivity, Independence, and Needs met, equal Great sleep (Bessey et al., 2013). To validate the use of this mnemonic, Allen et al. (2016) conducted a review of the evidence evaluating the empirical support for each of the *ABCs of SLEEPING* recommendations.

The development of the *ABCs of SLEEPING* app has been guided by a user-centered approach, as outlined by Lyon & Koerner (2016). This approach involves continuously engaging end-users such as parents and HCPs throughout the development and design phases to ensure that the content and recommendations address end-users' needs and desires. Many steps were taken to ensure the *ABCs of SLEEPING* intervention was liked by parents and implemented as intended, as well as demonstrating evidence of intended effect (i.e., improving sleep habits and insomnia symptoms). The first was a usability study which used Morville's User Experience Honeycomb model (Morville & Sullenger, 2010) to examine whether parents and HCPs viewed the intervention as useful, usable, desirable, valuable, accessible, credible, and findable (Howlett et al., 2020). Parents considered the intervention to be highly usable, desirable, accessible, and credible. Parent and HCP participants gave feedback regarding how the intervention could be modified to meet their needs. Feedback from HCPs was to add a feature to share/receive data and that some families may require more support than the *ABCs of SLEEPING* intervention can offer. Parent feedback was to centralize all components of the intervention in one package – in the initial version components were provided as an online survey (check-in) and portable document files (PDFs; sleep report, sleep tips). Additional feedback from parents was to provide a method of prioritizing healthy sleep practice areas to focus on, adding features and aesthetic changes (e.g., including frequently asked questions, open text fields in check-in, adding more colour) and modifying the sleep tips to be less overwhelming, age-specific, and personalized. Modifications were made to address their feedback (i.e., centralized all components into a smartphone app, colour-coding and star system for prioritization, colour added, sleep tips adjusted according to feedback, etc.)

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Following this, we used Bowen et al.'s (2009) feasibility framework to understand important aspects of feasibility. This framework provides a guideline with approaches such as "can it work" (e.g., is there some evidence that the intervention might work with the intended population?), "does it work" (e.g., is there some evidence that the intervention may be efficacious or effective under ideal or actual circumstances?) and "will it work?" (e.g., will the intervention work in a real-life context, such as with populations that might adopt it into practice?) Additionally, this framework identifies important areas of feasibility that may be explored. Using the "can it work?" approach, we examined acceptability (i.e., satisfaction and suitability ratings of the intervention), fidelity (i.e., did parents use the intervention as intended by the researchers which was daily use of the sleep tips), and if there was evidence of preliminary effectiveness (i.e., testing pre/post changes of the intended outcomes of the intervention in a limited way) (see Chapter 2; Jemcov et al., 2021). Examining preliminary effectiveness is not equivalent to well-powered hypothesis testing; rather, our goal was to look for evidence of intended effects of the intervention (Bowen et al., 2009).

Results of the feasibility study were that the *ABCs of SLEEPING* intervention suggested preliminary effectiveness with a medium effect size based on subjective measures of sleep outcomes (i.e., sleep habits and insomnia severity improved following intervention use) and reasonable acceptability, but fidelity to the intervention was not as expected in that parents did not use the sleep tips daily. Parent feedback indicated that sleep tips required further refinement and more guidance regarding how to prioritize the sleep tips. Additionally, parents reported not remembering to use the sleep tips daily and noted a reminder feature would be helpful. Two features were added to the *ABCs of SLEEPING* intervention to address this feedback; sleep tips were refined (e.g., resources added) and a

to-do list (i.e., feature parents can use to prioritize which sleep tips to start with) and a reminder feature (i.e., push notification) were added.

Conducting a pilot RCT was deemed to be the next crucial step ahead of a full-scale RCT in the development and evaluation phase of this app. A pilot RCT allows for collecting feasibility data to inform a full-scale RCT. Specifically, recruitment potential, participant retention, and dropout rate while utilizing RCT methodology can be examined (Bond et al., 2023; Leon et al., 2011). Additionally, a priori calculations can be made with these data to estimate sample size for the full-scale RCT. Last, preliminary effectiveness can be examined with increased experimental control through randomization and using an objective sleep measure (actigraphy) increases rigour. As such, the present study's first aim was to provide estimates for an RCT; specifically, recruitment potential, participant retention, dropout rate, and sample size. The second aim was to examine, using the "does it work" approach, preliminary effectiveness by evaluating, for each group, differential change from baseline to follow-up for subjective measures of sleep habits, insomnia severity, and daytime functioning, and for an objective measure of sleep efficiency (SEF) and sleep onset latency (SOL). Given these aims the research questions are as follows:

(1) What are the recruitment potential, retention, dropout rate, and sample size estimates for a future full-scale RCT?

(2) Do parents in the treatment group report improvements based on subjective measures of their children's sleep habits, insomnia symptom severity, and behavioural functioning, compared to a waitlist control group?

(3) Do the children of the parents in the treatment group show improvements on objective actigraphy sleep measures (i.e., sleep onset latency [SOL] and sleep efficiency [SEF]), compared to a waitlist control group?

Method

Participants

Twenty-eight parents of typically developing English-speaking children were recruited using social media advertisements on Instagram and Facebook. The child of the participating parent was required to have at least one of three insomnia symptoms (i.e., difficulty falling asleep, staying asleep, and/or early morning awakenings) and did not require a diagnosis of insomnia. Insomnia symptoms were measured using the Pediatric Insomnia Severity Index (PISI); baseline scores described insomnia severity in our sample, but not as an eligibility criterion. Inclusion criteria were that parents (a) resided in Canada, (b) had internet/computer access and an email to complete online questionnaires, and (c) were comfortable reading and writing in English. Their children needed to (a) be between the ages of 6 to 12 years, (b) not have a diagnosis of a mental or physical health disorder that would significantly impact daily functioning, and (c) have one or more insomnia symptoms with no sleep apnea: difficulties falling asleep, staying asleep, and/or early morning awakenings with the inability to return to sleep. Ethics approval for this study was obtained through the IWK Health Centre Research Ethics Board (REB; 1027369).

Intervention

Participants randomized to the treatment group received one-month access to the *ABCs of SLEEPING* intervention that consisted of three components. The first component is the sleep check-in, which is a sleep assessment that parents complete when opening the app. Questions are answered about their children's sleep habits, and these answers algorithmically produce the second and third components, which are the sleep report card and sleep tips. Specifically, an algorithm automatically produces a sleep report that provides prioritized sleep tips using a star- and colour-coded system. The sleep report card

provides an overview of the child's sleep habits organized by the *ABCs of SLEEPING* mnemonic (see Introduction). Parents are provided with ratings using a three-star system so that they can identify healthy sleep practice areas they are doing well with (three stars), those that need some work (two stars), and more work (one star). The sleep tips are also organized by the mnemonic, providing the parent with sleep recommendations to make changes to areas identified as needing work. The areas needing no work are -coded as green, those needing some work are yellow, and those needing the most work are red.

Measures[1]

Eligibility Questionnaire (EQ).

We designed the 14-item EQ to assess the study's inclusion and exclusion criteria. Potential participants provided "yes" or "no" responses to each item. This questionnaire was fully automated with two outcomes: pass or fail eligibility screening.

Demographic Questionnaire (DQ).

Participants completed the DQ during the baseline period to describe the study sample. The DQ includes 24 or 29 items, depending on whether there is a partner/spouse. Demographic information (e.g., age, sex) was collected about the participating parent, their partner/spouse (if applicable), and their child. Items were compiled from the National Longitudinal Survey of Children and Youth (2011) as well as the Canadian Census.

Children's Sleep Habits Questionnaire (CSHQ) **(Owens et al., 2000).**

Participants completed the 52-item CSHQ at the baseline and follow-up periods. This questionnaire collects information regarding the frequency of the child engaging in certain sleep-related behaviors over the last typical week (e.g., child goes to bed at the same

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[1] For all Study 2 measures, please see Appendix B.

time each night) with a scale ranging from "Usually" (5-7 times; scored as 3) to "Rarely" (0-1 time; scored as 1). This questionnaire uses 31 select items to derive the total sleep disturbance score (which was used in this study). The total sleep disturbance score ranges from 33 to 99, and a score of 41 or higher indicates clinically significant sleep problems (Owens et al., 2000). This questionnaire was designed for school-age children and yields scores across eight subscales: bedtime resistance, sleep resistance, parasomnia, sleep disordered breathing, night-wakings, daytime sleepiness, sleep anxiety, and sleep onset delay, as well as a summative total sleep disturbance score. The CSHQ demonstrates good sensitivity (.80) and specificity in prior research (.72; Owens et al., 2000).

Bedtime Routines Questionnaire (BRQ) **(Henderson & Jordan, 2010).**

At baseline and follow-up, participants completed the 31-item BRQ that measures children's bedtime routines (e.g., read/listen to a story, watch TV, brush teeth) with a scale ranging from 1 (i.e., "almost never") to 5 (i.e., "nearly always"). The BRQ yields a summative score for the consistency of child's weekday and weekend bedtime routines, with higher scores indicating greater consistency; scores can range from 31 to 155. We utilized the total summative score for both weekday and bedtime routines. Overall, the BRQ demonstrates internal consistency in past research (0.69-0.90; Henderson & Jordan, 2010).

Strengths and Difficulties Questionnaire (SDQ) **(Goodman, 2007).**

Parents completed this 25-item measure during the baseline and the follow-up periods. The SDQ (assesses prosocial (e.g., considerate of other's feelings) and challenging behaviour (e.g., often loses temper) of children as reported by their parents. A summative total difficulties score, which was used in this study, includes the following factors: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship

problems, and the prosocial behavior scale is not included. Each item is measured on a scale ranging from 0 (i.e., "not true") to 2 (i.e., "certainly true"), with possible total difficulties scores ranging from 0 to 40 as 20 items are scored (Goodman, 2007). Reliability scores confirmed strong support for internal consistency in a representative Canadian sample of school-age children and adolescents (Hoffman et al., 2020).

***Pediatric Insomnia Severity Index (PISI)* (Byars & Simon, 2014).**

Participants completed the seven item PISI measure during the baseline period and the follow-up period. The PISI assesses insomnia symptoms using parental report of sleep maintenance problems, daytime sleepiness, and nocturnal sleep duration. Items (e.g., "my child takes longer than 30 minutes to fall asleep after going to bed") are rated on a 6-point scale ranging from 0 (i.e., "never") to 6 (i.e., "always") and a total summative score can be calculated with a minimum of 0 and a maximum of 30 using the first 5 items (Angelhoff et al., 2020). The total summative score was used to describe the severity of insomnia in this sample, as well as to assess changes in insomnia severity. The PISI has high internal consistency between items measuring sleep onset problems and sleep maintenance problems in past research (Byars et al., 2017).

Actigraphy.

An actigraph is a watch-like device, typically worn on the non-dominant wrist, that collects movement information using accelerometer technology. Previous studies have shown that the software algorithms used to analyze actigraphy data provide valid and reliable estimates of when participants are asleep and awake, as well as variables such as sleep latency and duration (Tryon, 2004). We used the Philips Actiwatch 2; the variables of interest were sleep onset latency (SOL; how quickly the child falls asleep once in bed and ready to sleep) and sleep efficiency (SEF; the percentage of time scored as asleep during

the period from the time the child in bed and ready to fall asleep to the time the child is out of bed for the day. Actigraph data were collected during the baseline and follow-up periods for a minimum of 5 corresponding nights of sleep diary and actigraphy, considered to provide a valid estimate of typical sleep (Sadeh, 2008). In our sample, participants wore the actigraph approximately 6 days out of 7 ($M = 6.07$, $SD = 0.87$).

***Sleep Diary (SLD)* (Corkum et al., 2018).**

Sleep diary data was collected to score the actigraphy data. It was completed online by parents who reported on their children's sleep for one-week during each of the baseline and follow-up periods. Information such as what time their child was "down for the night", was "up for the day", and anything unusual that happened during the day that could impact sleep was collected. This is information necessary to score the actigraphy data. The minimum requirement was five nights of corresponding sleep diary and actigraphy data. The diary took approximately five minutes to complete daily. Parents were provided with a paper template in their study package if they preferred to write down their entries and later document their sleep diaries online.

Procedure

Potential participants expressed interest in the study by either emailing the research coordinator, or by following a link in the study's social media advertisements that led parents to the online EQ form to assess eligibility. Upon completing the EQ, parents were automatically informed if they were eligible or not. If eligible, they were directed to the consent form which they completed online. Next, participants were emailed to arrange for a telephone call that was subsequently completed to review the consent form before proceeding. Parents were then sent an email with a REDCap link containing the baseline measures (i.e., DQ, CSHQ, BRQ, PISI, and SDQ). At the same time, participants were

mailed a study package containing an actigraph, instructions for using the actigraph, and a paper-copy of the SLD (the SLD paper-copy was intended for parents wanting to take notes on it to later input the information into REDCap). Parents were instructed to have their child wear the actigraph for one-week continuously and to complete an SLD each night that the actigraph was worn. After this week, the actigraph was sent back. Once the actigraph was returned and all the baseline measures were confirmed completed, this concluded the baseline period. Parents were then randomized to either the treatment or waitlist control group. Block randomization (defined as having a preset value of participants to be assigned to each group to ensure balance; Kang et al., 2008) was used with blocks of four. Those randomized to the treatment group were given access to the intervention and instructed to use the sleep tips daily for one-month. Following this month, participants were sent an actigraph again, along with a link to the SLD for the follow-up period. The same procedures were utilized for the follow-up period as the baseline, except no DQ was administered. After the follow-up, participants were thanked and provided with a $20 Amazon.ca gift card. Upon completing the follow-up, waitlist control group participants were given access to the intervention for one-month, but no additional data was collected (as noted above).

Data Analytic Approach

Participant flow through the study was tracked and was compiled in a CONSORT diagram (see Figure 3.1), which describes participant flow through the study. These descriptive statistics were used to estimate parameters needed for a full-scale RCT. To examine preliminary effectiveness, one analysis of covariance (ANCOVA) was conducted for each of the study's subjective and objective outcome measures (six ANCOVAs total) with baseline scores used as the covariate. Prior to conducting the analyses, the data were screened to examine whether ANCOVA assumptions were met. Normality of residuals was

assessed by reviewing QQ plots and multivariate outliers were assessed with Cook's distance (with values > 0.50 inspected for high influence). Additionally, assumption of equal variance was assessed using Levene's test. Those variables violating the equal variance or normality assumption were assessed with sensitivity checks by re-analyzing the data with robust ANCOVAs to examine whether the original ANCOVA results held (Rousseeuw et al., n.d.). Data from the non-robust ANCOVAs were reported if no differences were observed after completing the robust ANCOVA. Robust ANCOVA results are reported in the notes of the respective tables. Given the small sample size for both subjective and objective data, we examined ω^2 effect sizes due to their decreased bias with smaller sample sizes.

Given that participants were randomly assigned to the treatment and waitlist control group, independence of treatment and covariate were confirmed by design; thus, there was no need to compare treatment vs. control groups on baseline measures (Senn, 1994). A sensitivity power analysis was conducted in G*Power for ANCOVA with the following parameters: power = 0.80, α = 0.05, df = 1, groups = 2, covariate = 1. The sensitivity power analysis revealed that with a sample size of 28, the largest effect size that could be detected would be f = 0.55 (i.e., η_p^2 = .23).

Results

Participants and recruitment potential

The flow of participants through the study can be seen in the CONSORT diagram (Figure 3.1). In total, 552 participants entered the study by clicking a REDCap link provided through study advertisements (e.g., social media posts). Of these 552 parents, 265 completed the EQ of which 202 were eligible to enroll in the study. The most common reason for ineligibility noted was a diagnosis of a significant disorder either related to

mental or physical health (all reasons for ineligibility are provided in Figure 3.1). Of those eligible, 99 were responsive to an email requesting to complete a telephone call but only 41 completed the phone call with the study's researcher (AJ). One participant was ineligible after this phone call due to disclosing their child was taking sleep medication. As such, 40 entered the study's baseline period, and 32 completed this phase and were randomized to either the treatment group (n= 17; 10 females and 7 males) or the waitlist control group (n= 15; 11 females and 4 males). Two from each group (total of four) dropped out due to being non-responsive to emails or study procedures. As such, 28 participants completed the follow-up period which concluded their participation. Our final sample consisted of 28 parents of typically developing English-speaking children, 15 of which were in the treatment group (8 females and 7 males), and 13 were in the waitlist control group (9 females and 4 males). Insomnia severity at baseline for the whole child sample ($n = 37$) was $M = 15.30$, $SD = 4.16$, out of a maximum of 30. The insomnia severity at baseline for the final sample ($n = 28$) was $M = 15.70$, $SD = 4.43$. Please see Table 3.1 for a detailed breakdown of participant characteristics. Our final sample of participating parents' children were mostly White (71%) and female (64%), and parents were predominantly highly educated (85% had a bachelor's degree or higher) biological mothers (82%).

Estimations for full-scale RCT

Enrollment for the current pilot RCT was 202 participants eligible to participate. Projected participant retention rate was 70% and the dropout rate was 30%. Our a-priori sample size calculation for the future full-scale trial was made with the following parameters in G*Power: α error probability = 0.05, Power = 0.80, effect size f = 0.3145 (i.e., $\eta_p^2 = 0.09$, medium). These parameters estimated 82 participants would be required to observe a medium effect size per group for our main outcome measures (i.e., sleep habits;

CSHQ and BRQ). Based on the 30% dropout rate, the overall final sample size that would be required for the future full-scale RCT to retain 41 participants per group at follow-up is approximately having 118 participants enrolled for baseline. As such, the final sample size to detect a medium effect of the intervention would be 82 participants overall.

Preliminary effectiveness

__Subjective measures of sleep and behavioural functioning__. Prior to conducting the ANCOVAs the data was screened. The only assumption violated was that of equal variances as Levene's test was significant for the CSHQ and PISI variables. As such, robust ANCOVAs were conducted to examine if results were maintained. The robust ANCOVAs produced the same null hypothesis test results as the original ANCOVAs (described below) and robust ANCOVA data are reported in the notes section of Table 3.2 for the CSHQ and PISI. As such, the original ANCOVA results were described and maintained in the body of Table 3.2.

The ANCOVA conducted on the CSHQ total score outcome demonstrated significant changes in follow-up sleep habits when controlling for baseline scores and group assignment (i.e., waitlist control vs. treatment group), such that the CSHQ total score was lower at follow-up for those in the treatment group relative to the waitlist control group with 15% of the variance in the CSHQ explained by group membership ($f = 0.150$). The same was true for the BRQ weekday follow-up changes, such that the BRQ showed increased scores of consistency for those in the treatment group. Approximately 17% of the variance in the BRQ weekday follow-up changes were explained by group membership ($f = 0.178$). Significant differences were not found for the BRQ weekend scores as weekend consistency did not improve in the treatment group relative to the waitlist control group. In terms of insomnia severity scores measured by the PISI, treatment group follow-up scores

were significantly lower at follow-up when controlling for baseline scores with a small effect. Last, behavioural functioning, as measured by SDQ scores, was significantly lower at follow-up when controlling for baseline scores (i.e., daytime functioning improved) in the treatment group with a small effect.

Two of the subjective measures examined have established clinical cut-offs scores, specifically, the CSHQ and the SDQ. The CSHQ has a clinical cut-off score of 41, with scores higher than 41 indicating significant sleep disturbance (Owens et al., 2000). For the SDQ, the clinical cut-off score is 17, with scores higher than 17 indicating clinically elevated behavioural concerns (Bryant et al., 2020). Our CSHQ results demonstrated that at baseline, our treatment group had significant sleep disturbance (M = 49.0, SD = 4.38) that was at the cut-off score at follow-up (M = 41.7, SD = 3.75). The same was not true for our control group who had significant sleep disturbance at baseline (M = 51.8, SD = 8.31) and follow-up (M = 49.2, SD = 7.84). At baseline, 100% of participant scores for the CSHQ were above the clinical cut-off of 41, and at follow-up 54% were above the cut-off for the treatment group. For the SDQ, our results followed a similar pattern to the CSHQ results such that our treatment group had clinically elevated behavioural symptoms at baseline (M = 18.8, SD = 3.59) that was at the cut-off score at follow-up (M = 17.3, SD = 3.82). Again, similar to the CSHQ results, our control group did not have the same pattern at the treatment group, as their baseline scores (M = 18.5, SD = 5.46) and follow-up scores (M = 20.3, SD = 3.90) were both clinically elevated. At baseline, 77% of participant scores for the SDQ were above the clinical cut-off of 17, and at follow-up 54% were above the cut-off for the treatment group. All other subjective sleep outcome means and standard deviations from baseline to follow-up are contained in Table 3.3.

Objective sleep measure (actigraphy). A detailed breakdown of the results for each variable of the objective sleep measure (actigraphy) are provided in Table 3.4 (ANCOVA results) and 3.4 (*M* and *SD* from baseline to follow-up), and briefly described in this section. Before conducting the ANCOVAs for SOL and SE it was identified that both violated the assumption of normality. Given this, robust ANCOVAs were conducted with no changes in the results of the ANCOVA and as such the results of the ANCOVAs are reported. No effect of the intervention was observed for either SOL or SE from baseline to follow-up for either group.

Discussion

The goal of this pilot RCT study was to estimate parameters for a full-scale RCT and to investigate preliminary effectiveness of the recently revised *ABCs of SLEEPING* intervention by evaluating changes in school-age children's sleep and daytime functioning. Sleep was measured both subjectively (parent completed questionnaire) and objectively (actigraphy). Overall, our parent sample mostly consisted of highly educated White mothers, and their children were mostly female White and had high parent-reported baseline insomnia symptom severity. As for preliminary effectiveness, we noted improvements in sleep habits as measured by the CSHQ and BRQ for weekdays (not weekends), insomnia symptom severity (PISI), and in daytime functioning (SDQ). While clinically elevated at baseline, after treatment our treatment group's sleep disturbance score (CSHQ) and their behavioural functioning (SDQ) were at the cut-off as being clinically elevated while the control group remained clinically elevated. No significant effects of the intervention were found for objective sleep data (actigraphy).

Estimations for a future full-scale RCT

Important feasibility data (i.e., recruitment potential, retention, dropout rate, sample size estimation) was collected in this pilot RCT to inform practices for a future full-scale RCT which is the next step for future research evaluating the *ABCs of SLEEPING* intervention. This addressed our first research question focused on making estimations for a future full-scale RCT. Please note that estimates do not adjust for demographic covariates like age and sex. Analysis of our data revealed 552 participants clicked into REDCap prior to completing the eligibility questionnaire. Enrollment in the current pilot RCT was 202 participants. The current study's participant retention rate was 70% and the dropout rate was 30%. A-priori sample size calculations revealed 82 participants (41 per group) would be required to detect a medium effect size for our sleep habit measures (CSHQ and BRQ). Based on the participant dropout rate, the estimated sample size for the future-scale trial is approximately 118 participants needed at baseline in total to retain 41 participants per group by follow-up.

Subjective measures of sleep

Our second research question was focused on understanding changes in parent reported sleep habits, insomnia severity, and behavioural functioning of their children in response to the use of the *ABCs of SLEEPING* intervention. Given that the intervention aims to provide healthy sleep practice information so parents can adjust or continue their child's healthy sleep habits, our primary outcome variables were the CSHQ total sleep score and BRQ weekday and weekend consistency of sleep habits. Our results revealed gains in the treatment group, relative to the waitlist group, at the follow-up for the CSHQ and for the BRQ weekday consistency with small effect sizes. No statistically significant improvements were noted for BRQ weekend consistency. This demonstrates that the

intervention may have success in adjusting school-age children's sleep habits, specifically during weekdays. Although clinical significance cannot be concluded with our analyses, it may be possible that the CSHQ mean scores for the treatment group were improved from baseline to follow-up to be at the clinical cut-off score for having significant sleep disturbance while waitlist control group participants continued to have clinically significant sleep disturbance. While the treatment group likely continued to have significant sleep disturbance, it may be possible that their improvements were closely towards no longer being clinically significant. We also evaluated changes in insomnia symptom severity scores as a measure of children's insomnia symptoms (PISI), and their behavioural functioning (SDQ). Parent-reported insomnia symptom severity and behavioural functioning improved in the treatment group relative to the control group. For behavioural functioning, our treatment group's SDQ scores may have improved from baseline to follow-up to be at the cut-off score for clinically elevated behavioural concerns whereas the control group may have continued to have clinical level of elevations from baseline to follow-up. Similar to the CSHQ sleep disturbance scores, our treatment group's behavioural functioning also was closely towards no longer being considered clinically significant.

Week to weekend routine discrepancy has been well documented in the literature (Sun et al., 2019; Merdad et al., 2014; Chien et al., 2019). Lack of change during weekends may be explained by non-routine events typically occurring during this period of time (e.g., family/sporting events, holiday, etc.) and more routine events occurring during weekdays (e.g., school attendance). Improved behavioural functioning for the treatment group is unsurprising given the impact of insomnia on behavioural functioning being well-documented in the literature (Calhoun et al., 2017; Armstrong et al., 2014; de Zambotti et al., 2017; Haynes et al., 2011). Additionally, our behavioural functioning results are

consistent with that of previous research evaluating insomnia treatments via RCT that also found improved behavioural functioning (Hiscock et al., 2011; Shin et al., 2017). Although our data cannot confirm this, it may be possible that the *ABCs of SLEEPING* may indirectly improve behavioural functioning by directly improving sleep habits and/or insomnia severity.

Objective measure of sleep

Our third research question examined differential changes by group in objective sleep data (SE and SOL) as measured by actigraphy. No follow-up changes occurred in either the treatment or control group. This suggests that no effect of the intervention was observed on the objective sleep measure, despite subjective reports of improvements in sleep habits and insomnia severity. This is unsurprising given subjective (e.g., self-reported) and objective measures (e.g., actigraphy) have historically shown mixed results in the literature in both adult and child populations, with some research noting only moderate associations between subjective measures and objective measures of sleep duration (Arora et al., 2013; Girschik et al., 2012; Silva et al., 2007), while others noted weaker associations (Alfano et al., 2015; Silva et al., 2007; Benz et al., 2022). This is a common finding across RCTs examining sleep interventions broadly. A recent review conducted by Lah and Cao (2024), which included nine RCTs with older school-aged children and adolescents, also found differences in subjective measures but not objective measures of sleep (e.g., de Bruin et al., 2015a; de Bruin et al., 2015b; de Bruin et al., 2014; Corkum et al., 2016; Roberts et al., 2019; as outlined in Table 4 of their manuscript). It has been proposed that discrepancies between actigraphy and sleep questionnaire data may be influenced by factors such as memory, experiences and psychosocial pressures, recall

and/or sleep-related bias, and vague or inaccurate reporting (Iwasaki et al., 2010; Werner et al., 2008; Salbach-Andrae et al., 2010).

Limitations and strengths

The current study had a number of strengths. Specifically, the RCT methodology utilized allowed increased control when measuring sleep outcomes (e.g., randomization, controlling for sleep medication). Additionally, both subjective and objective measures were used to examine sleep. Last, pilot studies themselves provide helpful insights, including the opportunity to refine and develop new methodological practices when planning for a future full-scale RCT (Leon et al., 2011). For example, we are better able to understand and plan for the screening and recruitment process (e.g., total number of participants to be recruited and participant retention) and may incorporate new recruitment strategies to increase diversity.

This study was not without limitations. First, the current pilot RCT study examined effectiveness in a limited way (i.e., preliminary effectiveness). Specifically, our sample size overall was limited, especially for our objective measurement of sleep. Given this, the data should be interpreted with caution. Second, our sample consisted of mostly White and highly educated biological mothers and as such cannot be generalized to other populations. Third, we did not examine the fidelity of the intervention so it is not clear to what extent families used the intervention. Additionally, instructions regarding intervention use were not formalized. Specifically, instructions were provided via email at the start of intervention use and no reminders regarding the intended nature of use were provided throughout the one-month period. Fourth, we also did not evaluate whether the noted effects of the intervention were maintained after the one-month follow up period. As such, it is not clear whether changes in our subjective sleep measure variables were short-term or would be

maintained long-term. Last, the current study examined only two actigraphy sleep variables (SOL and SEF), but others could have been explored (e.g., total sleep time, wake after sleep onset). While we did not identify changes in SOL and SEF, it is possible that it may have been observed in other actigraphy measures not captured by this study. Given these noted limitations, before future full-scale testing for the *ABCs of SLEEPING* intervention these concerns should be addressed by creating recruitment goals to increase diversity of the sample and incorporating methodological changes to ensure increased confidence when drawing conclusions from the data (e.g., fidelity checks, follow-up period examining for maintained effects, increased sample size).

Future research

The next step for future research examining the *ABCs of SLEEPING* intervention is to conduct a full-scale RCT that incorporates knowledge acquired through this research (e.g., more representative sample, refined methodological practices). If confirmed effective, planning and learning about the implementation of the *ABCs of SLEEPING* intervention (i.e., dissemination of the intervention to the public) will be the next step to ensure it is success in addressing accessibility barriers.

Conclusion

In conclusion, parents using the *ABCs of SLEEPING* intervention reported improvements in their child's follow-up sleep habits, insomnia severity, and behavioural functioning, relative to parents of children who did not have access to the ABCs of SLEEPING app. We observed an effect of the intervention on these outcomes, although we did not observe the same for weekend consistency of bedtime routines. No changes were noted in objectively measured sleep. If found to be effective, and implementation is well planned, the *ABCs of SLEEPING* intervention has the potential to address some of the key

accessibility barriers experienced by families. Additionally, the *ABCs of SLEEPING* intervention would be the first evidence-informed mHealth program available for this age-group, addressing the current resource gap that exists.

Table 3.1.

Demographic and Descriptive Information for Participating Parents and Children (N = 28)

Parent Demographics	N (%)
Parents' relationship to child	
Father	4 (14)
Mother	24 (86)
Parents' Current Employment Status	
Full Time	21 (75)
Part Time	4 (14)
Homemaker	3 (10)
Estimated Household Income	
$29,999 and under	0 (0)
$59,999 – $30,000	0 (0)
$79,999 - $60,000	5 (18)
$80,000 - $124,999	9 (29)
$125,000 and over	14 (50)
Type of community of residence	
City	19 (68)
Town	6 (21)
Rural	3 (10)
Highest level of education	
Community college/high school	4 (14)
Bachelor's degree/undergraduate	13 (46)
Master's degree	7 (25)
Degree in medicine	4 (14)
Child Demographics	
Child Sex	
Male	10 (36)
Female	18 (64)
Child Mean Age in years (*SD*)	8.41(1.72)
Child's Ethnic or Cultural Heritage	
White	20 (71)
Indigenous	3 (10)
Other	5 (18)

Table 3.2.

Analysis of Covariance (ANCOVA) Results for Subjective Data

Variable		Mean Difference Between Baseline and Follow-up	df	F	P	ω²	95% CI Lower	95% CI Upper
CSHQ*	Group assignment	-5.557	1	11.5	.002	.150	-8.936	-2.177
	Baseline		1	32.4	<.001	.449		
	Residuals		25					
BRQ WD	Group assignment	2.443	1	10.1	.004	.178	0.863	4.023
	Baseline		1	15.3	<.001	.277		
	Residuals		25					
BRQ WE	Group assignment	1.457	1	2.93	.099	.036	-0.296	3.209
	Baseline		1	24.14	<.001	.436		
	Residuals		25					
PISI	Group assignment	-0.363	1	6.89	.015	.127	-6.002	-0.724
	Baseline		1	13.62	.001	.271		

Variable	Mean Difference Between Baseline and Follow-up	df	F	P	ω²	95% CI	
						Lower	**Upper**
Residuals		25					
SDQ Group assignment	-3.123	1	15.1	<.001	.138	-4.779	-1.467
Baseline		1	61.2	<.001	.588		
Residuals		25					

Note. df= degrees of freedom; PISI = Pediatric Insomnia Severity Index; CSHQ = Children's Sleep Habits Questionnaire; BRQ WD = Bedtime Routines Questionnaire Weekday; BRQ WE = Bedtime Routines Questionnaire Weekend; SDQ = Strengths and Difficulties Questionnaire; ω² were calculated to observe conservative effect sizes given the small sample size

* indicates that Levene's test was violated for CSHQ and PISI. Robustness checks were completed and results for CSHQ were as follows: mean difference = -5.56, CI 95%= -8.09 to -0.80, *p* = 0.019. Results for PISI were as follows: mean difference = -3.36, CI 95%= -7.25 to -0.49, *p* = 0.027. Both results indicate that results continue to be statistically significant when controlling for the violation of equality of variances for the CSHQ and PISI.

Table 3.3.

Baseline to Follow-up Descriptives for Subjective and Objective Sleep Variables

| | Baseline | | | | Follow-up | | | |
| | Treatment | | Waitlist Control | | Treatment | | Waitlist Control | |
Variable	M	SD	M	SD	M	SD	M	SD
Subjective								
CSHQ	49.0	4.3	51.8	8.3	41.7	3.7	49.2	7.8
BRQ WD	21.2	2.2	21.0	2.9	22.8	1.6	20.3	3.0
BRQ WE	20.4	3.1	18.9	4.2	21.8	1.7	19.5	3.7
PISI	15.4	3.9	16.0	4.7	11.2	4.9	14.9	3.2
SDQ	18.8	3.5	18.5	5.4	17.3	3.8	20.3	3.9
Objective								
SEF	84.9	3.5	75.8	17.1	85.4	1.6	83.5	5.9
SOL	34.2	53.1	17.3	17.0	6.89	6.2	6.67	8.5

Note. CSHQ = Children's Sleep Habits Questionnaire; BRQ WD = Bedtime Routines Questionnaire Weekday; BRQ WE = Bedtime Routines Questionnaire Weekend; SDQ = Strengths and Difficulties Questionnaire; SEF = sleep efficiency; SOL = sleep onset latency

Table 3.4.

Analysis of Covariance (ANCOVA) for Objective Sleep Variables

Variable		Mean Difference	df	F	p	ω²	95% CI Lower	95% CI Upper
SEF	Group assignment	2.5414 (percentage)	1	1.003	.336	.000	-2.988	8.071
	Baseline		1	0.437	.521	-.039		
	Residuals		12					
SOL	Group assignment	0.3241 (minutes)	1	0.00647	.937	-.074	-8.456	9.105
	Baseline		1	0.38516	.546	-.046		
	Residuals		12					

Note. df = degrees of freedom; SEF = sleep efficiency; SOL = sleep onset latency; CI = confidence interval; **ω²** were calculated to observe conservative effect sizes given the small sample size. Note that ω² statistics can sometimes be negative, unlike η_p^2. These should be interpreted as an effect size of zero (i.e., no variance explained), though statistical recommendations suggest reporting the negative values for use in meta-analyses (Okada, 2017).

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Figure 3.1.

The ABCs of SLEEPING Pilot RCT CONSORT Diagram

CONSORT Diagram
last updated March, 2023

Legend
- ● Eligibility and screening
- ● Randomization
- ● Baseline
- ● Follow-up
- ● Participants no longer participating
- ● End of study

Entered REDCap
n = 552

Started Eligibility Questionnaire
n = 282

Did not complete
n = 17

Completed Eligibility Questionnaire
n = 265

Ineligible (screened out)
n= 63

Reasons:
• Child not school-age n = 6
• Mental health dx n = 36
• Medical dx n = 18
• Medical sleep disorder dx n = 2
• Sleep medication n = 6

Note: reasons do not add to overall total as some had >1 reasons for inelgibility

Eligible (screened In)
n= 202

Signed up to complete telephone call
n = 99

Entered Baseline
n = 40
Target n = 40

Did not complete call (i.e., did not respond to invitation)
n = 58

Ineligible after phone call
n = 1

Total Baseline drop out n = 8

Reasons:
•Not interested n = 0
•No response n = 5
•Extenuating circumstance n = 1
•No time n = 2

Completed Baseline
n = 32

Randomization
n = 32

Treatment group
n = 17

Control group
n = 15

Entered Follow-up
n = 32

Total Follow-up drop out n = 4

Reasons:
•Not interested n = 0
•No response n = 4
•Extenuating circumstance n = 1
•No time n = 0

Note: reasons do not add to overall total as some had >1 reasons for dropping out.

Completed Follow-up
n = 28

Treatment group
n = 15

Control group
n = 13

End of study

Chapter 4: Barriers and Facilitators to the Implementation of a Mobile Health Sleep Intervention for School-Age Children: Perspectives of Parents and Healthcare Providers

The manuscript based on this implementation study is presented below. Readers are advised that Anastasija Jemcov, under the supervision of Dr. Penny Corkum, was responsible for the research question, methodology, analysis, and all aspects of the writing process. She received critical editorial feedback from her dissertation committee members (Dr. Isabel Smith and Dr. Sean MacKinnon). A version of the following manuscript is currently being prepared for submission.

Jemcov, A., Lamont, K., Mackinnon, S. P., Smith, I. M., & Corkum, P. (2024). Barriers and Facilitators to the Implementation of a Mobile Health Sleep Intervention for School-age Children: Perspectives of Parents and Healthcare Providers. [Manuscript in preparation].

Abstract

Sleep problems are prevalent among school-age children, but evidence-based interventions are not readily accessible (evidence-to-practice gap). Mobile health (mHealth) could help address this gap given the delivery format's accessibility. The *ABCs of SLEEPING* mHealth intervention was designed to provide accessible first-line sleep intervention. The app's potential implementation was explored by examining familiarity with apps, its demand, integration (search/use approach), and practicality (barriers/facilitators) with parents and healthcare providers (HCPs) who are its end-users. Thirty-three participants (14 parents and 19 HCPs) completed an interview after having used (parents) or reviewed (HCPs) the app. Interviews were analyzed using inductive theoretical thematic analysis and matrix analysis. Results highlighted end-users to have familiarity with apps generally but not with sleep apps, a demand for an app that provides first-line sleep intervention that is credible, accessible, and appealing. Integration findings indicated the app's daily use to be feasible, identified key considerations for downloading (e.g., security/privacy, credibility), and preferred cost models (i.e., one-time payment to upgrade). Facilitators to use were identified (parents: user-friendliness, credibility; HCPs: motivation and technology accessibility), and barriers (parents: busy schedules, daily stressors/demands, cost; HCPs; language, cost, support-level not suited for all families). Matrix analysis examined response consistency between end-users with complementarity identified for demand and integration themes, and unique themes for practicality (e.g., psychosocial factors identified by parents only). Overall, results provided insights which may inform a future implementation study. If effective and successfully implemented, *ABCs of SLEEPING* may address the current evidence-to-practice gap.

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Barriers and Facilitators to the Implementation of a Mobile Health Sleep Intervention for School-Age Children: Perspectives of Parents and Healthcare Providers

Sleep is important for the well-being and development of children (Harskamp van Ginkel et al., 2020); however, sleep problems are highly prevalent, affecting up to a third of school-age children (Dewald-Kaufmann et al., 2019). The most common problems are with falling asleep, staying asleep, and/or waking too early, which are clinically grouped as insomnia when they are chronic, frequent, and have negative impacts on daytime functioning (American Psychiatric Association [APA], 2022). Lack of sleep is associated with lower academic performance, less involvement in social and extracurricular activities, and other negative outcomes including difficulties regulating behaviour and emotions (Gomez-Fonseca & Genzel, 2020; Tomaso et al., 2021).

Insomnia-like symptoms in children are often behaviourally based and can be treated by appropriately trained primary care physicians and other healthcare providers (HCPs) without the assistance of a sleep specialist (Espie, 2023; Rigney et al., 2021). Treatment of sleep problems follows a stepped approach, moving through four stages from least to more involved approaches (Rigney et al., 2023; Weiss & Corkum, 2012). First, parental misinformation and inaccurate beliefs about sleep are addressed and sleep education is provided. Second, healthy sleep practices (i.e., "sleep hygiene") are implemented. Healthy sleep practices can be summarized by the mnemonic "*ABCs of SLEEPING*": Age-appropriate Bedtimes and wakeup times with Consistency, Schedules and routines, Location, Exercise and diet, no Electronics in the bedroom or before bed, Positivity, Independence, and Needs met, equal Great sleep (Bessey et al., 2013). In the third stage of treatment, specific behavioural strategies are implemented based on

psychological principles (e.g., operant conditioning), that have been found to be effective treatment for most children with behaviourally based sleep difficulties (Kodsi et al., 2022). Stage four is the use of non-prescription (e.g., antihistamine) or prescription (e.g., trazodone) medications for sleep (Boafo et al., 2020). As with any stepped approach, treatment options should be explored on the lower, less invasive steps before progressing to higher steps.

Despite clear guidelines on pediatric insomnia treatment, very few children receive treatment in the order indicated as best practice. For example, Meltzer et al. (2014) found that only five percent of participating children with identified sleep problems received evidence-based treatment for their insomnia symptoms. The reason for this evidence-to-practice gap is multifaceted and includes lack of help-seeking among parents, logistic issues (e.g., time and expense of attending intervention sessions), and lack of available resources (Devolin et al., 2013). Moreover, HCPs are not well trained in treating pediatric sleep problems (Thomas et al., 2016). For example, in Canada, only 19% of surveyed family physicians and 3% of total surveyed HCPs reported receiving formal training in pediatric sleep (Bock et al., 2016, Gruber et al., 2017). This lack of training, amongst other factors, has resulted in recommendation of medications prior to first-line behavioural strategies (Bock et al., 2016; Gruber et al., 2017; McDonagh et al., 2019). Given these barriers, it would be helpful to have an accessible evidence-based intervention for HCPs to recommend to parents and for parents to access to treat their children's insomnia symptoms.

Given that approximately 85% of Canadians own a smartphone for personal use (Statistics Canada, 2021), mobile health (mHealth) resources (i.e., smartphone applications, 'apps') can potentially address the above-noted accessibility barriers. As such, mHealth shows great promise in both providing care that is as effective as face-to-face

treatment and addressing many of the previously discussed barriers. Research using smartphone apps has demonstrated success in achieving desired sleep outcomes (e.g., better sleep quality) in infants, adolescents, and adults (Rayward et al., 2020; Yoshizaki et al., 2020; Yoshizaki et al., 2023; Murawski et al., 2019; Shin et al., 2017). For example, "Nenne Navi", an mHealth intervention developed for infants (mean age of 19.5 months) showed positive usability and effectiveness testing results (Yoshizaki et al., 2020; Yoshizaki et al., 2023). For adolescents, Quante et al. (2019) examined two publicly available apps (*mysleepbot*; https://mysleepbot.com/ and *sleeptime*: https://azumio.com), and found positive acceptability and perceived health benefits (e.g., physical health) of the interventions. Shin et al. (2017) systematically reviewed 16 studies examining the impact of smartphone app interventions for adult sleep disorders and sleep quality, finding that 88% of the reviewed studies demonstrated improvements in sleep quality. Although not a smartphone app, one identified mHealth intervention for school-age children is a program through which parents receive sleep-health-promoting messages from an internet platform (*Way to Health*, University of Pennsylvania; Mitchell et al., 2020; 2021). Results demonstrated high acceptability of the intervention but low fidelity in parents' use of strategies (Mitchell et al., 2020; 2021). Despite concerns around fidelity, children's sleep duration increased (Mitchell et al., 2020; 2021).

Given this gap in mHealth resources that provide evidence-based insomnia treatment recommendations for parents of school-aged children, or for HCPs to recommend to parents, we developed the "*ABCs of SLEEPING*" intervention. We are currently evaluating this app to ensure it meets the objective of being an evidence-based resource for parents to use and for HCPs to recommend.

In developing the *ABCs of SLEEPING* intervention, we incorporated a user-centered approach, in which the development and design of a product is an iterative process involving the target audience (i.e., end-users). End-users' opinions throughout this iterative process are collected and implemented as appropriate (Still & Crane, 2017; Pratt & Nunes, 2012; Zhai et al., 2023). As such, at each step of developing and evaluating the *ABCs of SLEEPING* intervention, we have involved end-users (i.e., parents and HCPs who may use the app) to ensure that the intervention is not only effective, but also valuable and relevant to them. Our research team's first step within this user-centered development process was to establish the evidence base for the healthy sleep practices content by conducting a systematic review (Allen et al., 2016). Following this, we completed a usability study (Howlett et al., 2020) in which participants reported the *ABCs of SLEEPING* intervention app to be useful, usable, desirable, valuable, accessible, credible, and findable (Howlett et al., 2020). Initially, the *ABCs of SLEEPING* intervention was envisioned as a resource given to parents at appointments with an HCP as an online link to access the *ABCs of SLEEPING* check-in (assessment) and emailed digital handouts of a sleep report and intervention tips. Feedback from these end-users was used to streamline the intervention to compile the components into a package. To do this, we designed an mHealth smartphone app given the emerging evidence for and promise of mHealth resources. Following the creation of the app, we adopted Bowen et al.'s (2009) feasibility theoretical framework for the remaining development and evaluation stages.

Bowen et al.'s (2009) framework provides a guideline of design approaches to evaluate an intervention before full-scale RCT testing. We conducted a feasibility study of the *ABCs of SLEEPING* smartphone app utilizing a "does it work?" approach, which focuses on the areas of acceptability (end-users' satisfaction/suitability of the intervention

ratings), preliminary effectiveness (evidence of improvements in sleep problems for end-users), and fidelity (are end-users using the intervention as the researchers intended?) (Bowen et al., 2009). We found reasonable acceptability and evidence for preliminary efficacy; however, fidelity was lower than expected (i.e., lower than daily use; Jemcov et al, 2021). Parent participants (end-users) provided qualitative feedback regarding possible adjustments (i.e., incorporating reminders, to-do list).

After incorporating this feedback, we conducted a pilot randomized control trial (RCT) to provide estimates needed for a full-scale RCT and to assess the program's preliminary effectiveness in changing children's sleep and behavioural functioning, (Chapter 3). Estimates based on the pilot RCT were a 70% recruitment rate, 30% dropout rate, and estimated sample size for a future RCT was 118 participants at the baseline and 82 total at follow-up (41 per group) to detect a medium effect of the intervention on the intended main outcome measures (i.e., Children's Sleep Habits Questionnaire, CSHQ, and Bedtime Routines Questionnaire, BRQ). Parents reported improved sleep habits, insomnia severity, and behavioural functioning; no changes were identified based on actigraphy, an objective sleep measure (please see Chapter 3).

Given the completion of the pilot RCT study the next step would be to examine the effectiveness of the *ABCs of SLEEPING* intervention. However, exploring implementation simultaneously provide unique benefits such as more rapidly disseminating the intervention (Curran et al., 2012). However, in order to do so the groundwork must be completed in order to inform a hybrid effectiveness-implementation study. As such, the next step was to examine the implementation potential of the *ABCs of SLEEPING* intervention by collecting the qualitative perspectives of end-users in order to plan for successful implementation that may be evaluated in a future hybrid effectiveness and implementation study. The current

study used the "will it work?" approach (Bowen et al., 2009), which focuses on demand, integration, and practicality. We also investigated familiarity, not included in Bowen's et al. (2009), to examine our sample's experience with having used or recommended smartphone applications (have parents used/HCPs recommended apps and if so, what kind). Our three research questions were:

(1) *Familiarity:* How familiar are the parents and HCPs with smartphone apps in general and those that support sleep in children specifically?

(2) *Demand:* Is there a demand from parents and HCPs for smartphone apps like the *ABCs of SLEEPING,* as a means of delivering interventions for pediatric sleep problems?

(3) *Integration:* How do parents and HCPs search for resources like the *ABCs of SLEEPING* app and when, during sleep treatment, would they use it?

(4) *Practicality:* What are the barriers preventing and facilitators promoting parents using, and HCPs recommending, a smartphone app like the *ABCS of SLEEPING*?

Method

The current study evaluated the barriers and facilitators to the potential implementation of the *ABCs of SLEEPING* intervention from the perspective of its end-users (i.e., parents and HCPs) utilizing a qualitative study design, guided by the Bowen et al. (2009) feasibility framework. To estimate the sample size required for this study, an a priori precision analysis for inter-rater reliability statistics was conducted using R version 4.0.3. This analysis estimated the minimum sample size as 22 (i.e., 11 parents and 11 HCPs) to attain an interrater reliability kappa of 0.80 between two raters, assuming a lower bound of 0.30 and a 95% confidence interval. The current study included 33 participants (14

parents, 19 HCP). Ethics approval for this study was obtained through the IWK Health Research Ethics Board (REB 1027369).

Participants

Parent Participants

Inclusion criteria for parent participants were their child: (a) had one or more insomnia symptoms (difficulties falling/staying asleep and/or early morning awakenings) but an insomnia diagnosis was not required, (b) was aged from 6 to 12 years of age, and (c) did not have a mental health diagnosis or physical health condition(s) that substantially impaired their daily functioning (i.e., defined as the child being ambulatory, not hospitalized or in residential care, and able to complete developmentally appropriate daily activities). The (d) family was required to reside in Canada, (e) parent was required to have internet/computer and smartphone access and an email account for completion of online questionnaires, to complete an interview via Microsoft Teams, and to access the intervention, (f) able to read and write in English. Exclusion criteria were that the child (1) had no known intrinsic sleep disorders (e.g., sleep apnea) and (2) was not taking medication to treat sleep problems.

Fourteen Canadian, English-speaking parent participants with internet access were recruited that had prior experience with the *ABCs of SLEEPING* intervention through previous research involvement. Overall, most parent participants were White and highly educated. See Table 4.1 for participating parent demographics.

HCP Participants

To participate, healthcare providers were required to (a) practice within Canada, (b) see children aged 6 to 12 years (i.e., experience with family-focused practice), (c) see patients/clients with sleep problems, and (d) have internet/computer access for interviews

via Microsoft Teams. Participating HCPs (n = 19) were 5 clinical psychologists, 5 physicians (2 psychiatrists, 1 family physician, 2 pediatricians), 8 nurses (1 nurse practitioner, 7 nurses), and 1 "other HCP"[1]. Of these 19 HCP participants, 16 identified as female and three identified as male. The number of years having worked with children varied substantially (range: 4 to 20 years), as did the percentages of their practices focused on sleep (10 to 70%). See Table 4.2 for participating HCP demographics.

Procedure

Parents and HCPs were recruited using social media ads on Facebook and Instagram or were directly contacted via a recruitment email using a list of parents and HCPs indicating interest in future research. Those interested clicked on a link in the social media ads or recruitment email, which directed them to the study's consent form through the secure, web-based REDCap (Research Electronic Data Capture; Harris et al., 2009; Harris et al., 2019) platform. After completing the consent form, participants were emailed to arrange a time for a 30-minute semi-structured interview via Microsoft Teams. We provided HCP participants with a 10-minute video about the *ABCs of SLEEPING* intervention to watch before the interview and log-in information to review the app (although the latter was not required). All parent participants had prior experience with the *ABCs of SLEEPING* intervention for one month as participants in a pilot RCT (Chapter 3).

Two interviewers were involved in each interview (AJ, KL), one leading the interview and one providing support (e.g., solving technical issues). At the beginning of the interview, the lead interviewer reviewed the consent process and presented an opportunity for participants to ask questions. The interview had four sections[2]. The first section focused

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[1] For blinding purposes, given n = 1, "other HCP" label was used.
[2] A copy of the parent and HCP interview transcripts can be found in Appendix C, respectively.

on participants' familiarity with smartphone apps by asking about their general knowledge and use of apps in general and sleep apps specifically. The second section asked questions related to demand (e.g., who would want to use the *ABCs of SLEEPING* app?), the third focused on integration (e.g., how they would search for the *ABCs of SLEEPING* app?), and the fourth addressed questions about practicality (e.g., barriers and facilitators to using/recommending the *ABCs of SLEEPING* app). All interviews were audio-recorded and automatically transcribed using Microsoft Teams and were checked by the researchers. Upon completing the interview, participants were compensated with a $20 Amazon.ca gift card.

Intervention

The *ABCs of SLEEPING* app contains three components. The first is a questionnaire regarding the child's sleep, the "check-in" ("*ABCs of SLEEPING* Questionnaire" in a previous study, Howlett et al., 2020). The app uses an algorithm to calculate scores on the check-in for each area of the *ABCs of SLEEPING* mnemonic and reports these on a one-to three-star system in the second component, the sleep report. The three-star system indicates priority for the sleep intervention areas: one star indicates an area of most need; two stars indicate that some need for this sleep intervention area; and three stars indicate no need to focus on this sleep intervention area. Sleep recommendations ("sleep tips") are provided and colour-coded for importance algorithmically following the check-in. Each recommendation is organized under the *ABCs of SLEEPING* mnemonic: red denotes high importance, yellow indicates medium importance, and green indicates that this area does not require intervention.

Data Analytic Approach

The qualitative data were analyzed using a realist epistemological approach. This viewpoint acknowledges the existence of an external reality independent of our own perceptions and beliefs. Participants in our study expressed viewpoints that, as researchers, we believed we could identify with reduced bias by involving a second rater and through discussions among the lead researcher (AJ), a second coder (KL), and a senior researcher (PC). Characteristics of the researchers and their biases, assumptions, motives, and positions of power throughout the research process are described according to the consolidated criteria for reporting qualitative research (COREQ; Tong et al., 2007) in Table 4.3.

The contents of the interview transcripts were analyzed using inductive theoretical thematic analysis (Braun & Clarke, 2021). The first step was for the lead researcher to compare the transcripts produced by Microsoft Teams to the audio-recordings. The corrected transcripts were then uploaded to the qualitative analysis software NVivo (QRS International, 2020). Using this platform, the six phases of thematic analysis were completed by the lead researcher and the second rater. These phases were: (a) becoming familiar with the data by reviewing all transcripts, (b) generating initial codes, (c) searching for themes, (d) reviewing themes, (e) defining and organizing the themes, and (f) producing a report. The first step was satisfied by the primary rater reading the transcripts and noting initial impressions to generate codes. These codes were then applied to the data by a second rater. The senior researcher provided feedback regarding the approach to coding and was consulted regarding any coding disagreements. Interrater reliability between the primary and secondary coders was excellent for the parent data ($\kappa = 0.83$) and substantial for the HCP data ($\kappa = 0.79$) (Landis & Koch, 1977).

A matrix analysis was conducted to examine the complementarity of themes between parent and HCP participants. Our approach was informed by the guidelines provided by Farmer et al. (2006). First, we sorted themes endorsed by both groups based on their similarity (e.g., judged based on the meaning derived from the themes and codes), and grouped them under a metatheme. After this step, we examined the level of consistency in meaning and prominence between the themes under the metatheme and labelled their agreement on these two components using the four Farmer et al. (2006) agreement levels: agreement, partial agreement, dissonance, and silence. "Meaning" in the context of this research was defined as the degree to which the themes agreed on the core concept captured by the theme by both groups, and "prominence" was the number of participants in each group endorsing the theme. We assigned prominence cut-offs to help us conceptualize and communicate our understanding of high, medium, and low levels of prominence. We defined these post hoc as 60% or more participants indicating a theme as being high prominence, 40-59% as medium (approximately half), and 30-39% as low prominence. We excluded themes below 30% as our cut off for endorsement to constitute a theme. Regarding agreement levels, 'agreement' describes agreement on both meaning and prominence, 'partial agreement' on either meaning or prominence, 'silence' describes a theme endorsed by one group (parents or HCPs), and 'dissonance' refers to opposing themes between groups (differed on meaning and prominence). This analysis was completed by lead researcher AJ; senior researcher PC provided consultation regarding the sorting process and agreement ratings.

Results

Familiarity with Apps

All parents in our sample had used smartphone apps for self-help (100%), half (50%) had used an app other than the *ABCs of SLEEPING* to help with their children's sleep, and 93% had used an app for another area of concern about their children (e.g., school, mental or physical health concerns). When asked if they had searched for sleep apps, 36% reported that they had and 50% reported that one had been recommended to them to help with sleep. Last, 93% of our sample had a non-sleep app recommended to them previously.

Most of the HCPs in our sample (84%) had recommended apps to patients/clients but 89% reported that they had not recommended an app for sleep. Reasons provided were not knowing which apps were evidence-based (32%), which were most appropriate and relevant for children (37%), or because recommending apps did not fit within their current practice (47%). Within our sample, 63% of HCPs reported that they had recommended mental health apps and 32% had recommended apps to support physical health (neither including sleep).

Demand, Integration, and Practicality themes

The themes that arose for demand, integration, and practicality are outlined below. All data (i.e., themes, codes, percentages, and sample quotes) are included in Tables 4.4 to 4.9. These data are organized based on the order of the interview questions. The threshold for including a theme for each research question was that at least 30% of participants within the group (parents or HCPs) endorsed a theme. Below is a summary of the findings, see tables for details including themes, percentage of people endorsing each theme, codes, and

example quotes generated in response to each question within the areas of demand, integration, and practicality.

Demand

Parents and HCPs were each asked five questions about demand. Parents' responses resulted in 11 themes and 35 codes (Table 4.4). For HCPs, responses resulted in six themes and 22 codes (Table 4.5).

Parent Data. Parent participants indicated a high need for this app and provided reasons that related to its content, helpfulness, and appearance. Parent participants indicated that the target audience for the app would be parents of younger children and those with children struggling with sleep. Pros of the app were that it was accessible and convenient, self-paced, and that there was no wait to use the app. Cons were lack of support compared to face-to-face interventions and that apps would not be ideal for those needing more intensive treatment.

HCP Data. HCP participants also identified demand for the *ABCs of SLEEPING* that related to its content and a need for the resource. A wide target audience for the app was identified (e.g., all age groups, any parent or caregiver, and HCPs). Pros were that the app was accessible and helped to address wait times. The only con identified was that apps do not provide the level of support that face-to-face treatment may offer.

Integration

Based on the parent data 18 themes and 48 codes were identified across the eight questions about integration (Table 4.6). For HCPs, 19 themes and 44 codes were identified (Table 4.7).

Parent Data. The *ABCs of SLEEPING* app was reported to be most suitable as a first step in sleep treatment and as a prevention tool. Parents reported they would download the *ABCs of SLEEPING* app. Most parents would look for a sleep app like this by searching app stores or the internet, and some would ask others or go to social media to find out about such an app. Before downloading an app, parents reported that they check reviews, previews, and use trials. Appealing qualities the parents noted about the *ABCs of SLEEPING* app were its organized information and customized/personalized experience, although some parents wanted more customization and others reported that there were no unappealing qualities. Parents stated that conveying that the app presents recommendations that are evidence-based would be critical. Factors important in their search for apps are its credibility (feeling as though it was evidence-based), and security/privacy. Parents reported that using the ABCs as recommended would be feasible and the preferred cost models was a free basic version with the option to pay to upgrade and/or a one-time cost.

HCP Data. The HCP participants also expressed that the *ABCs of SLEEPING* app was suitable as a first-line intervention, that they would download it to review it, and that they would search for such an app by consulting with their colleagues, and by searching reliable internet sources and/or the App Store. HCPs would take cost, a thorough review of the app, credibility, and aesthetics into consideration before recommending an app. HCPs found ease of use and the aesthetics of the *ABCS of SLEEPING* to be its appealing qualities, but some felt that features needed adjusting (e.g., adding an option for parents to share data with them). HCPs reported that it was critical to convey that the *ABCs of SLEEPING* is evidence-based, and that it takes time and consistency to see improved sleep. Credibility was the most important factor cited by HCPs, and most reported that daily use of the app would be feasible, although some felt this would depend on the family. The preferred cost

models were reported to be a free basic version with a paid upgrade to premium option and/or a one-time cost option.

Practicality

Two questions were asked of both parents and HCPs that focused on practicality. Based on the parent data seven themes and 22 codes were extracted (Table 4.8) and four themes and 10 codes were identified from HCP data (Table 4.9).

Parent Data. Potential barriers identified were affordability, busy schedules, daily stressors and other psycho-social factors, lack of awareness of the app, and forgetting to use the app. Facilitators were that the app is user-friendly and credible.

HCP Data. Barriers identified by HCPs were accessibility (e.g., affordability, technology, language) and that some families would require further support than the *ABCs of SLEEPING* app could offer. Facilitators were families that were technologically savvy and ready for change.

Matrix Analysis

A matrix analysis was conducted to examine the complementarity of themes that emerged for parent and HCP participants when asked the demand, integration, and practicality interview questions. For demand (Table 4.10), all participants in both groups felt there was a need for the *ABCs of SLEEPING* and reasons were provided. The parent group indicated good appearance as a reason. When asked who would want to use the app, each group endorsed distinct themes, with parent participants indicating specific groups (e.g., parents of young children), and HCPs giving broader responses (e.g., helpful for a wide range of people). Both groups agreed on pros (i.e., accessibility, lack of wait times) and cons (i.e., cannot offer the same level of support as face-to-face treatment). Only the

parent group identified that the *ABCs of SLEEPING* app may not work for those who need more intensive sleep treatment.

When asked about integration (Table 4.11), both groups identified that the app is best suited as a first step before seeking face-to-face treatment, and parents reported it would be useful as a prevention tool. The groups indicated they would search for the *ABCs of SLEEPING* app the same way, by looking to others and searching the App Store. However, parents and HCPs differed about what sources they would search, with parents indicating news and social media and HCPs indicating reliable internet sources. Both groups indicated that if the *ABCs of SLEEPING* app was found in their search that they would download it, but that they would need to review an app before purchasing/recommending. There was no overlap in what the groups found appealing; each identified distinct themes. Parents found the organized information and customized experience to be appealing, while the HCPs indicated that the *ABCs of SLEEPING* was easy to use, and they liked its aesthetic features. There was partial agreement about what parents and HCPs found unappealing; both groups wanted adjustments, with parents suggesting more customization and HCPs requesting specific features (e.g., data sharing). Some parent participants reported nothing unappealing about the *ABCs of SLEEPING*. Both groups indicated that it was critical to convey to parents/other parents the credibility of the *ABCs of SLEEPING*. When asked about what factors were important to them when considering purchasing/recommending an app, both groups identified credibility and only the parent group identified the importance of security and privacy. Last, both groups preferred a free basic version with the option to upgrade to a premium version and a one-time cost.

For practicality (Table 4.12) overlap for both groups was found for accessibility as a barrier; the parent group also identified busy schedules. There was no overlap for facilitators, both groups indicating distinct themes. The parent group identified the *ABCs of SLEEPING* being user friendly and a credible source as facilitators, and the HCP group identified as facilitators that the family needed technological knowledge and to be ready for change.

Discussion

Our goal was to study the potential implementation of the *ABCs of SLEEPING* intervention by interviewing its intended end-users (parents and HCPs). We examined four constructs: (a) how familiar the intended end-users of the *ABCs of SLEEPING* are with mHealth), (b) participants' perspectives on the demand for the *ABCs of SLEEPING* intervention, (c) participants views as to when during sleep treatment they would utilize this type of resource, and (d) potential barriers and facilitators when using or recommending the smartphone app for a child's insomnia treatment.

Both parents and HCPs were well versed with smartphone apps, but HCPs did not typically recommend apps to help their patients/clients to sleep better. Both groups reported demand for the *ABCs of SLEEPING* intervention as a first step in sleep treatment for children. Further, the parent group indicated it may be used as a resource to prevent sleep problems. All parent and HCP participants had similar approaches to searching for apps and factors they considered before downloading or recommending apps (e.g., security, credibility) as well as preferred cost-models. Several potential barriers such as affordability) and facilitators were reported by parents (e.g., user friendliness) and HCPs (e.g., family being technologically savvy). Last, results of a matrix analysis revealed

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complementarity between parent and HCP themes for demand and integration, but less for the area of practicality as parents and HCPs identified distinct potential barriers and facilitators to using the *ABCs of SLEEPING* intervention.

Familiarity

Regarding our first research question, those apps that parents and HCPs reported using and recommending were in areas that had been better established empirically in the mHealth literature (e.g., physical and mental health; Baumann et al., 2022; Sutherland et al., 2019). Our HCP sample expressed their reasoning for not recommending apps which was related to uncertainties about which apps are evidence-based, appropriate, or fit within their practice. These uncertainties may relate to the lack of training for providing sleep treatment that is commonly reported by HCPs in the literature (Zhou et al., 2021; Boerner et al., 2015; Sullivan & Cao, 2021; Zhou et al., 2021; Kovacic et al., 2002; Saleem et al., 2017). As such, our results underscore the importance of ensuring HCPs are made aware of current evidence-based mHealth resources.

Demand

It was clear that participants were all aware of the lack of sleep mHealth resources for school-age children. Those aspects highlighted as desirable for the *ABCs of SLEEPING* intervention align with those identified in previous research (Tan-MacNeill et al., 2020). With accessibility among those qualities listed as a "pro" with the *ABCs of SLEEPING*, mHealth may be a viable solution to the evidence-to-practice gap from the perspectives of end-users, as proposed (Lah & Cao, 2024; Santarossa et al., 2018; Buckman et al., 2021; Kreps & Neuhauser, 2010; Tan-MacNeill et al., 2020; Billings et al., 2021). An additional "pro" was lack of wait times, consistent with the view of some researchers that mHealth and digital interventions may ease burden to healthcare and address wait times (Bakker et

al., 2016). However, mHealth smartphone apps can only improve access for those who have a smartphone or tablet and may not address all barriers that result from health disparities, such as for those who are socially disadvantaged and/or have minority status (Billings et al., 2021; Bommakanti et al., 2020).

Last, although mHealth interventions show great promise for achieving desired sleep outcomes for children such as decreased insomnia severity (Rayward et al., 2020; Murawski et al., 2019; Shin et al., 2017), most participants indicated that the *ABCs of SLEEPING* intervention could not offer the same one-on-one support as a face-to-face intervention. This perspective is in line with some research demonstrating that mHealth interventions that include one-on-one support features can provide similar support to face-to-face intervention. However, each mode of intervention delivery has its advantages and disadvantages (Santarossa et al., 2018). A paucity of research compares child mHealth sleep interventions to face-to-face intervention (Kallestad et al., 2021; Lancee et al., 2016; Arnedt et al., 2021; Gieselmann & Pietrowsky, 2019). Research has been with adults that has examined this, however. For example, when comparing mHealth-delivered cognitive behavioural therapy for insomnia (CBT-I) to face-to-face delivery, Kallestad et al. (2021) reported that both methods improved sleep outcomes (e.g., dysfunctional sleep beliefs) but a face-to-face delivery was preferred. A potential reason was that face-to-face treatment may offer more opportunity to personalize treatment for the client/patient.

Integration

When implemented, both parents and HCPs considered the *ABCs of SLEEPING* intervention to be a first-line sleep intervention (as intended), and parent participants highlighted it would also be a helpful prevention tool, to enhance sleep health rather than

address insomnia (Buysse, 2014). This viewpoint is consistent with a strengths- rather than a deficit-based model, supporting the *ABCs of SLEEPING* as a sleep health promotion app.

Credibility and privacy/security were noted as important factors considered prior to downloading any app. These results are consistent with literature demonstrating a relationship between credibility and treatment adherence as users may engage more with an app that they feel is evidence-based (Ritterbrand et al., 2010; Alfonsson et al., 2016).

Practicality

The barriers identified are consistent with ones commonly referenced in the literature (Tan-MacNeill et al., 2020; Billings et al., 2021; Paterson et al., 2019; Roberts & Ulmer, 2024; Stinson et al., 2006; Boerner et al., 2013). As for facilitators, there is currently no research examining these for sleep mHealth resources, specifically for a school-age population.

Strengths and Limitations

In terms of our study's strengths, this research fills an important gap in the treatment of sleep problems in school-age children via an mHealth platform. Second, an iterative and user-centered design was used across the development and evaluation of this program, which employed a multi-method approach. Third, we used the Bowen et al. (2009) feasibility framework to organize the research questions and the semi-structured interview. Fourth, this study utilized both parent and HCP groups who are considered the end-users for the *ABCs of SLEEPING* intervention and thus we captured perspectives of people who will use the program and recommend the program. Last, our results provide a novel understanding of facilitators for future implementation.

This study was not without limitations. First, our parent sample consisted of White highly educated biological mothers with well-above average household incomes (over

80k), therefore we have not captured viewpoints and barriers experienced by more diverse families. Our HCP sample was larger than the parent group and also over-represented females. Given these characteristics and small numbers, we caution against generalizing these results to all parents and HCPs. Second, interviewers and the senior researcher were involved in the development and modification of the *ABCs of SLEEPING* intervention, of which participants were aware. This may have introduced bias on both the interviewers and interviewee's part given our active involvement in evaluating and modifying the intervention. Last, there were differences in experience with using the *ABCs of SLEEPING* intervention between our groups; parents had used it consistently for one-month whereas all HCPs reported that they reviewed a 10-minute video and had the option to download the app to review prior to completing the interview (but data were not collected on who many viewed it).

Future Directions

Future research examining the *ABCs of SLEEPING* intervention will involve evaluating its effectiveness via a full-scale RCT, however implementation must also be considered in light of the current study's results. Specifically, these results support an evidence-to-practice gap for insomnia treatment for school-age children. Conducting an implementation study with end-users will not only be a helpful step for promoting successful dissemination of the *ABCs of SLEEPING* intervention but may also provide an enhanced understanding of the current study's noted themes via an enhanced study design (e.g., the use of recommended mixed methods for implementation research and an implementation framework to guide data collection; Greenhalgh et al., 2004). Given this, the next step in research would be to conduct a hybrid effectiveness-implementation study in order to address both of these components. This study design would be most ideal given

its benefit of rapid dissemination (Curran et al., 2012); an important consideration given the current sleep intervention resource gap that the ABCs of SLEEPING may address.

Conclusion

In conclusion, perspectives were notably aligned between parents and HCPs, such as the perceived need for a resource like the *ABCs of SLEEPING* intervention. Both groups reported it to be first-line before beginning more intensive sleep treatment. They also agreed on methods for searching and downloading an app, and preferences for app cost models. Understanding these shared perspectives is important for the successful implementation of the *ABCs of SLEEPING* intervention to address school-age children's sleep problems by bridging the current evidence-to-practice gap. The *ABCs of SLEEPING* intervention holds strong promise for promoting positive changes in children's sleep practices and fostering a strengths-based approach to their sleep health.

Table 4.1.

Demographic Information for Parent Participants and Their Children and Healthcare Provider Participants (N = 14)

Parent Demographics	N (%)
Participants' relationship to child	
Biological mother	12 (86)
Biological father	2 (14)
Participants' Current Employment Status	
Full Time	11 (79)
Homemaker	3 (21)
Estimated Household Income	
$79,999 and under	4 (28)
$80,000 - $124,999	6 (43)
$125,000 and over	4 (28)
Type of community of residence	
City	9 (64)
Town	3 (21)
Rural	2 (14)
Highest level of education	
Diploma from community college	2 (14)
Bachelor's degree/undergraduate	9 (64)
Master's degree	3 (21)
Child Demographics	
Child Sex	
Male	8 (57)
Female	6 (43)
Child Mean Age in years (*SD*)	8.67 (1.72)
Child's Ethnic or Cultural Heritage	
White	10 (72)
Other	4 (28)

Table 4.2.

Demographic Information for Healthcare Provider Participants (N = 19)

HCP Demographics	N (%)
Profession	
Clinical Psychologist	5 (26)
Physician	5 (26)
Registered Nurse	8 (42)
Other HCP	1 (6)
HCP Sex	
Female	16 (84)
Male	3 (16)
Practice Area	
Primarily Health Focused	7 (37)
Primarily Mental Health Focused	8 (57)
Both (50/50)	4 (21)
Years Working with Children	
5+ Years	9 (47)
10+ Years	4 (21)
15+ Years	3 (16)
20+ Years	3 (16)
Percentage of Sleep-Focused Practice	
10%	4 (21)
20-30%	4 (21)
40-50%	7 (37)
60-70%	4 (21)

Table 4.3.

Consolidated Criteria for Reporting Qualitative Studies (COREQ; Tong et al., 2007) Checklist

Domains	Guide questions/description	Answer
Domain 1 Research team and reflexivity		
Personal Characteristics		
1. Interviewer/facilitator	Which author/s conducted the interviews?	The research team consisted of Dr. Penny Corkum (Research Supervisor), Anastasija Jemcov (Graduate Student, PhD Candidate), Kate Lamont (Undergraduate Student), Dr. Isabel Smith (Dissertation Committee Member), and Dr. Sean Mackinnon (Dissertation Committee Member). Anastasija Jemcov and Kate Lamont completed the interviews with participants. All research team members were involved with reviewing and interpreting the data
2. Credentials	What were the researcher's credentials at the time of the interviews?	Graduate Student, PhD Candidate (Jemcov), and Undergraduate Student (Lamont). Dr. Penny Corkum was the primary research supervisors and Dr. Isabel Smith and Dr. Sean Mackinnon were both dissertation committee members for Anastasija Jemcov.
3. Occupation	What was their occupation at the time of the study?	Interviewers were both students

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Domains	Guide questions/description	Answer
4. Gender	Was the researcher male or female	Research team members were all female with the exception of Dr. Sean Mackinnon (male).
5. Experience and training	What experience or training did the researcher have?	Anastasija Jemcov was a trainee in a clinical psychology program as a researcher-clinician. Kate Lamont was a trainee completing her undergraduate degree in medical sciences. Her contribution was to fulfill an academic requirement as an independent studies student; she was supervised by Jemcov.

All other research team members (Corkum, Smith & Mackinnon) were researchers and professors with extensive training in qualitative data analysis. |
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	All research team members did not have a relationship to participants prior to study commencement.
7. Participant knowledge of interviewer	What did the participants know about the researcher? *e.g., personal goals, reasons for doing the research*	Interviewees were aware of the interviewer's background. Specifically, Anastasija Jemcov and Kate Lamont's role as students, primary area of research as sleep in typically developing school-age children, location of graduate studies, and their university affiliation and involvement with investigating and modifying the *ABCs of SLEEPING* app. For all other research team members, participants were aware of their university affiliation and involvement with investigating and modifying the *ABCs of SLEEPING* app.

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Domains	Guide questions/description	Answer
8. Interviewer characteristics	What characteristics were reported about the interviewer/facilitator? *e.g., bias assumptions, reasons and interests in the research topic*	The interviewers' roles in the development of the app were clear via the consent form. Participants may have surmised interviewer's ethnicity from visual features and last name; reason for research topic was reported as helping to better understand the potential implementation of the *ABCs of SLEEPING* intervention. Participants only met the interviews (Jemcov & Lamont) and were made aware of the research team via a consent form. They may have surmised their ethnicity from last name.

Domain 2: Study design

Theoretical framework

9. Methodological orientation and theory	What methodological orientation was stated to underpin the study? *e.g., grounded theory, discourse analysis, ethnography, phenomenology, content analysis*	The methodological orientation utilized was inductive thematic analysis, and a matrix analysis.

Participant selection

10. Sampling	How were participants selected? *e.g., purposive, convenience, snowball*	A combination of random and purposive sampling
11. Method of approach	How were participants approached? *e.g., face-to-face, telephone, mail, email*	For study recruitment, parent participants who had participated in a pilot RCT examining the *ABCs of SLEEPING* app were approached via email to participate in the interview. HCP participants were recruited via social media ads, and through a contact list.

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Domains	Guide questions/description	Answer
12. Sample size	How many participants were in the study?	14 parents/caregivers and 19 HCPs
13. Non-participation	How many people refused to participate or dropped out? Reasons?	A total of 28 parents were contacted to participate, and of those 28, 14 agreed to participate. No parent participants dropped out of the study. To recruit HCPs a blast email list was used containing 18,021 HCPs. Of these HCPs contacted, 19 agreed to participate.
Setting		
14. Setting of data collection	Where was the data collected?	Data were collected online using Microsoft Teams. Transcripts were automatically produced by Microsoft Teams in a Word document and subsequently corrected by Jemcov and Lamont using recordings of the interviews.
15. Presence of non-participants	Was anyone else present beside the participants and researchers?	No one else was present.
16. Description of sample	What are the important characteristics of the sample?	Sample characteristics are all described within the manuscript. Further details about the sample can also be located in the demographic characteristics listed in Table 4.1.
Data collection		
17. Interview guide	Were questions, prompts, guides, provided by the authors? Was it pilot tested?	The interview guides are provided in Appendix C. The interview guide was pilot tested among the researchers (Jemcov & Lamont) and supervisor (Corkum).

Domains	Guide questions/description	Answer
18. Repeat interviews	Were repeat interviews carried out? If yes, how many?	No repeat interviews were carried out
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Only audio recordings (no video) were used in order to protect participant privacy.
20. Field notes	Were field notes made during and/or after the interview?	The interviews were audio-recorded and automatically transcribed. Transcriptions were corrected later using the audio-recordings. As such notes were not necessary during the interview.
21. Duration	What was the duration of the interview?	The interviews were designed to last 30 minutes (range = 20 to 32 minutes)
22. Data saturation	Was data saturation discussed?	Yes, among the researchers (Jemcov & Lamont), and supervisor (Corkum).
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	Transcripts were not returned to participants for comment or correction. Transcripts were audio recorded to ensure accuracy.
Domain 3: Analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	Three coders were involved in the data analysis (Corkum, Jemcov & Lamont). Jemcov and Lamont completed the main coding and consulted Corkum to resolve coding disagreements.

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Domains	Guide questions/description	Answer
25. Description of the coding tree	Did authors provide a description of the coding tree?	The researchers provide a detailed breakdown of the approach taken when coding. Specifically, codes were identified to form a code book, that was then applied to the data to identify themes.
26. Derivation of themes	Were themes identified in advance or derived from the data?	Themes were derived from the data
27. Software	What software, if applicable, was used to manage the data?	NVivo (QRS International, 2020) and Microsoft Word were utilized to manage the data.
28. Participant checking	Did participants provide feedback on the findings?	No
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified?	Yes, quotations were used in tables. Quotations were not identified.
30. Data findings consistent	Was there consistency between the data presented and the findings?	Yes
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	We conducted a matrix analysis through which discordant themes (i.e., diverse cases) between groups were identified.

Table 4.4.

Parental Responses Regarding Demand for The ABCs of SLEEPING Smartphone App

Question 1: Why should the *ABCs of SLEEPING* be available for parents?		
Themes (% of parents endorsing themes)	Codes	Quote
a) Need for sleep apps as a resource (86%)	• The *ABCs of SLEEPING* should be available to parents • A lot of parents struggle with their child's sleep • Huge demand for sleep resources	*"I think it is a, is a helpful tool just because… from my experience there's a lot of parents out there that are struggling with what exactly are good sleep habits for their child"*
b) Good features and sleep information (86%)	• Enjoyed check-in, sleep report, and sleep tips • The *ABCs of SLEEPING* app provides a lot of information that is research backed • Gives good tips and feedback • Good for monitoring, tracking, and identifying patterns • The *ABCs of SLEEPING* information is not generic	*"You're going to get more with this… more information, more background, and the good sleep routines information. So much information"*
c) Good appearance (64%)	• The *ABCs of SLEEPING* has a nice appearance/name • Has a good user interface	*"I liked the appearance of it… how it looks on the screen"*
d) Helped child's sleep, sleep habits, is helpful (64%)	• The *ABCs of SLEEPING* is useful and helpful • The *ABCs of SLEEPING* sleep tips are effective • Helped child sleep and/or learn how to sleep	*"You did help my child learn to sleep, and I really appreciate that"*

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Question 2: What type of demand is there for this app, who would want to use it?

Themes (% of parents endorsing themes)	Codes	Quote
a) Parents with younger children would want to use it (86%)	• Would be most helpful for younger kids • App is helpful for younger kids, below age 6	*"I think parents or caregivers of children that are younger, even kids that are still napping. I think it would be really, really strong to build those foundations and the app gives these, it provides those fundamental building blocks of day-to-day routines and sleep is a big part of our life and building a good routine on that from the beginning."*
b) Parents with children struggling with sleep would want to use it (43%)	• Helpful for parents with children that have sleep problems • Helpful for parents who want to try another approach	*"This is definitely for families that are having troubles with their child sleeping throughout the night.... And also other families that are curious about whether or not they could be doing something more to help their child fall asleep better or more efficiently"*

Question 3: Do you see any benefits/ "pros" of using the *ABCs of SLEEPING* app when compared to other ways to receive treatment (e.g., face-to-face)?

Themes (% of parents endorsing themes)	Codes	Quote
a) Accessible (79%)	• It's accessible, convenient, and more available • Easier than face-to-face • Don't need to take time off work to use it • Keeps information all in one place	*"I think it's accessible at a time that's convenient to the user. I know for me I always have my phone with me, so in that way it's easily accessible. I don't have to set up a schedule to meet with someone"*

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Themes (% of parents endorsing themes)	Codes	Quote
b) Self-paced (50%)	• Self-paced • You can use it "at your convenience" or "on your own time"	*"I think the biggest advantage is the convenience. You can download it and use it on your own time. Whereas if you were seeking face-to-face help or appointments with a professional, you would have to go through more steps and plan ahead more. This is more of a self-help tool than anything."*
c) No wait-times (36%)	• No wait times/reduces wait times • Immediate self-help • An app is easier timewise • Apps have an advantage that it lessens demand on healthcare system	*"The fact that you can just have it on your phone so when you suddenly remember you were going to look into that, you can just do that right then – I think is really good and you can start right away. There's no wait time, there's no making appointment, there's no you have to wait a week to start doing something. You can just start right now and then you can look at next steps after that if that doesn't help, but I think the fact that it's right there and there's no delay."*

Question 4: Do you see any downsides/ "cons" of using the _ABCs of SLEEPING_ app when compared to other ways to receive treatment (e.g., face-to-face)?

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Themes (% of parents endorsing themes)	Codes	Quote
a) Does not have the same type of support face-to-face treatment can offer (50%)	• Downside to app is you can't ask for clarification like you can with an HCP • HCP has your history, can offer support and validation/ more tailored advice • Face-to-face treatment is more personalized • Wants the app to have more support (e.g., use with sleep consultant/coach) •	*"The only kind of drawback I would see is like if you had a question or needed clarification on something, like what something means specifically, you can't get that right away. But I don't know, from my experience it seems pretty clearly worded so… but that's kind of the only drawback I would see."*
b) Does not work for those who need more intensive sleep treatment (50%)	• Sleep tips are general or not dynamic, and are limited for their child's needs • A general approach/doesn't work for those needing more intensive treatment • Not good for kids with special or specific needs	*"I would say that within the app, uh, the resources are kind of limited. It's more things that you can do within your home and sometimes I think that sleeping issues may extend further into the realm of needing treatment, whether it's medicinal or a therapy type of treatment that is not accessible in the app."*

Table 4.5.

HCP Responses Regarding Demand for The ABCs of SLEEPING Smartphone App

Question 1: Why should the *ABCs of SLEEPING* app should be available as an app for parents?		
Themes (% of HCPs endorsing themes)	Codes	Quote
a) Asks relevant sleep questions and provides good sleep information (68%)	• Provides information on how to improve child's sleep • Should be available as it is a good resource • Has good information/recommendations/assessment questions	*"It hits on the foundation of healthy habits for kids…. And I think it makes it in a way that's relevant. These behaviours are all important and the information provided about them are great"*
b) Sleep problems are a common concern that needs to be addressed (47%)	• Should be available because sleep problems are a common concern • There is a large need for more sleep resources for parents to use	*"Sleep is a huge problem. Even if people don't have anxiety, depression, etc."*

Question 2: What type of demand do you see for this app? For example, who might want to use it?		
Themes (% of HCPs endorsing themes)	Codes	Quote
a) Helpful for a wide range of people (79%)	• Helpful for all age groups • Mentions app being helpful for various groups (i.e., school-aged, young children, adolescents, kids with neurodevelopmental disorders) • Helpful for any parent/caregiver • Helpful for HCPs	*"I think it could be helpful for anyone, I could even imagine parents of older kids wanting to use it, especially if they're noticing issues with their kids falling asleep or staying asleep, or issues with their mood too"*

Question 3: Do you see any benefits/ "pros" of recommending the *ABCs of SLEEPING* app when compared to other ways to receive treatment (e.g., face-to-face)?

Themes (% of HCPs endorsing themes)	Codes	Quote
a) Accessible (58%)	• It can be with you whenever you need it • All information is stored in one place • Easily accessed • Apps are accessible cost-wise • Most people understand how to use apps • A lot of people will always have their phone in their hand	*"We live and breathe by our phones now… so that's something they can keep in their hand and look at in a more compact and direct kind of way"*
b) Helps address wait times (42%)	• Helpful for addressing wait times • No waitlist to use an app • Gives family something to try while waiting for another treatment	*"If I think about people waiting at the sleep clinic to see a specialist, that wouldn't be an issue with this app. While families wait, they can do something like this as an actionable item"*

Question 4: Do you see any downsides/ "cons" of recommending the *ABCs of SLEEPING* app when compared to other ways of receiving treatment (e.g., face-to-face)?

Themes (% of HCPs endorsing themes)	Codes	Quote
a) Apps are missing the support, clarification, and validation that face-to-face offers (47%)	• Downside of app is you can't ask further questions/clarification • You don't have someone to troubleshoot with • You don't receive validation • It cannot address other mental health concerns	*"I think not having an opportunity to ask further questions or if they're stuck, they may need another person to help guide them if sleep continues to be poor"*

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Table 4.6.

Parental Responses Regarding Integration of The ABCs of SLEEPING Smartphone App

Question 1: At what stage of trying to help a child sleep better do you think this app would be best suited (e.g., before seeking out face-to-face intervention)?		
Themes (% of parents endorsing themes)	Codes	Quote
a) Best suited as a first-step tool (71%)	• ABCs is not suitable for more intensive sleep problems • Good first step before more intensive approaches. Before face-to-face intervention	"ABCs would be best for somebody who's a new parent and is kind of getting ready for those… age-appropriate milestones as they get older, I definitely think it could be a really helpful app"
b) Prevention tool (43%)	• Preventative measure • A good tool before sleep becomes a problem	"Depending on where the family is at, I think it [ABCs of SLEEPING] provides good tips to follow even before sleep is a problem. It can help with starting out with good habits"

Question 2: What approach do/would you take while searching for an app like the ABCs of SLEEPING? (E.g., Where do you look? Do you search the App Store and/or internet, ask a friend and/or healthcare provider?		
Themes (% of parents endorsing themes)	Codes	Quote
a) Would search the App Store or internet (71%)	• Would search App Store Would use Google	"I'd probably search the App Store and I would Google "kids sleeping app" and see what Google recommends"

Themes (% of parents endorsing themes)	Codes	Quote
b) Would look to others for recommendations (36%)	• Would use word of mouth (e.g., friends, professionals, HCPs) • Word of mouth via support groups (e.g., parentings groups, local chat rooms)	*"I'm fortunate to have a large group of healthcare provider friends, so that would probably be my first source of information. If something worked for one of them, I would be really interested to hear what they had tried from their kind of professional but also parent standpoint. I also find that the local chat rooms for parents is a great resource"*
c) Would look to social media or news media (36%)	• Search social media • News media • Newsletters • Public postings	*"I would go on Twitter and search sleep apps for kids and see what's coming up and what's being mentioned."*

Question 3: If the *ABCs of SLEEPING* app was found in your search for sleep apps, would you download it? Why/Why not? What are some things that you take into consideration before doing so (e.g., cost, ratings)?

Themes (% of parents endorsing themes)	Codes	Quote
a) Would download it if found during a search (79%)	• Would download the ABCs app if it was found in their search	*"Yes, I would download the ABCs of SLEEPING"*
b) Checks reviews before downloading (71%)	• Checks reviews and ratings before downloading • More likely to download app with good ratings, written reviews • Parent checks how many downloads the app has	*"I always read the comments to see what people say about it, so if they're like "this was a great app" or if someone says "this particular version isn't good". So mostly looking at the ratings, how many stars it has, how many downloads it has. If it only has like 5 downloads, then you kind of wonder if that's not the best one."*

Themes (% of parents endorsing themes)	Codes	Quote
c) Checks previews/uses trial before downloading (57%)	• Checks previews/what it looks like before downloading • Wants a trial or preview before committing to downloading • Interested to see what the app looks like ahead of time	"If there was a short video, or if there were those slides that you could click through to sort of see sometimes what an app looks like or maybe a trial period, that could be really helpful."

Question 4: What would you find appealing about this app?

Themes (% of parents endorsing themes)	Codes	Quote
a) Provides organized information (57%)	• Information is not overwhelming • Information is organized • Enjoyed the color coding • Filters in what you should work on	"I found that it had a nice way of showing me specifically which things I have to work on and which things I don't have any problems with. There tends to be, let's say one or two on areas of high priority, and then a lot in the middle. It gives me the focused areas to start with, so that's helpful"
b) Provides customized, personalized experience (43%)	• Tips are specific to you • Tips are customized/personalized	"You'll get personalized recommendations and those kinds of things, that's where there's the value in it. This is a personal like sleep plan."

Question 5: What would you find unappealing?

Themes (% of parents endorsing themes)	Codes	Quote
a) Want more customization, personalized experience (57%)	• Want push notifications/reminders to be more personalized • Personalized notifications would increase use of sleep tips	"It would be good to have tailored reminders. Like a reminder that says "hey, make sure that screens are turned off by now" around dinner time"
b) Nothing unappealing (43%)	• Nothing unappealing about the app • Don't see any downsides	"I can't really think of anything that was unappealing."

Question 6: What information is critical to convey to other parents about this app?

Themes (% of parents endorsing themes)	Codes	Quote
a) It is evidence-based (36%)	• Research backed • Evidence-based • A study has been conducted on this app • Associated with a university/research team	*"That it's research backed, and that is has proven results."*

Question 7: What factors do/would you consider during your search? (E.g., Does it look credible? Does it look nice? Does it look at ratings?) Based on your experience with the app, what information is critical to convey to parents about this app?

Themes (% of parents endorsing themes)	Codes	Quote
a) Credibility (79%)	• Trustworthy, reputable, or credible source (e.g., university, research study) • Take into consideration who developed the app • Supported by research • Made by experts	*"It's based out of a university and a research study, so it has some like credentials behind it instead of just some random person or developer telling you how to help your child sleep. So, I think it just lends some credibility to it because there are so many apps and they all kind of look the same. So, I think that that's good."*
b) Security/privacy (36%)	• More likely to download an app if its secure • More likely to download an app if its private • More likely to download an app if it feels safe	*"That there was some sort of level of recognition of privacy... because if I'm starting to put input information on my child and their sleep habits and giving people sort of an insight into our life, like an insight into our daily routines, I kind of just like to keep that as private and secure as I can... I wanna make sure that it's safe"*

Question 8: And how often did you use the ABCs app within the 1-month you had it? Can you describe how you used the app?		
Themes (% of parents endorsing themes)	Codes	Quote
a) Used the *ABCs of SLEEPING* app as recommended (mostly daily use of tips, weekly/bi-weekly check-ins) (100%)	• Used app as recommended (i.e., daily use) • Parents indicated that daily use is or can be feasible • Used app once a week for a check in/or bi-weekly for check-in • Says weekly check-ins feasible/would do check in weekly	*"I think it's feasible. I mean, you probably can't do a report every single day but maybe once a week, or once every two weeks. And then work on the suggestions over that period of time."*

Question 9: As you know, it is important to keep an app up-to-date and available. To do this, there is a cost, and we are trying to figure out the best way to do this. There are three models that exist, there's the 1-year subscription, one-time cost, or having a free basic version with the option to pay to unlock a premium version. What do you think of these options?

Themes (% of parents endorsing themes)	Codes	Quote
a) Prefers free basic with update/upgrade to premium (57%)	• Prefers free basic with update/upgrade to premium • Prefers to have a trial period and then pay	*"I think having the last option. Having like a free basic trial version and then paying for the premium version would probably get a lot of buy in because again people kind of want to see if this is helpful for them before I actually paying for it. So that's how I view it personally. So definitely having the trial, or having the basic version and then on top of that, the premium version would probably be having a better buy in"*
b) A one-time cost preferred (36%)	• One-time cost • One-time low cost	*"For myself personally, I find the one-time fee the most desirable"*

Table 4.7.

HCP Responses Regarding Integration of The ABCs of SLEEPING App

Question 1: At what stage of trying to help a patient/client sleep better do you think apps would be best suited (e.g., before trying more intensive approaches like specific behavioural interventions or medication)?		
Themes (% of HCPs endorsing themes)	Codes	Quote
a) Best as a first-line treatment (89%)	• Best used as a first-line treatment before more intensive approaches • ABCs should be used before medications • A good resource to use as a family waits to see a specialist	*"If sleep hygiene recommendation was sufficient for the family, I would try recommending this first, and certainly before medication"*
Question 2: What approach do you/would you take while searching for an app like the *ABCs of SLEEPING*? Where do you look? Do you search the app store and/or internet? Ask a colleague?		
Themes (% of HCPs endorsing themes)	Codes	Quote
a) Search for apps by consulting with colleagues (58%)	• Ask colleagues about apps they've used/recommended • Listen for app recommendations at conferences from expert speakers	*"As a healthcare professional, I would reach out to a colleague who is an expert in the area, and consult with them to see if they have any recommendations"*
b) Search reliable Internet sources for apps (53%)	• Google Scholar search • PubMed search • Credible healthcare websites	*"I follow different institutions like CAMH, SickKids… like different websites that send out news information, so I would keep my eye out for news about new apps that way"*
c) App Store search (42%)	• Search App store for apps	*"I would search the App Store as a first step"*

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Question 3: If the _ABCs of SLEEPING_ was found in your search for sleep apps, would you download it? Why/why not? What are some things that you take into consideration before recommending the app (e.g., cost, ratings)?

Themes (% of parents endorsing themes)	Codes	Quote
a) Affordability (95%)	• Considers cost before recommending • Less likely to recommend apps with in-app purchases • Prefers free apps	_"I will be much more hesitant of apps with in-app purchases. I'll still download those with in-app purchases, but I'll take a look at what people can access for free, because I'm cognisant that cost can be a barrier to some people"_
b) Must complete review/investigation of app before recommending (79%)	• Would download app and review before recommending • Carefully examines resources before recommending them • Examines ratings	_"I would want to try out an app before recommending and see if I liked the functionality of it. I'd use some sort of trial or look into recent reviews to see if people like it and see if it'll be sufficient"_
c) Credibility (79%)	• Credibility of the app is important when deciding to download the app • Does the app look affiliated with a university or hospital-based program • Need to verify that the app is evidence-based	_"I would want to know the details of who developed the app. So, was the app developed through a university? Was it peer-reviewed? Things like that would make me feel more convinced"_
d) Would download the _ABCs of SLEEPING_ app if found during a search (63%)	• Would download ABCs	_"I mean, of course! And I have!"_
e) Aesthetics (42%)	• Looks of the app matter • Graphics/presentation of the app	_"I think a professional appearance would play a role. It's not that it alone would make me inclined to download it, but if it looked haphazard, I might be disinclined to download it"_

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Question 4: What did you find appealing about this app?

Themes (% of parents endorsing themes)	Codes	Quote
a) Easy to use (42%)	• ABCs is easy to use • Runs smoothly • Easy to navigate • User friendly	*"It's very nice, and operates nicely, like it runs smoothly and efficiently"*
b) Aesthetics (37%)	• Liked how the ABCs app looked	*"I found the layout was attractive. It was bright, and the colours were really nice"*

Question 5: What did you find unappealing about this app?

Themes (% of parents endorsing themes)	Codes	Quote
a) Some features to be adjusted (42%)	• Would like to have the option to share/receive data • Decrease length of the check-in	*"It would be nice to have data. That would be really helpful when working with the family. If there was a way to have the parent send me the information, that would be a great feature to add"*

Question 6: Based on what you have seen with the app, what information is critical to convey to parents about this app?

Themes (% of parents endorsing themes)	Codes	Quote
a) It is an evidence-based helpful resource (47%)	• It is critical to convey that the ABCs app is evidence-based • ABCs is a helpful resource for families • ABCs is a helpful resource for HCPs	*"It's very credible and highly evidence-based, that's a huge factor that I would emphasize"*
b) It takes time and consistency to see improved sleep (42%)	• Critical to convey that it takes time to see changes • Critical to convey that it takes consistency to see changes	*"I think conveying to parents that there's no immediate fixes when working towards these changes…and that they need to have faith in the process and consistency in terms of implementing it"*

Question 7: What factors do/would you consider during your search? (E.g., Does it look nice? Does it look credible? Do you look at ratings?)		
Themes (% of parents endorsing themes)	**Codes**	**Quote**
a) Credibility (79%)	• App is associated with an academic organization • Research-based • Evidence-based • Credibility importance	*"I would want verification of its efficacy or evidence, or whether the resource had some validity to it. There's a lot out there, and it's important to know which resources have evidence to support use"*

Question 8: From your perspective, would recommending the use of the *ABCs of SLEEPING* everyday be feasible for families?		
Themes (% of parents endorsing themes)	**Codes**	**Quote**
a) Daily use of sleep tips and weekly check-ins is feasible (58%)	• Daily/regular use would be feasible • Believes that patients/clients would use the app as recommended	*"I think it's feasible to use everyday, I think just remembering to do it"*
b) Daily/consistent use depends on the family (53%)	• Depends on family's motivation • Depends on current stressors family may be experiencing	*"It depends on each family. Some patients are ready to make continuous, sustained change, and other patients may not be there yet"*

Question 9: As you know, it is important to keep an app up-to-date and available. To do this, there is a cost, and we are trying to figure out the best way to do this. There are three models that exist, there's the 1-year subscription, one-time cost, or having a free basic version with the option to pay to unlock a premium version. What do you think of these options?		
Themes (% of parents endorsing themes)	**Codes**	**Quote**
a) Free version with pay to unlock premium preferred (47%)	• Prefer free version with pay to upgrade • Okay with pay to upgrade to premium from a basic version	*"My preference is the free basic version. It allows families to see the app and it gives them a chance to do a trial first and then if they really like it, they can upgrade"*
b) One-time cost option preferred (47%)	• Prefers one-time cost option	*"I'm kind of a fan of upfront cost because, depending on how much it is, you don't need to renew every year"*

Table 4.8.

Parental Responses Regarding the Practicality of The ABCs of SLEEPING Smartphone App

Question 1: What barriers do you see getting in the way of using the *ABCs of SLEEPING* app?		
Themes (% of parents endorsing themes)	Codes	Quote
a) Affordability (86%)	- Would download if free/low cost - Cost as a barrier - Low SES impacting ability to use tips/low access to technology - High cost could deter from downloading - Apps are low cost compared to face-to-face treatment	*"The other options of seeing someone face-to-face can cost money like quite a bit of money that might not be accessible to most families… I don't know if there will be a cost to the ABCs app when it comes out, but I would suggest it to be like a lower cost."*
b) Busy schedules/time (79%)	- It's hard to make time/busy schedule - Lack of time to look for apps - Busy schedules as a barrier	*"Umm, mainly that I'm very busy and it's hard to take the time to prioritize working on sleep or using the sleeping app"*
c) Daily stressors, demands on parents, other psycho-social factors (79%)	- There's a lot of demands parents deal with (e.g., if they have more than one child, parenting difficulties) - Daily stressors and distractions as a barrier - Not having motivation	*"For example, like sports and activities and things like that that draw me away, their siblings, if I'm not home when this particular child's going to sleep, which then would make it hard for me to accurately record information in the app"*
d) Awareness of app (50%)	People not knowing about the app/not being able to find it as a potential barrier	*"Finding it would be the first one. Obviously, there would need to be some sort of push for advertisement and I'm not sure how that happens. I really think that would be a big one, is just having knowledge about the app.*

Question 1: What barriers do you see getting in the way of using the *ABCs of SLEEPING* app?

Themes (% of parents endorsing themes)	Codes	Quote
e) Forgetting to use the app (50%)	• Forgetting to use the app • Need to have reminders • Remembering to use it	*"Uh remembering is a big one. I always start with the best intentions and then life gets in the way and you kind of forget."*

Question 2: What facilitators do you see aiding the use of the *ABCs of SLEEPING* app?

Themes (% of parents endorsing themes)	Codes	Quote
a) User-friendly (86%)	• Easy to use • User-friendly • Simple and concise • Simple to navigate	*"Yeah, I find that it was easy enough to do every day. It's quick, the points are concise so it's easy to read, and you don't have to really dedicate a lot of time to using it. It was easy to navigate"*
b) From a credible source (50%)	• Associated with a university • Based in research/is being evaluated • Was made by sleep experts	*"it's really important to know that it's coming from a research team, and it isn't coming from someplace... or someone random"*

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Table 4.9.

HCP Responses Regarding the Practicality of The ABCs of SLEEPING Smartphone App

Question 1: Are there any factors that would make it hard for you to recommend a smartphone app (i.e., barriers)?		
Themes (% of parents endorsing themes)	Codes	Quote
a) Accessibility (53%)	• Cost for families as a barrier • Technology accessibility needed to use ABCs • Language barriers (if non-English speaking) • Cultural differences	*"Even in 2023 some families don't have access to smartphones, so that would be a barrier, not having access to the technology they need to use the app"* *"It might be difficult to use this app if you're non-English speaking or if English is your second language"*
b) Some families will need more support (32%)	• Some families will need more intensive treatment • App is not the best fit for all families	*"Sleep is multifactorial, and for some families they will need more than what an app can offer"*
Question 2: Are there any factors that make it easy for you to recommend a smartphone application (i.e., facilitators)?		
Themes (% of parents endorsing themes)	Codes	Quote
a) If family is technologically savvy (47%)	• Families who have needed technology • Families who use apps regularly	*"I would be more likely to recommend an app if I hear from the parent that they're used apps before and have found them helpful, really knowing that they can navigate that kind of resource"*
b) If family is ready for change (50%)	• No obvious current stressors precluding family from engaging in treatment • Family is motivated/ready for sleep change	*"It can be overwhelming to start a new program for those parents that are already overwhelmed, so I would really be thinking about what other types of stressors are going on for the family"*

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Table 4.10.

Matrix Analysis for Demand

Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
Question 1: Do you think the *ABCs of SLEEPING* app should be available as an app for parents? Why?			
a) Need for the mHealth sleep resources	Need for sleep apps as a resource (86%)	Sleep problems are a common concern that needs to be addressed (47%)	Partial Agreement • What was similarly expressed between parents and HCPs was a need. From the parents' perspective they expressed a specific need for a resource like the *ABCs of SLEEPING*, and the HCPs expressed that the sleep problems themselves need to be addressed. • In terms of prominence, parent group theme had medium prominence and HCP group had high prominence.
b) The *ABCs of SLEEPING* should be available because it has good sleep information	Good features and sleep information (86%)	Asks relevant sleep question and provides good sleep information (68%)	Agreement • Both groups brought up that the *ABCs of SLEEPING* has good sleep information when asked why they believe the app should be available to parents. • Both themes had high prominence in both groups.
N/A	Good appearance (64%)	N/A	Silence • The parent group endorsed that the *ABCs of SLEEPING* has a good appearance. • This theme was not present for HCPs. Prominence was high among the parent participants.

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Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	

Question 2: What type of demand is there for this app, who would want to use it?

Metathemes	Parent	HCP	Agreement Level
N/A	Parents with younger children would want to use it (86%) Parents with children struggling with sleep would want to use it (43%)	Helpful for a wide range of people (79%)	Dissonance • The themes endorsed by the parent group are much more specific about what group the *ABCs of SLEEPING* app would be helpful for while the HCP group were much broader. • Prominence was approximately the same as there was one high prominence theme identified for the parent group. One parent theme was medium prominence.

Question 3: Do you see any benefits/ "pros" of using/recommending the *ABCs of SLEEPING* app when compared to other ways to receive treatment (e.g., face-to-face)?

Metathemes	Parent	HCP	Agreement Level
The *ABCs of SLEEPING* is accessible	Accessible (79%)	Accessible (58%)	Partial agreement • Both groups discussed the same benefit of the *ABCs of SLEEPING* being its accessibility. • The prominence of this theme for parents was high, while it was medium for HCPs.
The *ABCs of SLEEPING* does not have wait times	No wait-times (36%)	Helps address wait times (pro) (42%)	Agreement • Both groups discussed the same benefit of the *ABCs of SLEEPING* being that it does not have wait times. • The prominence of this theme was medium for both groups.

Question 4: Do you see any downsides/ "cons" of using/recommending the *ABCs of SLEEPING* app when compared to other ways to receive treatment (e.g., face-to-face)?

Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
The *ABCs of SLEEPING* cannot offer the same support that face-to-face can (e.g., validation, clarification)	Does not have the same type of support face-to-face treatment can offer (50%)	Apps are missing the support, clarification, and validation that face-to-face offers (47%)	Agreement • Both groups discussed that the *ABCs of SLEEPING* downside compared to face-to-face treatment is that it cannot offer the same level of support. • Both groups had medium prominence for these themes.
N/A	Does not work for those who need more intensive sleep treatment (50%)	N/A	Silence • The parent group brought up that a more intensive treatment may be needed for some families, which the *ABCs of SLEEPING* cannot provide. • Prominence was medium among parent participants.

Note. Themes excluded from the analyses were those that the other participant could not speak to (e.g., specifically: experience using the app from the parent role, or HCP discusses a work-related practice). >60% = high prominence, 40-59% = medium prominence, and 30-39% = low prominence. Agreement level definitions: agreement describes full agreement on meaning and prominence, partial agreement is agreement on one both not both meaning and prominence, silence describes a theme endorsed by one group but not the other (parent *vs.* HCP), and dissonance was opposing themes between groups that differed on meaning and prominence; **List of demand themes excluded as it was parents speaking about their experience using the app:** (1) the *ABCs of SLEEPING* should be available as it helped child's sleep, sleep habits, is helpful and (2) *ABCs* is self-paced

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Table 4.11.

Matrix Analysis for Integration

Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
Question 1: At what stage of trying to help a child sleep better do you think this app would be best suited (e.g., before seeking out face-to-face intervention)?			
The *ABCs of SLEEPING* is best suited as a first step before face-to-face treatment	Best suited as a first-step tool (71%)	Best as a first-line treatment (89%)	Agreement • Both groups answered that the *ABCs of SLEEPING* app would be best as a first step before seeking out face-to-face treatment. • Both themes had high prominence in both groups.
N/A	Prevention tool (43%)	N/A	Silence • The parent group discussed the *ABCs of SLEEPING* app as being a prevention tool. This was not a theme brought up by the HCP group. • Prominence was medium among parent participants.
Question 2: What approach do/would you take while searching for an app like the *ABCs of SLEEPING*? (E.g., Where do you look? Do you search the App Store and/or internet, ask a friend/healthcare provider?			
Would look to others to find smartphone app recommendations	Would look to others for recommendations (36%)	Search for apps by consulting with colleagues (58%)	Partial Agreement • When asked what approach they would take when searching for an app like the *ABCs of SLEEPING*, both groups discussed consulting others about recommendations for smartphone apps. • Prominence differed where the parent group had low prominence, and there was medium prominence for the HCP group.

Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
Would search the App Store for an app like the *ABCs of SLEEPING*	Would search the App Store or internet (71%)	App Store search (42%)	Partial Agreement • When asked what approach they would take when searching for an app like the *ABCs of SLEEPING*, both groups indicated they would search the App Store. • Parent group's theme had high prominence and HCP group's theme had medium prominence.
N/A	Would look to social media or news media (36%)	Search reliable Internet sources for apps (53%)	Dissonance • Both groups said they would search online platforms when searching for an app like the *ABCs of SLEEPING*, but those listed were differed. HCPs discussed the importance of the source being reliable, listing academic sources that parents may or may not have full access to (e.g., PubMed, Google Scholar). News and social media were not brought up by the HCP group. • Prominence was low for the parent group and medium for the HCP group
Question 3: If the *ABCs of SLEEPING* was found in your search for sleep apps, would you download it? Why/why not? What are some things that you take into consideration before downloading/recommending the app (e.g., cost, ratings)?			
Would need to complete a review before downloading an app	Checks reviews before downloading (71%) Checks previews/ uses trial before downloading (57%)	Must complete review/investigation of app before recommending (79%)	Agreement • Both groups discussed the importance of learning more about an app through a review of it before downloading. • Both groups reported these themes with high prominence.

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| Metathemes | Participant Group Themes | | Agreement Level |
	Parent	HCP	
N/A	N/A	Affordability (95%) Credibility (79%) Aesthetics (42%)	Silence • When asked about things they would take into consideration before downloading/recommending the app, three themes came up for the HCP group that did not come up for the parent group. These related to considering the affordability, credibility, and the aesthetics of the app before recommending. • Prominence was high for HCP group themes
Would download the *ABCs of SLEEPING* app if found during a search	Would download the *ABCs of SLEEPING* app if found during a search (79%)	Would download the *ABCs of SLEEPING* app if found during a search (63%)	Agreement • Both groups indicated that they would download the *ABCs of SLEEPING* if it was found during a search for a sleep resource. • Prominence of the themes were high for both groups
Question 4: What would you find appealing about this app?			
N/A	Provides organized information (57%) Provides customized, personalized experience (43%)	Easy to use (42%) Aesthetics (37%)	Dissonance • When asked what was found to be appealing about the *ABCs of SLEEPING* app, both groups identified unique themes that did not overlap in meaning. Parents identified organized information and the customized, personalized experience as qualities most appealing. HCPs identified easy to use and the aesthetics as being most appealing. • Prominence was medium for the parent group and low to medium for the HCP group.

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Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
Question 5: What would you find unappealing?			
Suggested adjustments to the *ABCs of SLEEPING*	Want more customization, personalized experience (57%)	Some features to be adjusted (42%)	Partial Agreement • When asked what was found to be unappealing about the *ABCs of SLEEPING* app, there was some overlap in meaning in the themes identified. Both groups discussed adjustments. The parent group only discussed wanting the experience to be more personalized, while the HCP group discussed specific features that could be adjusted. • Prominence of the themes was medium for both groups
N/A	Nothing unappealing (43%)	N/A	Silence • Only the parent group had participants who identified that there was nothing unappealing about the *ABCs of SLEEPING* app. • Prominence was medium among parent participants.
Question 6: Based on what you have seen with the app, what information is critical to convey to parents about this app?			
The *ABCs of SLEEPING* has credibility	It is evidence-based (36%)	It is an evidence-based helpful resource (47%)	Partial Agreement • When asked what was critical to convey to parents about the *ABCs of SLEEPING* app, both groups identified its credibility. • Prominence was medium for the HCP group and low for the parent group.

Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
N/A	N/A	It takes time and consistency to see improved sleep (42%)	Silence • When asked what was critical to convey to parents/other parents about the *ABCs of SLEEPING* app, only the HCP group identified that it is critical to convey that it takes time and consistency to see improved sleep. • Prominence was medium among HCP participants.

Question 7: What factors do/would you consider during your search? (E.g., Does it look nice? Does it look credible? Do you look at ratings?) Based on your experience with the app, what information is critical to convey to parents about this app?

Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
It is important for an app to have credibility	Credibility (79%)	Credibility (79%)	Agreement • When asked what factors the groups would consider during their search for an app like the *ABCs of SLEEPING*, they both indicated credibility as being important. • Prominence of the themes was high for both groups
N/A	Security/privacy (36%)	N/A	Silence • When asked what factors the groups would consider during their search for an app like the *ABCs of SLEEPING*, only the parent group identified security and privacy of the app as being an important factor. • Prominence was low for parent participants.

Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
Question 8: As you know, it is important to keep an app up-to-date and available. To do this, there is a cost, and we are trying to figure out the best way to do this. There are three models that exist, there's the 1-year subscription, one-time cost, or having a free basic version with the option to pay to unlock a premium version. What do you think of these options?			
Preference for a free basic version with the option to upgrade	Prefers free basic with update/upgrade to premium (57%)	Free version with pay to unlock premium preferred (47%)	Agreement • Both groups expressed a preference for a free basic version with the option to upgrade to a premium version. • Both groups endorsed this theme with medium prominence
Preference for one-time cost	A one-time cost preferred (36%)	One-time cost option preferred (47%)	Partial Agreement • Both groups expressed a preference for a one-time cost option. • One-time cost option was more preferred by the HCP group with medium prominence, compared to the parent group having low prominence.

Note. Themes excluded from the analyses were those that the other participant could not speak to (e.g., specifically: experience using the app from the parent role, or HCP discusses a work-related practice). >60% = high prominence, 40-59% = medium prominence, and 30-39% = low prominence. Agreement level definitions: agreement describes full agreement on meaning and prominence, partial agreement is agreement on one both not both meaning and prominence, silence describes a theme endorsed by one group but not the other (parent vs. HCP), and dissonance was opposing themes between groups that differed on meaning and prominence; **List of integration themes excluded:** (1) used the *ABCs of SLEEPING* app as recommended (mostly daily use of tips, weekly/bi-weekly check-ins), (2) daily use of sleep tips and weekly check-ins is feasible, and (3) daily/consistent use depends on the family

Table 4.12.

Matrix Analysis for Practicality

Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
Question 1: What barriers do you see getting in the way of using/recommending the *ABCs of SLEEPING* app?			
Accessibility as a potential barrier	Affordability (86%)	Accessibility (53%)	Partial Agreement • When asked what barriers they see in getting in the way of using/recommending the *ABCs of SLEEPING* app, both groups indicated accessibility as a barrier. HCPs identified accessibility more broadly, while the parent group more specifically identified cost, which is a type of accessibility barrier. • Prominence differed with it being high in the parent group, and medium in the HCP group.
N/A	Busy schedules/time (79%) Daily stressors, demands on parents, other psycho-social factors (79%) Awareness of app (50%) Forgetting to use the app (50%)	N/A	Silence • When asked what barriers they see in getting in the way of using/recommending the *ABCs of SLEEPING* app, these are themes that the parent group endorsed with no overlap with the HCP group. • Prominence was high for parent participants indicating "busy schedules" and "daily stressors", and medium for those indicating "awareness" and "forgetting to use app" as barriers.

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Metathemes	Participant Group Themes		Agreement Level
	Parent	HCP	
Question 2: What facilitators do you see aiding the use/recommendation of the *ABCs of SLEEPING* app?			
N/A	User-friendly (86%) From a credible source (50%)	N/A	Silence ● When asked what facilitators they see in aiding the use/recommendation of the *ABCs of SLEEPING* app, these are themes that the parent group endorsed with no overlap with the HCP group. ● Prominence was high for parent participants indicating the intervention to be "user-friendly", and medium for parent participants indicating the intervention to be "a credible source".
N/A	N/A	If family is technologically savvy (47%) If family is ready for change (50%)	Silence ● When asked what facilitators they see in aiding the use/recommendation of the *ABCs of SLEEPING* app, these are themes that the HCP group endorsed with no overlap with the parent group. ● Prominence for parent participants was medium.

Note. Themes excluded from the analyses were those that the other participant could not speak to (e.g., specifically: experience using the app from the parent role, or HCP discusses a work-related practice). >60% = high prominence, 40-59% = medium prominence, and 30-39% = low prominence. Agreement level definitions: agreement describes full agreement on meaning and prominence, partial agreement is agreement on one both not both meaning and prominence, silence describes a theme endorsed by one group but not the other (parent vs. HCP), and dissonance was opposing themes between groups that differed on meaning and prominence. **No themes were excluded for practicality.**

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Chapter 5: Discussion

In this chapter, I will summarize the main findings of each study as they relate to the objectives of the dissertation. Next, I will discuss the theoretical considerations, followed by strengths and limitations of the research. Following this, the clinical implications and the directions for future research are discussed. Last, I will provide overall conclusions of this dissertation.

Overview of Findings

The *ABCs of SLEEPING* is a mobile health (mHealth) intervention that was designed to provide evidence-based information about healthy sleep practices to parents of school-age children ages 6 to 12 years with insomnia symptoms. The goal of the current dissertation was to refine and evaluate the *ABCs of SLEEPING* using end-user feedback through research studies guided by Bowen et al.'s (2009) feasibility framework.

This dissertation was composed of three studies that each had the objective to examine relevant areas of feasibility (i.e., acceptability, fidelity, preliminary effectiveness, demand, integration, and practicality; Bowen et al., 2009) and an additional area outside of this framework, familiarity. The Bowen et al. (2009) framework has three design options (i.e., 'can it work?', 'does it work?', and 'will it work?). Study 1 utilized the 'can it work?' design option and examined the intervention's acceptability (i.e., satisfaction and suitability), fidelity (i.e., was the intervention being used as intended, which is daily use of the sleep tips), and preliminary effectiveness (i.e., is there evidence that the intervention may improve healthy sleep practices and insomnia symptom severity). Information gathered in Study 1 was used to modify the *ABCs of SLEEPING* app, and this modified program was further evaluated in the second and third dissertation studies. Study 2 utilized

a 'does it work?' approach in which a pilot randomized controlled trial (RCT) was conducted to collect data to inform a future full-scale RCT (e.g., sample size calculation), and to examine preliminary effectiveness of the revised intervention. Study 3 utilized a 'will it work?' approach, examining the perspectives of parents and HCPs on how the app might be implemented. This study explored end-users' familiarity with apps like the *ABCs of SLEEPING* and mHealth generally, demand for the intervention, how it can be searched for and used (integration), and barriers and facilitators to using the *ABCs of SLEEPING* intervention (practicality). The three objectives of the dissertation and how each was addressed across the three dissertation studies are described below.

Objective 1: Conduct a feasibility study

This first objective was addressed in Study 1 (Chapter 2). We examined acceptability (i.e., parent ratings of satisfaction with, and suitability of the *ABCs of SLEEPING* intervention), fidelity (i.e., parents use of the sleep tips), and preliminary effectiveness (i.e., changes pre- to post-test in parent-reported sleep data). The findings were that parents found the *ABCs of SLEEPING* intervention to be acceptable as most parents found the three components of the *ABCs of SLEEPING* to be satisfying and suitable. The intervention's sleep tips were not used with high fidelity. Parents reported that they used the sleep tips only three out of seven days a week, whereas the expected level of fidelity was to use these daily. Additionally, evidence of preliminary effectiveness was found, with parents reporting improved sleep habits and insomnia symptom severity in their children from pre- to post-test, although post-test scores remained clinically elevated. Qualitative data from most parents highlighted that the *ABCs of SLEEPING* intervention was easy to understand and use, well-organized, reinforced good sleep habits, and provided

appropriate recommendations. However, a minority of parents felt the intervention was not suitable for their children and found the sleep tips hard to implement.

Consistent with user-centered design (Lyon & Koerner, 2016), qualitative feedback from users provided direction on modifications to address acceptability and fidelity concerns. First, a reminder feature was added (i.e., pop-up reminders to use the sleep tips) to address parent feedback that indicated they would forget to use the sleep tips. Parents also provided feedback that the *ABCs of SLEEPING* app identified too many areas to work on and found it overwhelming. They indicated a need for support to prioritize areas to work on. As such, a to-do list feature (i.e., a list the user creates with sleep tips they want to implement) was added. Last, parents wanted the information in the sleep tips to be more specific, but also found the information to be overwhelming. To address this, links to reliable resources (e.g., healthychildren.org) were added for those needing more specific information. These modifications to the *ABCs of SLEEPING* intervention were made prior to conducting Studies 2 and 3.

Objective 2: Conduct a pilot RCT

We next conducted a pilot RCT using Bowen et al.'s (2009) 'does it work' approach (Study 2, Chapter 3). In this study, our first objective was to collect feasibility data (i.e., recruitment potential, participant retention, and dropout rate) to inform a future full-scale RCT (sample size estimation). Our second objective was to examine preliminary effectiveness of the modified intervention with increased experimental control (waitlist control group; controlled for sleep medication) comparing change from baseline to follow-up (4 weeks after randomization). Recruitment rate was 70%, dropout rate was 30%. A priori power analysis revealed that to achieve a medium effect size (0.31), a full-scale RCT

would require 82 participants (41 per group), therefore 118 participants would need to be recruited given the dropout rate identified.

For preliminary effectiveness, we found statistically significant improvements in children's parent-reported weekday bedtime routines, sleep habits, insomnia severity, and behavioural functioning from baseline to follow-up in our treatment group relative to our waitlist control group. Mean post-intervention scores for clinical levels of symptoms for sleep and behavioural functioning were at the clinical cut-off for our treatment group. No changes were found based on actigraphy data (i.e., sleep efficiency [SEF] or sleep onset latency [SOL]) from baseline to follow-up.

These preliminary effectiveness results are similar to the findings of Study 1, which gives more support to the possible effectiveness of this intervention, albeit the intervention did not normalize children's sleep or daytime behaviour in either study. These findings are consistent with research evaluating mHealth for sleep disorders and sleep quality, which generally find improvements in sleep following intervention use, and behavioural functioning improvements are a common finding among RCTs aimed at improving insomnia (Shin et al., 2017; Hiscock et al., 2011). Also, in line with previous research, only weekday sleep habits were reported to improve in consistency (Sun et al., 2019; Chien et al., 2019). Objective sleep data did not map onto our subjective sleep data findings, which is consistent with most research comparing subjective and objective sleep data in which the two types of measures are often unrelated (Arora et al., 2013; Girschik et al., 2012; Silva et al., 2007; Benz et al., 2022).

Objective 3: Conduct an implementation barriers and facilitators study

Last, we conducted a qualitative study to examine potential implementation of the *ABCs of SLEEPING* app (Study 3, Chapter 4). Using Bowen et al.'s (2009) 'will it work' approach, Study 3 evaluated familiarity (i.e., how familiar the parents and healthcare providers (HCPs) are with smartphone apps in general and those that support sleep in children), demand (i.e., need for, and/or degree to which the target population would want/use the intervention), integration (i.e., how parents and HCPs would search for the intervention), and practicality (i.e., barriers and facilitators to intervention use).

Parents and HCPs used or recommended self-help apps generally, but the use and recommendation of sleep apps was limited. Our HCP participants did not recommend sleep apps due to uncertainty about suitability of the apps or because mHealth for sleep did not fit within their current practices. Parents and HCPs reported strong demand for the intervention, with both groups noting a need for a resource like the *ABCs of SLEEPING* intervention. In terms of who might be the target audience for the intervention, parent participants noted parents of younger children, while HCP participants responses were broader (i.e., the intervention being helpful for a wide range of people). Integration data (i.e., how the intervention is searched for/used) provided insight into preferred cost models (i.e., findings) and how end-users would search for a resource like the *ABCs of SLEEPING* (e.g., asking others). Both groups emphasized the importance of factors such as credibility (e.g., evidence-based, associated with research/university) when finding an intervention. Barriers and facilitators were also identified by both groups. Those noted were consistent with ones commonly referenced in the literature (Tan-MacNeill et al., 2020; Billings et al.,

2021; Paterson et al., 2019; Roberts & Ulmer, 2024; Stinson et al., 2006; Boerner et al., 2013).

Overall, our results further support the need for interventions to help bridge the evidence-to-practice gap that exists for insomnia treatment for school-age children. There was a clear need for mHealth sleep resources like the *ABCs of SLEEPING* intervention, but currently HCPs do not feel confident in recommending any of the existing apps. Having information about potential implementation (e.g., barriers and facilitators) is important in order to move forward with disseminating the *ABCs of SLEEPING* intervention, which has the potential to bridge the gap by being an accessible evidence-based intervention. However, research has demonstrated that interventions being established as effective is not sufficient to ensure that they are adopted into practice and may not be if needs and desire of the target population are not considered (King et al., 2020; Huijg et al., 2013). As such, the *ABCs of SLEEPING* implementation should be evaluated to ensure its success.

Theoretical Considerations

In this section the theoretical considerations of this dissertation are discussed. User-centered design, Bowen et al.'s (2009) framework, and the evidence-to-practice gap are reviewed, including their strengths and limitations within this program of research.

The User-Centered Approach

This dissertation was based on user-centered theory, which posits that inclusion of representatives of an intervention or program's intended audience ensures increased positive impact and relevancy of an intervention (Still & Crane, 2017; Pratt & Nunes, 2012). According to this theory, it is likely that our user-centered approach contributes to

the positive qualitative feedback received and improved quantitative outcomes noted following use of the *ABCs of SLEEPING* intervention in Studies 1 to 3.

Our user-centered approach specifically involved collecting qualitative and quantitative data in order to inform changes to the *ABCs of SLEEPING* intervention's content, features, and aesthetics. Following usability study user-centered feedback (a study that is not part of this dissertation; Howlett et al., 2020) the *ABCs of SLEEPING* intervention was updated to an mHealth format (e.g., addressing feedback about wanting app components centralized), the content was updated (e.g., age-specific information was included, information was refined to be more concise to address participants indicating overwhelm), and the aesthetics (e.g., more colourful). Further feedback was identified from the feasibility study (Study 1) via modifications to the features (e.g., adding reminder to-do list features, colour coding to indicate what area to work on first), and content (e.g., further resources added to the sleep tips). Study 3 also identified modifications to the program that should be addressed in the future to meet the needs of HCP end-users (e.g., parent-to-HCP data-sharing feature). For a summary of all feedback and modifications, see Table 5.1. For a timeline of the development and evaluation of the *ABCs of SLEEPING* app, see Figure 5.1.

A systematic review by Chandran et al. (2020) included twenty studies using a user-centered approach to enhance operations within a healthcare context (e.g., usability and acceptability research with frontline HCPs) with results indicating the user-centered approach to have positive impacts, such as reduced financial costs and treatment errors, for healthcare systems. It is likely that the positive feedback about the app received in Studies 1 to 3 was the result of using user-centered approach to modify the program to meet the

needs of end-users. For example, some parents reported the *ABCs of SLEEPING* app to be personalized, a quality identified as desirable in other interventions (Ledel Solem et al., 2020). Parents and HCPs both noted the *ABCs of SLEEPING* app to provide good sleep information. This may have been due to new features (i.e., reminder and to-do list features) and editing content (i.e., age-specific information, additional resources) in response to parent feedback.

Table 5.1.

End-user Feedback Informing ABCs of SLEEPING Modifications

Study	Feedback		Modifications
	Parent	HCP	
Systematic Review (Allen et al., 2016)	N/A	N/A	• Hierarchy established for recommendations based on evidence within healthy sleep practice areas • Intervention developed for ages 1 to 12 years
Usability Study (Howlett et al., 2020)	• Centralize the sleep check in, report, and tips • Need to know what sleep tip areas to prioritize • Reduce amount of information as overwhelming • Include more age-specific information • Include more information about night wakings	• Add feature for HCPs to receive data from the parent users (e.g., their sleep report or responses to a check-in) • Consider how to provide more support to families that require it	• All components of intervention (sleep check-in, report, and tips) centralized into a smartphone application • Healthy sleep practice areas were colour coded and a star-system implemented into sleep report to let parents know what sleep tip areas to prioritize using hierarchy based on the

Study	Feedback		Modifications
	Parent	HCP	
Usability Study (Howlett et al., 2020)	• Include areas for parents to write comments • Enhance visual look & feel of the app by adding more colour • Make more personalized • Include "frequently asked questions" section		evidence from the systematic review • Sleep tips edited to be more concise and age-specific (i.e., school-age children) • Open textbox fields included in sleep check-in • Night waking information included • Colour added through intervention • An "about the program" tab included
Feasibility Study (Jemcov et al., 2021)	• Sleep tips require refinement (i.e., more specific information) • Too much to implement (i.e., more prioritization needed) Reminders needed to use sleep tips	N/A	• A to-do list feature was added so parents may create a list of sleep tips to work on • A reminder feature was added as a pop-up notification that parents could enable if required • Sleep tips were further refined (e.g., adding links to outside resources)
Implementation Barriers and Facilitators Study	• App should be available to the public • If not available to the public, then a one-time cost model is preferred or free basic version of the app with pay to upgrade • More support may be needed for some families	• One-time cost model preferred or free basic version of the app with pay to upgrade • Add feature so parent can send to the HCP data from check-in to inform assessment and treatment planning • Some families may need more support	N/A

Figure 5.1.

Timeline of the Development and Evaluation of the ABCs of SLEEPING

Intervention Development Timeline

2013 ▷▷▷▷▷ 2024

Bessey et al. (2013)
ABCs of SLEEPING menmonic created for clinical use

Allen et al. (2016)
Systematic review completed. Evidence for *ABCs of SLEEPING* healthy sleep practice areas established.

Howlett et al. (2019)
Usability study completed. Feedback collected from end-users to inform modifications.

Jemcov et al. (2021)
Feasibility study completed. Feedback collected from end-users to inform modifications.

Jemcov et al. (2024)
Pilot RCT and implementation barriers & facilitators study conducted. Next step identified: hybrid effectiveness-implementation study

2014-2016
Idea to create an intervention. Next step identified: evaluate level of evidence for each area of the mnemonic.

2016-2019
The *ABCs of SLEEPING* intervention created to have three components: questionnaire, sleep report, recommendation handouts. Next step identified: collect end-user feedback.

2019-2020
Feedback used from usability study to adapt the *ABCs of SLEEPING* intervention. Modified based on feedback (e.g., adapted to a smartphone app).

2021 - 2024
Feedback used from feasibility study to adapt the *ABCs of SLEEPING* intervention. Based on feedback (e.g., additional features).

2024 (current)
Adapting intervention to additional populations (i.e., age groups, NDDs), hybrid effectiveness-implementation study

The Bowen Feasibility Framework

The three research studies included in this dissertation were all guided by Bowen's et al. (2009) feasibility framework. Specifically, Bowen's et al. (2009) framework provided a roadmap through which the *ABCs of SLEEPING* app was evaluated comprehensively in order to understand if there was evidence that the intervention might work for the intended population ('can it work?' design), if there was some evidence that the intervention might be effective under actual conditions ('does it work?' design), and if the intervention could be implemented with those end-users that might adopt the intervention as practice ('will it work?' design).

To our knowledge, the *ABCs of SLEEPING* app is the only intervention to have utilized all design options of the Bowen et al. (2009) framework and the majority of their recommended areas of focus (six out of eight). We examined acceptability (e.g., satisfaction ratings with intervention), demand (e.g., need for, and/or degree to which the target population would want/use the intervention), fidelity (e.g., is the intervention being used as the researchers intended. Referred to as 'implementation' in the Bowen et al., 2009 framework), practicality (e.g., barriers or facilitators to using the intervention), integration (e.g., how an intervention can be searched for, or used), and preliminary effectiveness (e.g., examining pre/post changes with limited methodology such as lower statistical power, convenience sample). Adaptation and expansion were two areas of focus not addressed in this dissertation but are areas of interest for future research (please see the future directions for research section of this chapter).

Frameworks have been developed or applied (e.g., Graeme, 2018; Eldrige et al., 2016; Marshall et al., 2013; Ssegawa & Muzinda, 2021) that identify key areas to be examined within a feasibility study (e.g., pilot RCT; Eldrige et al., 2016). Bowen et al. (2009) appears to be most widely used and cited by many researchers examining feasibility (e.g., Huberty et al., 2019; Dorado et al., 2016; Neves et al., 2019). Using Bowen's feasibility framework for this dissertation to evaluate the *ABCs of SLEEPING* app, the key strengths and weaknesses were identified. The key strength relates to planning. Specifically, the framework provides organization and structure to creating a cohesive program of research in preparation for full-scale testing. Specific outcomes have been pre-identified and well-established to be important to evaluate prior to full-scale RCT testing. Conversely, the key weakness was the degree of uncertainty regarding results for critical

areas, such as preliminary effectiveness. Our preliminary effectiveness results from Studies 1 and 2 provide promise for the intervention improving (but not normalizing) children's parent-reported sleep habits, insomnia severity, and behavioural functioning.

The Evidence-to-Practice Gap

The goal of the *ABCs of SLEEPING* app is to create an accessible evidence-based program to bridge the evidence-to-practice gap for treating pediatric insomnia. To that end, it is critical to establish effectiveness and to understand how to ensure implementation success. Implementation science is defined as "the scientific study of methods that promote the systematic uptake of research findings and other evidence-based practices into routine practices to improve the quality and effectiveness of health services and care" (Eccles & Mittman, 2006). This body of research has underscored the importance of examining barriers and facilitators that impact uptake of interventions into clinical use prior to full-scale RCT testing (Bauer & Kirchner, 2020; Landsverk et al., 2012). Given that mHealth is a newer intervention modality, examining barriers and facilitators via feasibility studies is recommended (Luther et al., 2022; Landsverk et al., 2012; Bowen et al., 2009). This can be done by examining "potential implementation" in a real-world setting such as asking about potential barriers and facilitators and what modifications could be made to the intervention to maximize its implementation (Curran et al., 2012).

Our findings from Study 1 (Chapter 2) and Study 3 (Chapter 4) identified key barriers and facilitators from both parents and HCPs. These barriers and facilitators can be used to enhance implementation potential. First, these results may improve adoption of the *ABCs of SLEEPING* app. For example, clinicians' attitudes toward changes in practice (e.g., reservations toward recommending new interventions) have been identified to impact

adoption (Cochrane et al., 2007; Forsner et al., 2010). In line with this literature, results from Study 3 showed that HCP participants expressed uncertainties about recommending sleep apps (i.e., unsure which were appropriate and/or evidence-based) and had reservations about adopting sleep mHealth interventions into their practices. Second, these results suggest the importance of tailoring the *ABCs of SLEEPING* app to unique contexts prior to full-scale testing. For example, parent feedback from Study 1 was that remembering to use the intervention was a barrier, and in response a reminder feature was added. Last, these results can improve resource allocation. For example, barriers and facilitators identified areas that resources can be directed towards such as evaluating different methods to enhance parent and HCP awareness of the intervention (e.g. via social media, local community advertisements, partnerships with community centres/programs).

Having identified barriers and facilitators of implementation through Studies 1 and 3, and preliminary effectiveness in Study 2, the next step in evaluating the *ABCs of SLEEPING* app is to (a) conduct a full-scale RCT in order to determine if the intervention is effective, and (b) conduct an implementation study to ensure translation of the *ABCs of SLEEPING* app from the "lab" to being commercially available for clinical use. Typically, research to practice uptake follows a step-like approach progressing from feasibility/pilot research to effectiveness RCTs, and finally, to an implementation study. Following these steps in research has been argued by some to contribute to slower uptake (Glasgow et al., 2003; March et al., 2005; Tunis et al., 2003). Slower uptake is problematic in the context of the current evidence-to-practice gap for pediatric insomnia treatment. To address this, a rapid approach would be ideal. Curran et al. (2012) proposed blending effectiveness and implementation studies to increase speed of uptake. Curran et al. (2012) describe three

approaches to these hybrid studies: (a) evaluating effectiveness via a RCT and gathering information about potential implementation, (b) examining effectiveness and implementation in a limited manner (e.g., smaller sample sizes, convenience sample) due to limited resources (e.g., funding), and (c) testing an implementation strategy while collecting data on relevant effectiveness outcomes in a full-scale RCT and implementation study. Given that the *ABCs of SLEEPING* app has been prepared for full-scale testing, using the third hybrid effectiveness-implementation approach involving full-scale testing for the *ABCs of SLEEPING* app would be justified.

Strengths and Limitations

First, user-centered feedback was used in a stepped approach when modifying the *ABCs of SLEEPING* app. The feedback was collected directly from end-users – parents who would use the program and HCPs who would recommend the program, and as such we were able to make changes to the program that met with the needs of the end-users. The second strength was that all three studies followed a consistent feasibility framework that was used to organize our research outcomes. This especially assisted the qualitative analytic process as it provided coders with a set of defined areas to examine (i.e., acceptability, fidelity, familiarity, demand, integration, and practicality). The third strength was that both a pilot RCT and a implementation barriers and facilitators study were conducted, which laid a strong foundation for a full-scale hybrid implementation-effectiveness study as a final step in the program's development. The fourth strength was that the *ABCs of SLEEPING* app is novel as currently there are no smartphone app mHealth interventions that deliver evidence-based sleep information to parents of school-age children.

While there were many strengths to the research within this dissertation, there are important limitations to be considered. Three limitations areas were identified. First, there were factors that impacted the generalizability of our results such as a lack of diversity and small sample sizes. With regard to diversity, our parent participants across Studies 1 to 3 were mostly White, well-educated biological mothers, and our HCP participants were also mostly female. Generalizability of the findings is also impacted by all studies having small convenience samples. This limits our ability to draw conclusions about the improvements in healthy sleep practices, insomnia severity, and behavioural functioning. A well-powered full-scale RCT would be required in order to draw firm conclusions about the program's effectiveness. The second key limitation was related to user-centered design. Our HCP end-users were not included in the evaluation of the *ABCs of SLEEPING* app and as such their end-user feedback was not used when making modifications. Additionally, a co-design approach was not used (i.e., involving end-users as active collaborators) when developing the *ABCs of SLEEPING* app. Last, our third key limitation to the research is related to the intervention itself. The *ABCs of SLEEPING* app was designed to address insomnia, but our results suggest that it may be more appropriate for promoting sleep health than treating insomnia (e.g., prevention and/or knowledge mobilizing tool as opposed to an insomnia intervention). This idea is further elaborated upon below.

Clinical Implications

This dissertation focused on the development, evaluation, and future implementation of the *ABCs of SLEEPING* app, and provided the necessary information to conduct the final step in the development of this app – a full-scale hybrid effectiveness-implementation study. If effective and commercially available, the *ABCs of SLEEPING*

app would provide parents with an accessible evidence-based mHealth intervention. While this app was designed for parents of children with insomnia/insomnia symptoms, the pilot RCT findings (Study 2, Chapter 3) suggest that the program may be more appropriate as a sleep health promotion tool to improve sleep in those without a sleep disorder. Although the program resulted in statistically significant improvements in sleep practices and insomnia symptom severity, it is not known if these changes were clinically significant. However, some families qualitatively reported valuing the changes (e.g., families reporting the intervention reinforced good sleep habits). Moreover, parents and HCPs indicated that the program would be best used as a prevention tool, and that parents of children with sleep disorders most likely will require more support than what is provided from the *ABCs of SLEEPING* app. Given the limited nature of the data, these conclusions should be interpreted with caution until further evaluated in a full-scale hybrid effectiveness-implementation study.

If these results hold in a full-scale hybrid effectiveness-implementation study, reframing the *ABCs of SLEEPING* app to be a sleep health promotion tool is a new perspective given the intent of the app would move away from treating insomnia symptoms to providing feedback and sleep tips in order to enhance current sleep health. Sleep health is a relatively new term that has gained increased attention given sleep health shifts away from a deficits-based model focused on identifying and treating sleep problems/disorders (Buysse, 2014). A deficits-based model has been historically used in the literature given that there is utility in identifying and treating sleep disorders (Buysse, 2014). However, a shift has occurred toward a much more strengths-based model of "sleep health" given the absence of sleep problems and symptoms do not alone define healthy sleep (Buysse, 2014).

Sleep health has been defined by Buysse (2014) as a multi-dimensional pattern of sleep-wake that is focused on individual, social, and environmental demands that promote overall well-being. The *ABCs of SLEEPING* app may better serve to promote engagement in healthy sleep practices by increasing accessibility to evidence-based knowledge about healthy sleep practice areas that are all covered by the *ABCs of SLEEPING* mnemonic. There is a lack of resources for sleep health and as such the *ABCs of SLEEPING* app would fill this evidence-to-practice gap.

Last, the results of this research can support the implementation of the *ABCs of SLEEPING* app as a sleep health program for parents and HCPs. Three examples are provided below. First, increasing HCPs' knowledge and awareness of mHealth apps will be important given uncertainties they expressed in Study 3. This may be an important area of focus in future implementation research. Second, the results support the development of more mHealth sleep resources for school-age children in order to address the evidence-to-practice gap (e.g., parents and HCPs reported strong demand). In Study 2, both parents and HCPs believed there was a strong need for additional resources. Third, our results may inform changes to how evidence-based mHealth apps for clinical use are currently displayed in app stores (e.g., include descriptions about the app's credibility, add free trials or previews, update cost models to those preferred).

Future Directions for Research

This dissertation research was conducted to prepare the *ABCs of SLEEPING* app for a full-scale effectiveness RCT. The next steps will be to conduct the full-scale hybrid effectiveness-implementation study to determine if the *ABCs of SLEEPING* app is effective for improving sleep and sleep habits for school-age children and an implementation study

to ensure its adoption into clinical use/practice. The results from Studies 2 and 3 laid a foundation upon which to conduct a future hybrid effectiveness-implementation study. As defined by Curran et al. (2012), this would involve simultaneously examining the effectiveness of the *ABCs of SLEEPING* app with improving intended sleep outcomes and evaluating implementation within a real-world context (e.g., adoption of recommending the app in local clinics and advertisement campaigns to reach end-users).

Areas of feasibility in Bowen et al.'s (2009) framework were examined in the current dissertation, except adaptation and expansion. These are areas of important focus for future research when adapting the *ABCs of SLEEPING* app for other populations and settings. For adaptation (i.e., changing the content of the intervention for a new population or setting), some of this research is currently being conducted. For example, the program is being adapted for infants and adults. Additional future directions for adaptation were also pulled directly from our results. For example, our HCP sample reported in Study 3 that the *ABCs of SLEEPING* app would be helpful for children with neurodevelopmental disorders (NDD). With regard to expansion, if the *ABCs of SLEEPING* app is determined to have effectiveness and successful implementation in one setting (e.g., implemented through HCPs who recommended the *ABCs of SLEEPING* app at local clinics), additional implementation efforts could be explored (e.g., social media, news media promotion).

Busy schedules and psychosocial factors (e.g., daily stressors) were commonly noted as barriers among parent participants, and their suggested addressing these by incorporating features into the app to facilitate the use of the intervention. As such, the app was modified to include features that would prompt parents to use the sleep tips each day to enhance fidelity (i.e., reminders feature) and better organize which to sleep tip to focus

on (i.e., to-do list feature). Parents in Study 3 reported using the sleep tips more often than parents in Study 1, although these cannot be compared directly. These results further underscore the importance of incorporating end-users in the development and evaluation of an intervention in order to meet needs and create an intervention that is relevant to these users. Researchers developing and evaluating interventions are encouraged to collect and incorporate feedback from end-users to inform relevant and effective interventions or approach intervention development collaboratively (i.e., co-design).

Third, it will be important for future research to determine what contributes to the effectiveness of mHealth sleep intervention for children. For example, our parent users indicated that some families may require further support than the *ABCs of SLEEPING* app can provide. Some research has investigated this for adult digital interventions, and future research may consider exploring whether added support features (e.g., option for a coach) would enhance outcomes compared to a version without these features (Santarossa et al., 2018).

Conclusion

The research outlined in this dissertation contributed to the development, evaluation, and future implementation of the *ABCs of SLEEPING* mHealth app through three studies employing a user-centered approach. This dissertation research demonstrated promising feasibility results in the areas of acceptability, fidelity, preliminary effectiveness, familiarity, demand, integration, and practicality. Additionally, this dissertation research emphasized the importance of taking a user-centered approach, as it is posited that involving end-users translate to interventions that are more relevant, and effective for the intended population (i.e., parents and HCPs). It directly contributed to the development and

evaluation of a mHealth resource that is needed by end-users, as well as contributed to the growing body of literature for mHealth resources for sleep as there are no mHealth interventions for parents to use with their school-age children. Finally, the research underscored the importance of accessibility to relevant interventions, especially when considering the evidence-to-practice gap that exists for mHealth sleep interventions and programs for children.

References

Alfano, C. A., Patriquin, M. A., De Los Reyes, A. (2015). Subjective – objective sleep comparisons and discrepancies among clinically-anxious and healthy children. *Journal of Abnormal Child Psychology, 43*(7), 1343-1353. 10.1007/s10802-015-0018-7

Allen, S. L., Howlett, M. D., Coulombe, A. J., & Corkum, P. V. (2016). ABCs of SLEEPING: A review of the evidence behind pediatric sleep practice recommendations. *Sleep Medicine Reviews, 29*, 1-14. https://doi.org/10.1016/j.smrv.2015.08.006

Alfonsson, S., Olsson, E., & Hursti, T. (2016). Motivation and treatment credibility predicts dropout, treatment adherence, and clinical outcomes in an internet-based cognitive behavioral relaxation program: A randomized controlled trial. *Journal of Medical Internet Research, 18*(3): e52. 10.2196/jmir.5352

American Academy of Sleep Medicine (2023). *"Insomnia." International classification of sleep Disorders – text revised* (3rd ed.). American Academy of Sleep Medicine.

American Psychiatric Association (2022). *Diagnostic and statistical manual of mental disorder – text revised* (5th ed., text rev.). American Psychiatric Association.

Angelhoff, C., Johansson, P., Svensson, E., & Sundell, A. L. (2020). Swedish translation and validation of the pediatric insomnia severity index. *BMC Pediatrics, 20*(1)*,* 1-8. https://doi.org/10.1186/s12887-020-02150-5

Arnedt, J. T., Conroy, D. A., Mooney, A., Furgal, A., Sen, A., & Eisenberg, D. (2021). Telemedicine versus face-to-face delivery of cognitive behavioural therapy for insomnia: a randomized controlled noninferiority trial. *Sleep, 44*(1), 1-11. https://doi.org/10.1093/sleep/zsaa136

Arora, T., Broglia, E., Pushpakumar, D., Lodhi, T., & Taheri, S. (2013). An investigation into the strength of the association and agreement levels between subjective and objective sleep duration in adolescents. *PloS One, 8*(8), e72406. https://doi.org/10.1371/journal.pone.0072406

Armstrong, J. M., Ruttle, P. L., Klein, M. H., Essex, M. J., Benca, R. M. (2014). Associations of child insomnia, sleep movement, and their persistence with mental health symptoms in childhood and adolescence. *Sleep, 37*(5), 901-909. https://dx.doi.org/10.5665/sleep.3656

Atkins, L., Francis, J., Islam., R., O'Conner, D., Patey, A., Ivers, N., Foy, R., Duncan, E. M., Colquhoun, H., Grimshaw, J. M., Lawton, R., & Michie, S. (2017). A guide to using the theoretical domains framework of behaviour change to investigate

implementation problems. *Implementation Science, 12*(77), https://doi.org/10.1186/s13012-017-0605-9

Bakker, D., Kazantzis, N., Rickwood, D., & Rickard, N. (2016). Mental health smartphone apps: Review and evidence-based recommendations for future developments. *Journal of Medical Internet Research: Mental Health, 3*(1): e7. https://doi.org/10.2196/mental.4984

Bauer, M. S., & Kirchner, J. (2020). Implementation science: What is it and why should I care? *Psychiatry Research, 283,* https://doi.org/10.1016/j.psychres.2019.04.025

Baumann, H., Fiedler, J., Wunsch, K., Woll, A., & Wollesen, B. (2022). MHealth interventions to reduce physical inactivity and sedentary behavior in children and adolescents: Systematic review and meta-analysis of randomized controlled trials. *JMIR Mhealth Uhealth, 10*(5), https://doi.org/10.2196/35920

Becker, S. P., Langberg, J. M., & Byars, K. C. (2015). Advancing a biopsychosocial and contextual model of sleep in adolescence: A review and introduction to the special issue. *Journal of Youth and Adolescence, 44*, 239-270. 10.1007/s10964-014-0248-y

Benz, F., Riemann, D., Domschke, K., Spiegelhalder, K., Johann, A. F., Marshall, N. S., & Feige, B. (2022). How many hours do you sleep? A comparison of subjective and objective sleep duration measures in a sample of insomnia patients and good sleepers. *Journal of Sleep Research, 32*, https://doi.org/10.1111/jsr.13802

Bessey, M., Coulombe, J. A., & Corkum, P. V. (2013). Sleep hygiene in children with ADHD: Findings and recommendations. *The ADHD Report, 21*(3), 1-7. 101521adhd20132131

Billings, M. E., Cohen, R. T., Baldwin, C. M., Johnson, D. A., Palen, B. N., Parthasarathy, S., Patel, S. R., Russell, M., Tapia, I. E., Williamson, A. A., & Sharma, S. (2021). Disparities in sleep health and potential intervention models: A focused review. *SLEEP: CHEST Reviews, 159*(3), 1232-1240. https://doi.org/10.1016/j.chest.2020.09.249

Bock, D. E., Roach-Fox, E., Seabrook, J. A., Rieder, M. J., & Matsui, D. (2016). Sleep-promoting medications in children: Physician prescribing habits in Southwestern Ontario, Canada. *Sleep Medicine, 17*, 52-56. https://doi.org/10.1016/j.sleep.2015.10.003

Boafo, A., Greenham, S., Sullivan, M., Bazaid, K., Suntharalingam, S., Silbernagel, L., Magner, K., & Robillard, R. (2020). Medications for sleep disturbance in children and adolescents with depression: a survey of Canadian child and adolescent psychiatrists. *Child and Adolescent Psychiatry and Mental Health, 14*(10), 1-8. https://doi.org/10.1186/s13034-020-00316-8

Bourchtein, E., Langberg, J. M., & Eadeh, H. (2020). A review of pediatric nonpharmacological sleep interventions: Effects on sleep, secondary outcomes, and populations with co-occurring mental health conditions. *Behavior Therapy, 51*(1), 27-41. https://doi.org/10.1016/j.beth.2019.04.006

Bowen, D. J., Kreuter, M., Spring, B., Cofta-Woerpel, C-W., Linnan, L., Weiner, D., Bakken, S., Kaplan, C. P., Squiers, L., Fabrizio, C., & Fernandez, M. (2009). How we design feasibility studies. *American Journal of Preventative Medicine, 36*(5), 452-457. https://doi.org/10.1016/j.amepre.2009.02.002

Boerner, K. E., Coulombe, J. A., & Corkum, P. V. (2015). Barriers and facilitators of evidence-based practice in pediatric behavioral sleep care: Qualitative analysis of the perspectives of health professionals. *Behavioural Sleep Medicine, 13*(1), 36-51. https://doi-org.ezproxy.library.dal.ca/10.1080/15402002.2013.838766

Bommakanti, K. K., Smith, L. L., Liu, L., Do, D., Cuevas-Mota, J., Collins, K., Munoz, F., Rodwell, T. C., & Garfein, R. S. (2020). Requiring smartphone ownership for mHealth interventions: who could be left out? *BMS Public Health, 20*(81). https://doi.org/10.1186/s12889-019-7892-9

Bond, C., Lancaster, G. A., Campbell, M., Chan, C., Eddy, S., Hopewell, S., Mellor, K., Thabane, L., & Eldridge, S. (2023). Pilot and feasibility studies: extending the conceptual framework. *Pilot and Feasibility Studies, 9*(24), 1-10. https://doi.org/10.1186/s40814-023-01233-1

Borrelli, B., Ritterband, L. M. (2015). Special issue on eHealth and mHealth: Challenges and future directions for assessment, treatment, and dissemination. *Health Psychology, 34*, 1205-1208. https://doi.org/10.1037/hea0000323

Borbély, A. A. (1982). A two-process model of sleep regulation. *Human Neurobiology, 1*(3), 195-204. 10.1111/jsr.13598

Buckman, J. E. J., Saunders, R., Leibowitz, J., & Minton, R. (2021). The barriers, benefits and training needs of clinicians delivery psychological therapy via video. *Behavioural and Cognitive Psychotherapy, 49*(6), 696-720. https://doi.org/10.1017/S1352465821000187

Budhi, E. R., Trudnak, T. E., Martinasek, M. P., Oberne, A. B., Fuhrmann, H. J., & McDermott, R. J. (2013). Mobile phone-based behavioural interventions for health: A systematic review. *Health Education Journal, 72*(5), 564-583. https://doi.org/10.1177/0017896912452071

Bruni, C., Angriman, M., Calisti, F., Comandini, A., Esposito, G., Cortese, S., & Ferri, R. (2018). Practitioner review: Treatment of chronic insomnia in children and

adolescents with neurodevelopmental disabilities. *The Journal of Child Psychology and Psychiatry, 59*(5), 489-508. https://doi.org/10.1111/jcpp.12812

Braun, V., Clarke, V. (2021). *Thematic Analysis: A Practical Guide.* SAGE Publications Ltd.

Bryant, A., Guy, J., The CALM Team, & Holmes, J. (2020). The strengths and difficulties questionnaire predicts concurrent mental health difficulties in a transdiagnostic sample of struggling learners. *Frontiers in Psychology, 12,* https://doi.org/10.3389/fpsyg.2020.587821

Buysse, D. J. (2014). Sleep health: Can we define it? Does it matter? *Sleep, 37*(1), 9-17. https://dx.doi.org/10.5665/sleep.3298

Byars, K., & Simon, S. (2014). Practice patterns and insomnia treatment outcomes from an evidence-based pediatric behavioral sleep medicine clinic. *Clinical Practice in Pediatric Psychology, 2*(3), 337-349. https://doi.org/10.1037/cpp0000068

Byars, K. C., Simon, S. L., Peugh, J., & Beebe, D. W. (2017). Validation of a brief insomnia severity measure in youth clinically referred for sleep evaluation. *Journal of Pediatric Psychology, 42*(4), 466-475. https://doi/org/10.1093/jpepsy/jsw077

Carmona, N. E., Usyatynky, A., Kutana, S., Corkum, P., Henderson, J., McShane, K., Shapiro, C., Sidani, S., Stinson, J., & Carney, C. E. (2021). A transdiagnostic self-management web-based app for sleep disturbance in adolescents and young adults: feasibility and acceptability study. *JMIR Formative Research, 5*(11): e25392. https://doi.org/10.2196/25392

Calhoun, S. L., Fernandez-Mendoza, J., Vgontzas, A. N., Liao, D., & Bixler, E. O. (2014). Prevalence of insomnia symptoms in a general population sample of young children and preadolescents: gender effects. *Sleep Medicine, 15*(1), 91-95. https://doi.org/10.1016/j.sleep.2013.08.787

Calhoun, S. L., Fernandez-Mendoza, J., Vgontzas, A. N., Mayes, S. D., Liao, D., & Bixler, E. O. (2017). Behavioural profiles associated with objective sleep duration in young children with insomnia symptoms. *Journal of Abnormal Child Psychology*, *45*(2), 337-344. https://doi.org/10.1007/s10802-016-0166-4

Canadian Society for Exercise Physiology. (2019). *Canadian Physical activity guidelies and Canadian 24-hour movement guidelines for children and youth.* Retrieved from https://csepguidelines.ca

Chan, C., West, S., & Glozier, N. (2017). Commencing and persisting with a web-based cognitive behavioral intervention for insomnia: a qualitative study of treatment completers. *Journal of Medical Internet Research, 19*(2), e37. https://doi.org/10.2196/jmir.5639

Chandran, S., Al-Sa'di, A., & Ahmad, E. (2020). Exploring User Centered Design in Healthcare: A Literature Review. *2020 4th International Symposium on Multidisciplinary Studies and Innovative Technologies (ISMSIT),* 1-8. https://doi.org/10.1109/ISMSIT50672.2020.9255313

Chaput, J., Gray, C. E., Poitras, V. J., Carson, V., Gruber, R., Olds, T., Weiss, S. K., Gorber, S. C., Kho, M. E., Sampson, M., Belanger, K., Eryuzlu, S., Callender, L., & Tremblay, M. S. (2016). Systematic review of the relationships between sleep duration and health indicators in school-age children and youth. *Applied Physiology, Nutrition, and Metabolism, 41*, S266-S282. https://doi.org/10.1139/apnm-2015-0627.

Cheng, P., Santarosaa, S., Kalmbach, D., Sagong, C., Hu, K., & Drake, C. (2023). Patient perspectives on facilitators and barriers to equitable engagement with digital CBT-I. *Sleep Health: Journal of the National Sleep Foundation, 9*(5), 571-578. https://doi.org/10.1016/j.sleh.2023.07.003

Chien, C., Cheung, P., & Chen, C. (2019). The relationship between sleep duration and participation in home, school, and community activities among school-aged children. *Frontiers in Neuroscience, 13*, 1-8. https://doi.org/10.3389/fnins.2019.00860

Cliffe, B., Croker, A., Denne, M., Smith, J., & Stallard, P. (2020). Digital cognitive behavioral therapy for insomnia for adolescents with mental health problems: feasibility open trial. *JMIR Mental Health, 7*(3): e14842. https://doi.org10.2196/14842

Cochrane, L. J., Olson, C. A., Murray, S., Dupuis, M., Tooman, T., & Hayes, S. (2007). Gaps between knowing and doing: Understanding and assessing the barriers to optimal health care. *The Journal of Continuing Educational Health Professionals, 27*, 94-102. https://doi.org/10.1002/chp.106

Combs, D., Goodwin, J. L., Quan, S. F., Morgan, W. J., Shetty, S., & Parthasarathy, S. (2016). Insomnia, health-related quality of life and health outcomes in children: A seven-year longitudinal cohort. *Scientific Reports, 6,* 27921. https://doi.org/10.1038.srep27921

Corkum, P. V. Reid, G. J., Hall, W. A., Godbout, R., Stremler, R., Weiss, S. K., Gruber, R., Witmans, M., Chambers, C. T., Begum, E. A., Andreou, P., & Rigney, G. (2018). Evaluation of an internet-based behavioural intervention to improve psychosocial health outcomes in children with insomnia (Better Nights, Better Days): Protocol for a randomized controlled trial. *JMIR Research Protocols, 7*(3): e76. https://doi.org/10.2196/resprot.8348.

Corkum, P., Lingley-Pottie, P., Davidson, F., McGrath, P., Chambers, C. T., Mullane, J., Laredo, S., Woodford, K., & Weiss, S. K. (2016). Better Nights/Better Days—distance intervention for insomnia in school-aged children with/without ADHD: A randomized controlled trial. *Journal of Pediatric Psychology*, *41*(6), 701–713. https://doi.org/10.1093/jpepsy/jsw031

Curran, G. M., Bauer, M., Mittman, B., Pyne, J. M., & Stetler, C. (2012). Effectiveness-implementation hybrid designs: Combining elements of clinical effectiveness and implementation research to enhance public health impact. *Medical Care, 50*(3), 217-226. https://doi.org/10.1097/MLR.0b013e3182408812

Curcio, G., Ferrara, M., & De Gennaro, L. (2006). Sleep loss, learning capacity and academic performance. *Sleep Medicine Reviews, 10*(5), 323–337. https://doi.org/10.1016/j.smrv.2005.11.001

Damschroder, L. J., Reardon, C. M., Opra Widerquist, M. A., Lowrey, J. (2022). The updated consolidated framework for implementation research based on user feedback. *Implementation Science, 17*(75), https://doi.org/10.1186/s13012-022-01245-0

de Bruin, E. J., Bögels, S. M., Oort, F. J., & Meijer, A. M. (2014). Efficacy of internet and group-administered cognitive behavioral therapy for insomnia in adolescents: a pilot study. *Behavioural Sleep Medicine, 12,* 235-254. https://doi.org/10.1080/15402002.2013.784703

de Bruin, E. J., Bögels, S. M., Oort, F. J., & Meijer, A. M. (2015a). Efficacy of cognitive behavioral therapy for insomnia in adolescents: a randomized controlled trial with internet therapy, group therapy and a waiting list condition. *Sleep, 38*, 1913-1926. https://doi.org/10.5665/sleep.5240

de Bruin, E. J., Bögels, S. M., Oort, F. J., & Meijer, A. M. (2015b). Differential effects of online insomnia treatment on executive functions in adolescents. *Sleep Medicine, 16*, 510-520. https://doi.org/10.1016/j.sleep.2014.12.009

de Zambotti, M., Goldstone, A., Colrain, I. M., & Baker, F. C. (2018). Insomnia disorder in adolescence: diagnosis, impact, and treatment. *Sleep Medicine Reviews, 39,* 12-24. https://doi.org/10.1016/j.smrv.2017.06.009

Dewald, J. F., Meijer, A. M., Oort, F. J., Kerkhof, G. A., & Bögels, S. M. (2010). The influence of sleep quality, sleep duration, and sleepiness on school performance in children and adolescents: A meta-analytic review. *Sleep Medicine Review, 14*(3), 179-189. https://doi.org/10.1016/j.smrv.2009.10.004

Dewald-Kaufmann, J., de Bruin, E., & Michael, G. (2019). Cognitive behavioral therapy for insomnia (CBT-i) in school-aged children and adolescents. *Sleep Medicine Clinics*, *14*(2), 155–165. https://doi.org/10.1016/j.jsmc.2019.02.002

Devolin, M., Phelps, D., Duhaney, T., Benzies, K., Hildebrandt, C., Rikhy, S., & Churchill, J. (2013). Information and support needs among parents of young children in a region of Canada: A cross-sectional survey. *Public Health Nursing, 30*(3), 193–201. https://doi.org/10.1111/phn.12002

Denis, D., Eley, T. C., Rijsdijk, F., Zavos, H. M. S., Keers, R., Espie, C. A., Luik, A. I., Badini, I., Derveeuw, S., Hodsoll, J., & Gregory, A. M. (2020). Is digital cognitive behavioural therapy for insomnia effective in treating sub-threshold insomnia: a pilot RCT. *Sleep Medicine, 66,* 174-183. https://doi.org/10.1016/j.sleep.2019.10.007

Dorado, J. S., Martinez, M., McArthuer, L. E., & Leibovitz, T. (2016). Healthy environments and response to trauma in schools (HEARTS): A whole-school, multi-level, prevention and intervention program for creating trauma-informed, safe and supportive schools. *School Mental Health, 8*(1), 163-176. https://doi.org/10.1007/s12310-016-9177-0

Draxten, M., Flattum, C., & Fulkerson, J. (2016). An example of how to supplement goal setting to promote behavior change for families using motivational interviewing. *Health Communication, 31*(10), 1276-1283. https://doi.org/10.1080/10410236.2015.1062975

Eccles, M. P., & Mittman, B. S. (2006). Welcome to implementation science. *Implementation Science, 1*(1), 1-3. https://doi.org/10.1186/1748-5908-1-1

Edinger, J. D., & Sampson, W. S. (2003). A primary care "friendly" cognitive behavioral insomnia therapy. *Sleep, 26*(2), 177-182. https://doi.org/10.1093/sleep/26.2.177

Edgar, D., Dement, W., & Fuller, C. (1993). Effect of SCN lesions on sleep in squirrel monkeys: evidence for opponent processes in sleep-wake regulation. *Journal of Neuroscience, 13*(3), 1065-1079. https://doi/org/10.1523/jneurosci.13-03-01065.1993

Eldridge, S. M., Chan, C. L., Campbell, M. J., Bond, C. M., Hopewell, S., Thabane, L., & Lancaster, G. A. (2016). CONSORT 2010 statement: extension to randomized pilot and feasibility trials. *BMJ, 355*, i5239. https://doi.org/10.1136/bmj.15239

Espie, C. A. (2023). Revisiting the psychobiological inhibition model: a conceptual framework for understanding and treating insomnia using cognitive and behavioural therapeutics (CBTx). *Journal of Sleep Research, 32*(6): e13841. https://doi.org/10.1111/jsr.13841

Erlingsson, C., & Brysiewicz, P. (2017). A hands-on guide to doing content analysis. *African Journal of Emergency Medicine, 7*(3), 93-99. http://dx.doi.org/10.1016/j.afjem.2017.08.001

Falch-Madsen, J., Wichstrøm, L., Pallesen, S., Jenson, M. R., Bertheussen, L., Solhaug, S., & Steinsbekk, S. (2021). Predictors of diagnostically defined insomnia in child and adolescent community samples: A literature review. *Sleep Medicine, 87*, 241-249. https://doi.org/10.1016/j.sleep.2021.09.003

Farmer, T., Robinson, K., Elliot, S., & Eyles, J. (2006). Developing and implementing a triangulation protocol for qualitative health research. *Qualitative Health Research, 16*(3), 377-394. https://doi.org/10.1177/1049732305285708

Fedele, D. A., Cushing, C. C., Fritz, A., Amaro, C. M., & Ortega, A. (2017). Mobile health interventions for improving health outcomes in youth: a meta-analysis. *JAMA Pediatrics, 171*(5), 461-469. https://doi.org/10.1001/jamapediatrics.2017.0042

Finn, C. A., & Sladeczek, I. E. (2001). Assessing the social validity of behavioral interventions: a review of treatment acceptability measures. *School Psychology Quarterly, 16*(2), 176-206. https://doi.org/10.1521/scpq.16.2.176.18703

Forsner, T., Hansson, J., Brommels, M., Wistedt, A. A., & Forsell, Y. (2010). Implementing clinical guidelines in psychiatry: A qualitative study of perceived facilitators and barriers. *BMC Psychiatry, 10*(8), 1-10. https://doi.org/10.1186/1471-244X-10-8

Fricke-Oerkermann, L., Plück, J., Schredl, M., Heinz, K., Mitschke, A., Wiater, A., & Lehmkuhl, G. (2007). Prevalence and course of sleep problems in childhood. *Pediatric Sleep Problems, 30*(10), 1371-1377. https://doi.org/10.1093/sleep/30.10.1371

Gartlehner, G., Hansen, R. A., Nissman, D., Lohr, K. N., & Carey, T. S. (2006). Criteria for distinguishing effectiveness from efficacy trials in systematic reviews. *Agency Healthc. Res Qual, 12,* 1-28.

Gieselmann, A. & Pietrowskey, R. (2019). The effects of brief chat-based and face-to-face psychotherapy for insomnia: A randomized waiting list controlled trial. *Sleep Medicine, 61*, 63-72. https://doi.org/10.1016/j.sleep.2019.03.024

Girschik, J., Fritschi, L., Heyworth, J., & Waters, F. (2012). Validation of self-reported sleep against actigraphy. *Journal of Epidemiology, 22*(5), 462-468. https://doi.org/10.2188/jea.JE20120012

Glasgow, R. E., McKay, H. G., Piette, J. D., & Reynolds, K. D. (2001). The RE-AIM framework for evaluating interventions: what can it tell us about approaches to chronic illness management? *Patient Education and Counseling, 44*(2), 119-127. https://doi.org/10.1016/S0738-3991(00)00186-5

Glasgow, R. E., Lictenstein, E., & Marcus, A. C. (2003). Why don't we see more translation of health promotion research to practice? Rethinking the efficacy-to-effectiveness transition. *American Journal of Public Health, 93,* 1261-1267. https://doi.org/10.2105/AJPH.93.8.1261

Goodman, R. (2007). The strengths and difficulties questionnaires: a research note. *Journal of Child Psychology and Psychiatry, 38*(5), 581-586. https://doi.org/10.1111/j.1469-7610.1997.tb01545.x

Gomez-Fonseca, A., & Genzel, L. (2020). Sleep and academic performance: considering amoung, quality and timing. *Current Opinion in Behavioral Science, 33,* 65-71. https://doi.org/10.1016/j.cobeha.2019.12.008

Government of Canada, S. C. (2023, January 25). *Telecommunications: Connecting Canadians*. Statistics Canada. Retrieved February 8, 2023, from https://www.statcan.gc.ca/en/subjects-start/digital_economy_and_society/telecommunications

Graeme, D. (2018). A brief summary of pilot and feasibility studies: Exploring terminology, aims, and methods. *European Journal of Integrative Medicine, 24*, 65-70. https://doi.org/10.1016/j.eujim.2018.10.017

Gregory, A. M., Cox, J., Crawford, M. R., Holland, J., & Harvey, A. G. (2009). Dysfunctional beliefs and attitudes about sleep in children. *Journal of Sleep Research, 18,* 422-426. https://doi.org/10.11111/j.1365-2869.2009.00747.x

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. *The Milbank Quarterly, 82*(4), 581-629. https://doi.org/10.1111/j.0887-37X.2004.00325.x

Grivell, N., Hoon, E., Chai-Coetzer, C., Fuller, J., & McEvoy, R. (2022). P049 Barriers and facilitators to the delivery of insomnia management by general practice nurses: a qualitative analysis of patient perspectives. *Sleep Advances, 3*(1), A47. https://doi.org/10.1093./sleepadvances/zpac029.122

Gruber, R. (2013). Making room for sleep: The relevance of sleep to psychology and the rationale for development of preventative sleep education program for children and adolescents in the community. *Canadian Psychology, 54*(1), 62-71. https://doi.org/10.1037/a0030936

Gruber, R., Constantin, E., Frappier, J. Y., Brouillette, R. T., & Wise, M. S. (2017). Training, knowledge, attitudes and practices of Canadian health care providers regarding sleep and sleep disorders in children. *Pediatrics & Child Health, 22*(6), 322-327. 10.1093/pch/pxx069

Hair, E., Halle, T., Terry-Humen, E., Lavelle, B., & Calkins, J. (2006). Children's school readiness in the ECLS-K: predictions to academic, health, and social outcomes in first grade. *Early Childhood Research Quarterly, 21*, 431-454. https://doi.org/10.1016/j.ecresq2006.09.005

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep Medicine Reviews, 21*, 50-58. https://doi.org/10.1016/j.smrv.2014.07.007

Harvey, A. G. (2002). A cognitive model of insomnia. *Behaviour Research and Therapy, 40*(8), 869-893. https://doi.org/10.1016/S0005-7967(01)00061-4

Hannon, K., & Hiscock, H. (2015). Sleep problems in children. *Australian family physician, 44*(12), 880-884.

Harris, P. A.,Taylor, R., Thielke, R., Payne J., Gonzalez N., & Conde J. (2009). Research electronic data capture (REDCap) – A metadata-driven methodology and workflow process for providing translational research informatics support**.** *Journal of Biomedical Informatics. 42(2), 377–381. https://doi.org/10.1016/j.jbi.2008.08.010*

Harris, P. A., Taylor R, Minor, B. L., Elliott, V., Fernandez, M., O'Neal, L., McLeod, L., Delacqua, G., Delacqua. F., Kirby, J., & Duda, S. N. (2019). The REDCap Consortium. The REDCap consortium: Building an international community of software partners**,** *Journal of Biomedical Informatics, 95, 103208.* https://doi.org/10.1016/j.jbi.2019.103208

Harskamp-van Ginkel, M. W., Kool, R. E., van Houtum, L., Belmon, L. S., Huss, A., Chinapaw, M. J. M., & Vrijkotte, T. G. M. (2020). Potential determinants during 'the first 1000 Days of life' of sleep problems in school-aged children. *Sleep Medicine*, *69*, 135–144. https://doi.org/10.1016/j.sleep.2019.12.020

Haynes, P. L., Parthasarathy, S., Kersh, B., & Bootzin, R. R. (2011). Examination of insomnia and insomnia treatment in psychiatric inpatients: Insomnia in psychiatric inpatients. *International Journal of Mental Health Nurings, 20*, 130-136. https://doi.org/10.1111/j.1447-0349.2010.00711.x

Henderson, J. A., Jordan, S. S. (2010). Development and preliminary evaluation of the bedtime routines questionnaire. *Journal of Psychopathology and behavioral assessment, 32*(2), 271-280. https://doi/org/10.1007/s10862-009-9143-3

Hiscock, H., Quach, J., Ukoumunne, O. C., Wake, M. (2011). A brief sleep intervention improves outcomes in the school entry year: A randomized controlled trial. *Pediatrics, 128*(4), 692-702. https://doi.org/10.1542/peds.2011-0409

Hiscock, H., Mulraney, M., Heussler, H., Rinehart, N., Schuster, T., Grobler, A.C., Gold, L., Bohingamu Mudiyanselage, S., Hayes, N., & Sciberras, E. (2019). Impact of a behavioral intervention, delivered by pediatricians or psychologists, on sleep problems in children with ADHD: a cluster-randomized translational trial. *Journal of Child Psychology and Psychiatry, 60*(11), 1230-1241. https://doi.org/10.1111/jcpp.13083

Howlett, M., Jemcov, A., Adams, A., & Corkum, P. (2020). ABCs of SLEEPING tool: Improving access to care for pediatric insomnia. *Clinical Practice in Pediatric Psychology*, *8*(1), 1–12. https://doi.org/10.1037/cpp0000301

Huberty, J., Eckert, R., Larkey, L., Kurka, J., Rodriguez De Jesus, S. A., Yoo, W., & Mesa, R. (2019). Smartphone-based meditation for myeloproliferative neoplasm patients: Feasibility study to inform future trials. *JMIR Formative Research, 3*(2), e12662. https://doi.org/10.2196/12662

Huijg, J. M., Crone, M. R., Verheijden, M. W., van der Zouwe, N., Middelkoop, B. J., Gebhardt, W. A. (2013). Factors influencing the adoption, implementation, and continuation of physical activity interventions in primary health care: a Delphi study. *BMC Family Practice, 14*(142). https://doi.org/10.1186/147-2296-14-142

Internet World Stats. (2020). Internet Usage and Population in North America. Retrieved from: https://www.internetworldstats.com/stats.htm

Iwasaki, M., Iwata, S., Iemura, A., Yamashita, N., Tomino, Y., Anme, T., Yamagata, Z., Iwata, O., & Matsuishi, T. (2010). Utility of subjective sleep assessment tools for healthy preschool children: a comparative study between sleep logs, questionnaires, and actigraphy. *Journal of Epidemiology, 20*(2), 143-149. https://doi.org/10.2188/jea.JE20090054

Jemcov, A., Keys, E., & Corkum, P. (2021). Evaluating the feasibility of the ABCs of SLEEPING mobile application: Exploring implementation, acceptability, and limited efficacy. *Clinical Practice in Pediatric Psychology*, *9*(2), 180–191. https://doi.org/10.1037/cpp0000400

Jemcov, A., Mackinnon, S. P., Smith, I. M., & Corkum, P. (2024). A Pilot Randomized Control Trial of the *ABCs of SLEEPING* mHealth Intervention for Parents of School-age Children with Insomnia Symptoms. [Manuscript in preparation]. Department of Psychology, Dalhousie University.

Jemcov, A., Lamont, K., Corkum, P. (2024). Barriers and Facilitators to the Implementation of a Mobile Health Sleep Intervention for School-Age Children: Perspectives of Parents and Healthcare Providers. [Manuscript in preparation]. Department of Psychology, Dalhousie University.

Jokela, T., Livari, N., Matero, J., & Karukka, M. (2003). The standard of user-centered design and the standard definition of usability: Analyzing ISO 13407 against ISO 9241-11. *Proceedings of the Latin American conference on Human-Computer Interaction* (pp. 53-60). New York: ACM Press.

Kallestad, H., Scott, J., Vedaa, Ø., Lydersen, S., Vethe, D., Morken, G., Stiles, T. C., Siversten, B., & Langsrud, K. (2021). Mode of delivery of cognitive behavioural therapy for insomnia: a randomized controlled non-inferiority trial of digital and face-to-face therapy. *Sleep, 44*(12). https://doi.org/10.1093/sleep/zsab185

Kang, M., Ragan, B. G., & Park, J. (2008). Issues in outcomes research: an overview of randomization techniques for clinical trials. *43*(2), 215-221. https://doi.org/10.4085/1062-6050-43.2.215

Kazdin, A. E., & Blase, S. (2011). Rebooting psychotherapy research and practice to reduce the burden of mental illness. *Perspectives on Psychological Science, 6,* 21-37. https://doi.org/10.1177/1745691610393527

Kempler, L., Sharpe, L. A., Marshall, N. S., & Bartlett, D. J. (2020). A brief sleep focused psychoeducation program for sleep-related outcomes in new mothers: A randomized controlled trial. *Sleep, 43*(11), 1-12. https://doi.org/10.1093/sleep/zsaa101

King, D. K., Shoup, J., Raebel, M. A., Anderson, C. B., Wagner, N. M., Ritzwoller, D. P., & Bender, B. G. (2020). Planning for implementation success using RE-AIM and CFIR frameworks: a qualitative study. *Frontiers in Public Health, 8*(59), https://doi.org/10.3389/fpubh.2020.00059

Kodsi, A., Bullock, B., Kennedy, G. A., & Tirlea, L. (2022). Psychological interventions to improve sleep in young adults: A systematic review and meta-analysis of randomized controlled trials. *Behavioral Sleep Medicine, 20*(1), 125-142. https://doi.org/10.1080/15402002.2021.1876062

Kovacić, Z., Marendić, M., Soljić, M., Pecotić, R., Kardum, G., & Dogas, Z. (2002). Knowledge and attitude regarding sleep medicine of medical students and physicians in Split, Croatia. *Croatian Medical Journal, 43*(1), 71-74.

Korff, M. V., & Tiemens, B. (2000). Individualized stepped care of chronic illness. *The Western Journal of Medicine, 172*(2), 133-137. https://doi.org/10.1136/ewjm.172.2.133

Kreps, G. L., & Neuhauser, L. (2010). New directions in eHealth communication: opportunities and challenges. *Patient Education and Counseling, 78*(3), 329-336. https://doi.org/10.1016/j.pec.2010.01.013

Lah, S., & Cao (2024). Outcomes of remotely delivered behavioral insomnia interventions for children and adolescents: systematic review of randomized controlled trials. *Frontiers in Sleep, 2*. https://doi.org/10.3389/frsle.2023.1261142

Lancee, J., Van Straten, A., Morina, N., Kaldo, V., & Kamphuis, J. H. (2016). Guided online or face-to-face cognitive behavioral treatment for insomnia: A randomized wait-list controlled trial. *Sleep, 39*(1), 183-191. https://doi.org/10.5665/sleep.5344

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics, 33,* 159-174. https://doi.org/10.2307/2529310

Landsverk, J., Brown, H., Chamberlain, P., Palinkas, L. A., & Horwitz, S. M. (2012). Design and analysis in dissemination and implementation research. In R. C. Brownson, G. A. Colditz, & E. K. Procter (Eds.), *Translating science to practice* (pp. 225-260). New York: Oxford University Press.

Ledel Solem, I. K., Varsi, C., Eide, H., Kristjansdottir, O. B., Børøsund, E., Schreurs, K. M. G., Waxenberg, L. B., Weiss, K. E., Morrison, E. J., Haaland-Øverby, M., Bevan, K., Zangi, H. A., Stubhaug, A., Solberg Nes, L. (2020). A user-centered approach to an evidence-based electronic health pain management intervention for people with chronic pain: design and development of EPIO. *Journal of Medical Internet Research, 22*(1), e15889. https://doi.org/10.2196/15889

Leon, A . C., Davis, L. L., & Kraemer, H. C. (2011). The role and interpretation of pilot studies in clinical research. *Journal of Psychiatric Research, 45*(5), 626-629. https://doi.org/10.1016/j.jpsychires.2010.10.008

Levenson, J. C., Kau, D. B., & Buysse, D. J. (2015). The pathophysiology of insomnia. *Chest, 147*(4), 1179-1192. https://doi.org/10.1378/chest.14-1617

Liu, X. C., Sun, Z. C., Uchiyama, M., Shibui, K., Kim, K., & Okawa, M. (2000) Prevalence and correlates of sleep problems in Chinese school aged children. *Sleep, 23*, 1053-62.

Lin, C., Strong, C., Scott, A. J., Broström, A., Pakpour, A. H., & Webb, T. L. (2018). A cluster randomized controlled trial of a theory-based sleep hygiene intervention for adolescents. *Sleep, 41*(11), 1-11. https://doi.org/10.1093/sleep/zsy170

Lunsford-Avery, J. R., Bidopia, T., Jackson, L., & Sloan, J. S. (2021). Behavioural treatment of insomnia and sleep disturbances in school-aged children and adolescents. *Child and Adolescent Psychiatric Clinics of North America, 30*(1), 101-116. https://doi.org/10.1016/j.chc.2020.08.006

Luther, L., Buck, B. E., Fischer, M. A., Johnson-Kwochka, A. V., Coffin, G., & Salyers, M. P. (2022). Examining potential barriers to mHealth implementation and engagement in schizophrenia: Phone ownership and symptom severity. *Journal of Technology in Behavioral Science, 7*, 13-22. https://doi.org/10.1007/s41347-020-00162-7

Lyon, A. R., & Koerner, K. (2016). User-centered design for psychosocial intervention development and implementation. *Clinical Psychology: Science and Practice, 23*(2), 180-200. https://doi.org/10.1111/cpsp.12154

Mack, L. J., & Rybarczyk, B. D. (2011). Behavioural treatment of insomnia: a proposal for a stepped-care approach to promote public health. *Nature and Science of Sleep, 3*, 87-99. http://doi.org/10.2147/NSS.S12975

March, J. S., Silva, S. G., Comptom, S., Shapiro, M., Califf, R., & Krishnan, R. (2005). The case for practical clinical trials in psychiatry. *American Journal of Psychiatry, 162,* 836-846. https://doi.org/10.1176/appi.ajp.162.5.836

Marshall, C., Lewis, D., & Whittaker, M. (2013). *M-health Technologies in Developing Countries: A Feasibility Assessment and a Proposed Framework* (pp. 1-47). Brisbane, QLD, Australia: University of Queensland,

Marcolino, M. S., Oliveira, J. A. Q., D'Agostino, M., Ribeiro, A. L., Alkmim, M. B. M., Novillo-Ortiz, D. (2018). The impact of mHealth interventions: Systematic review of systematic reviews. *JMIR mHealth uHealth, 6*(1): e23. https://doi.org/10.2196/mhealth.8873

Matricciani, L., Paquet, C., Galland, B., Short, M., & Olds, T. (2019). Children's sleep and health: A meta-review. *Sleep Medicine Reviews, 46*, 136-150. https://doi.org/10.1016/j.smrv.2019.04.011

Meltzer, L. J., Plaufcan, M. R., Thomas, J. H., & Mindell, J. A. (2014). Sleep problems and sleep disorders in pediatric primary care: Treatment recommendations, persistence, and Health Care Utilization. *Journal of Clinical Sleep Medicine*, *10*(4), 421–426. https://doi.org/10.5664/jcsm.3620

Meltzer, L. J., & Montgomery-Downs, H. E. (2011). Sleep in the family. *Pediatric Clinics of North America, 58*(3), 765-774. https://doi.org/10.1016/j.pcl.2011.03.010

Merdad, R. A., Merdad, L. A., Nassif, R. A., El-Derwi, D., & Wali, S. O. (2014). Sleep habits in adolescents of Saudi Arabia: Distinct patterns and extreme sleep schedules. *Sleep Medicine, 15*(11), 1370-1378. https://doi.org/10.1016/j.sleep.2014.06.008

McDonagh, M. S., Holmes, M. S., & Hsu, F. (2019). Pharmacologic treatments for sleep disorders in children: a systematic review. *Journal of Child Neurology, 34*(15), 1-11. https://doi.org/10.1177/0883073818821030

McDowall, P. S., Galland, B. C., Campbell, A. J., & Elder, D. E. (2017). Parent knowledge of children's sleep: A systematic review. *Sleep Medicine Reviews, 31,* 39-47. https://doi.org/10.1016/j.smrv.2016.01.002

McLay, L. K., & Lang, R. (2022). The role of reinforcement in the treatment of sleep problems. In: McLay, L. K., France, K. G., Blampied, N. M. (eds). Clinical Handbook of Behavioral Sleep Treatment in Children on the Autism Spectrum. Spring, Cham. https://doi.org/10.1007/978-3-030-99134-0_12

McLay, L., Sutherland, D., Machalicek, W., & Sigafoos, J. (2020). Systematic review of telehealth interventions for the treatment of sleep problems in children and adoelscents. *Journal of Behavioral Education, 29*, 222-245. https://doi.org/10.1007/s10864-020-09364-8

Mindell, J. A., Kuhn, B., Lewin, D. S., Meltzer, L. J., & Sadeh, A. (2006). Behavioural treatment of bedtime problems and night waking in infants and young children. *Sleep, 29,* 1263-1276.

Mindell, J. A., Meltzer, L. J., Carskadon, M. A., & Chervin, R. D. (2009). Developmental aspects of sleep hygiene: findings from the 2004 national sleep foundation sleep in america poll. *Sleep Medicine, 10*(7), 771-779. https://doi.org/10.1016/j.sleep.2008.07.016

Mitchell, J. A., Eck, C., Hickey, J., Huffnagle, N., Fiks, A. G., Zemel, B. S., Dinges, D. F., & Williamson, A. A. (2020). Parent-child perceptions about healthy sleep promotion in mobile health sleep extension intervention. *Sleep, 43,* (1), A362. https://doi.org/10.1093/sleep/zsaa056.948

Mitchell, J. A., Morales, K. H., Williamson, A. A., Huffnagle, N., Eck, C., Jawahar, A., Juste, L., Fiks, A. G., Zemel, B. S., & Dinges, D. F. (2021). Engineering a mobile platform to promote sleep in the pediatric primary care setting. *Sleep Advances, 2*(1). https://doi.org/10.1093/sleepadvances/zpab006

Mitchell, J. A., Morales, Williamson, A. A., Jawahar, A., Juste, L., Fiks, A. G., Zemel, B. S., Vajravelu, M. E., Zemel, B. S., & Dinges, D. F. (2023) Promoting sleep duration in the pediatric setting using a mobile health platform: A randomized optimization trial. *MedRxiv* [preprint]. https://doi.org/10.1101/2023.01.04.23284151

Morville, P., & Sullenger, P. (2010). Ambient findability: Libraries, serials, and the internet of things. *The Serials Librarian, 58,* 33-38. https://doi.org/10.1080/03615261003622999

Murawski, B., Plotnikoff, R. C., Rayward, A. T., Oldmeadow, C., Vandelanotte, C., Brown, W. J., & Duncan, M. J. (2019). Efficacy of an m-health physical activity and sleep health intervention for adults: A randomized waitlist-controlled trial. *American Journal of Preventative Medicine, 57*(4), 503-514. https://doi.org/10.1016/j.amepre.2019.05.009

Ng., A. S., Dodd, H. F., Gamble, A. L., & Hudson, J. L. (2013). The relationship between parent and child dysfunctional beliefs about sleep and child sleep. *Journal of Child and Family Studies, 22,* 827-836. https://doi.org/10.1007/s10826-012-9637-6

Neves, B. B., Franz, R., Judges, R., Beermann, C., & Baecker, R. (2019). Can digital technology enhance social connectedness among older adults? A feasibility study. *Journal of Applied Gerontology, 38*(1), 49-72. https://doi.org/10.1177/0733464817741369.

Newton, A. T., Corkum, P. V., Blunden, S., & Reid, G. J. (2021). Influences on help-seeking decisions for behavioral child sleep problems: Why parents do and do not seek help. *Clinical Child Psychology and Psychiatry, 26*(1), 207-221. https://doi.org/10.1177/1359104520963375

Nixon, G., Thompson, J., Han, D., Becroft, D., Clark, P., Robinson, E., Waldie, K. E., Wild, C. J., Black, P. N., Mitchell, E. A. (2008). Short sleep duration in middle childhood: risk factors and consequences. *Sleep: Journal of Sleep and Sleep Disorders Research, 31*(1), 71-78. https://doi.org/10.1093/sleep/31.1.71

Okada, K. (2017). Negative estimate of variance-accounted-for effect size: How often is it obtained, and what happens if it is treated as zero. *Behavior Research Methods, 49*(3), 979-987. 10.3758/s13428-016-0760-y

Owens J. A., Maxim, R., Nobile, C,, McGuinn, M., & Msall, M. (2000). Parental and self-report of sleep in children with attention-deficit/hyperactivity disorder. *Archives of Pediatric Adolescent Medicine, 154,* 549-55. https://doi.org/10.1001/archpedi.154.6.549

Owens, J. A., Spirito, A., & McGuinn, M. (2000). The children's sleep habits questionnaire (CSHQ): psychometric properties of a survey instrument for school-aged children. *Sleep, 23*(8), 1-9. https://doi.org/10.1093/sleep/23.8.1d

Owens, J. A., Spirito, A., McGuinn, M., & Nobile, C. (2000). Sleep habits and sleep disturbance in elementary school-aged children. *Journal of Developmental & behavioural pediatrics, 21*(1), 27-36. https://doi.org/10.1097/00004703-200002000-00005

Owens, J. A., Rosen, C. L., & Mindell, J. A. (2003). Medication use in the treatment of pediatric insomnia: results of a survey of community-based pediatricians. *Pediatrics, 111*(5), e628-e635. https://doi.org/10.1542/peds.111.5.e628

Owens, J. A., Rosen, C. L., Mindell, J. A., & Kirchner, H. L. (2010). Use of pharmacotherapy for insomnia in child psychiatry practice: A national survey. *Sleep Medicine, 11*(7), 692-700. https://doi.org/10.1016/j.sleep.2009.11.015

Paterson, J. L., Reynolds, A. C., Duncan, M., Vandelanotte, C., & Ferguson, S. A. (2019). Barriers and enablers to modifying sleep behavior in adolescents and young adults: a qualitative investigation. *Behavioral Sleep Medicine, 17*(1), 1–11. https://doi.org/10.1080/15402002.2016.1266489

Peersmann, S. H. M., Grootenhuis, M. A., van Straten, A. V., Tissing, W. J. E., Abbink, F., de Vries, A. C. H., Loonen, J., van der Pal, H. J. H., Kaspers, G. J. L., & van Litsenburg, R. R. L. (2022). Insomnia symptoms and daytime fatigue co-occurrence in adolescent and young adult childhood cancer patients in follow-up after treatment: Prevalence and associated risk factors. *Cancers, 14*, 1-5. https://doi.org/10.3390/cancers14143316

Perfect, M. M., Levine-Donnerstein, D., Archbold, K., Goodwin, J. L., & Quan, S. F. (2014). The contribution of sleep problems to academic and psychosocial functioning: Sleep, school, and psychosocial functioning. *Psychology in the Schools, 51*(3), 273-295. https://doi.org/10.1002/pits.21746

Peth-Pierce, R. (2000). *A good beginning: sending America's children to school with the social and emotional competence they need to succeed (monograph).* Bethesda, MD: The Child Mental Health Foundation and Agencies Network.

Pelayo, R., & Dubik, M. (2008). Pediatric sleep pharmacology. *Seminars in Pediatric Neurology, 15*(2), 79-90. https://doi.org/10.1016/j.spen.2008.03.004

Pratt, A., & Nunes, J. (2012). *Interactive Design: An Introduction to the Theory and Application of User-Centered Design;* Rockport Pub: Gloucester, MA, USA.

Procter, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., Griffey, R., & Hensley, M. (2011). Outcomes for implementation research: Conceptual distinctions, measurement challenges, and research agenda. *Administration and Policy in Mental Health and Mental Health Services Research, 38*, 65-67, https://doi.org/10.1007/s10488-010-0319-7

Quante, M., Khanpur, N., Kontos, E. Z. Bakker, J. P., Owens, J. A., & Redline, S. (2019). A qualitative assessment of the acceptability of a smartphone app for improving sleep behaviors in low-income and minority adolescents. *Behavioral Sleep Medicine, 17*(5), 573-585. https://doi.org/10.1080/15402002.2018.1432483

QSR International Pty Ltd. (2020) NVivo (released in March 2020), https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home

Rayward, A. T., Plotnikoff, R. C., Murawkshi, B., Vandelanotte, C., Brown, W. J., Holliday, E. G., & Duncan, M. J. (2020). Efficacy of an m-health physical activity and sleep intervention to improve sleep quality in middle-aged adults: The refresh study randomized controlled trial. *Annuals of Behavioral Medicine, 54*(7), 470-483. https://doi.org/10.1093/abm/kaz064

Reynolds, A. M., Spaeth, A. M., Hale, L., Williamson, A. A., LeBourgeois, M. K., Wong, S. D., Hartstein, L. E., Levenson, J. C., Kwon, M., Hart, C. N., Greer, A., Richardson, C. E., Gradisar, M., Clementi, M. A., Simon, S. L., Reuter-Yuill, L. M., Picchietti, D. L., Wild, S., Tarokh, L., Sexton-Radek, K., Malow, B. A., Lenker, K. P., Calhoun, S. L., Johnson, D. A., Lewin, D., & Carskadon, M. A. (2023). Pediatric sleep: current knowledge, gaps, and opportunities for the future. *Sleep, 47*(7). https://doi.org/10.1093/sleep/zsad060

Riemann, D., & Perlis, M. L. (2009). The treatment of chronic insomnia: a review of benzodiazepine receptor agonists and psychological and behavioral therapies. *Sleep Medicine Reviews, 13,* 205-214. https://doi.org/10.2147/NSS.S129975

Rigney, G., Gulati, P., Corkum., P., & Weiss, S. K. (2023). Sleep disorders. In *Neurodevelopmental Pediatrics: Genetic and Environmental Influences* (pp. 613-629). Cham: Springer International Publishing.

Rigney, G., Isaacs, J., Weiss, S., Shea, S., & Corkum, P., 'Sleep-Wake Disorders', in Thomas H. Ollendick, Susan W. White, and Bradley A. White (eds), *The Oxford Handbook of Clinical Child and Adolescent Psychology,* Oxford Library of Psychology (2018).

Rigney, G., Ali, N. S., Corkum, P. V., Brown, C. A., Constantin, E., Godbout, R., Hanlon-Dearman, A., Ipsiroglu, O., Reid, G. J., Shea, S., Smith, I. M., Van der Loos, H. F. M., & Weiss, S. (2018). A systematic review to explore the feasibility of a behavioural sleep intervention for insomnia in children with neurodevelopmental disorders: A transdiagnostic approach. *Sleep Medicine Reviews, 41*, 244-254. https://doi.org/10.1016/j.smrv.2018.03.008.

Rigney, G., Keys, E., Johnson, M., Paul, J., & Corkum, P. (2021). Sleep Problems. In: Allen, J., Hawes, D.J., & Essau, C. (Eds.). *Family-Based Intervention for Child and Adolescent Mental Health: A Core Competencies Approach*. (pp. 191-206). Cambridge: Cambridge University Press.

Ritterbrand, L., Thorndike, F., Vasquez, D., & Saylor, D. (2010). Treatment credibility and satisfaction with internet interventions. In *Oxford Guide to Low Intensity CBT Interventions.* Oxford University Press. https://doi.org/10.1093/med:psych/9780199590117.003.0022

Roberts, C. A., Smith, K. C., & Sherman, A. K. (2019). Comparison of online and face-to-face parent education for children with autism and sleep problems. *Journal of Autism and Developmental Disorders, 49*, 1410-1422. https://doi.org/10.1007/s10803-018-3832-2

Roberts, S., & Ulmer, C. S. (2024). Barriers in access to and delivery of behavioral sleep treatments. *Current Sleep Medicine Reports, 10,* 70-80. https://doi.org/10.1007/s40675-023-00270-9

Robinson-Shelton, A., & Malow, B. A. (2016). Sleep disturbances in neurodevelopmental disorders. *Current Psychiatry Reports, 18*(1). https://doi.org/10.1007/s11920-015-0638-1

Robbins, R., Grandner, M. A., Buxton, O. M., Hale, L., Buysse, D. J., Knutson, K. L., Patel, S. R., Troxel, W. M., Youngstedt, S. D., Czeisler, C. A., & Jean-Louis, G. (2019). Sleep myths: an expert-led study to identify false beliefs about sleep that impinge upon population sleep health practices. *Sleep Health, 5*(4), 409-417. https://doi.org/10.1016/j.sleh.2019.02.002

Robbins, R., Beebe, D. W., Byars, K. C., Grandner, M., Hale, L., Tapia, I. E., Wolfson, A. R., & Owens, J. A. (2022). Adolescent sleep myths: identifying false beliefs that impact adolescent sleep and well-being. *Sleep Health, 8*(6), 632-639. https://doi.org/10.1016/j.sleh.2022.08.001

Rossman, J. (2019). Cognitive-behavioral therapy for insomnia: An effective and underutilized treatment for insomnia. *American Journal of Lifestyle Medicine, 13*(6), 544-547. https://doi.org/10.1177/1559827619867677

Rousseeuw, P., Croux, C., Todorov, V., Ruckstuhl, A., Salibian-Barrera, M., Verbeke, T., Koller, M., & Maechler, M. (n.d.). Robustbase: Basic robust statistics. *The Comprehensive R Archive Network (CRAN).* https://cran.r-project.org/web/packages/robustbase/index.html

Santarossa, S., Kane, D., Senn, C. Y., & Woodruff, S. J. (2018). Exploring the role of in-person components for online health behavior change interventions: Can a digital person-to-person component suffice? *Journal of Medical Internet Research, 20*(4): e144. https://doi.org/10.2196/jmir.8480

Salbach-Andrae, H., Klinkowski, N., Lenz, K., Lehmkuhl, U. (2010). Agreement between youth-reported and parent-reported psychopathology in a referred sample. *European Child Adolescent Psychiatry, 18*, 136-143. https://doi.org/10.1007/s00787-008-0710-z

Saleem, A. H., Al Rashed, F. A., Alkharboush, G. A., Almazyed, O. M., Olaish, A. H., Almeneessier, A. S., & BaHammam, A. S. (2017). Primary care physicians' knowledge of sleep medicine and barriers to transfer of patients with sleep disorders. *Saudi Medical Journal, 38*(5), 553–559. https://doi.org/10.15537/smj.2017.5.17936

Sadeh A, Raviv A, Gruber R. (2000). Sleep patterns and sleep disruptions in school-aged children. *Developmental Psychology, 36*(3), 291-301. https://doi.org/10.1037/0012-1649.36.3.291

Sadeh, A. (2008). Commentary: Comparing actigraphy and parental report as measure of children's sleep. *Journal of Pediatric Psychology, 33*(4), 406-407. https://doi.org/10.1093/jpepsy/jsn018

Sadeh A, Mindell J, Rivera L. (2011). "My child has a sleep problem": a cross-cultural comparison of parental definitions. *Sleep Medicine, 12*(5), 478–82. https://doi-org /10.1016/j.sleep.2010.10.008.

Sandlund, C., Kane, K., Ekstedt, M., Westman, J. (2018). Patients' experiences of motivation, change, and challenges in group treatment for insomnia in primary care: a focus group study. *BMC Family Practice, 19*(111), 1-11. https://doi.org/10.1186/s12875-018-0798-2

Senn, S. (1994). Testing for baseline balance in clinical trials. *Statistics in Medicine*, *13*(17), 1715-1726.

Shin, J. C., Kim, J., & Grigsby-Toussaint, D. (2017). Mobile phone interventions for sleep disorders and sleep quality: systematic review. *JMIR mHealth uHealth, 5*(9): e131. https://doi.org/10.2196/mhealth.7244

Schreck, K. A. (2022). Bedtime fading and bedtime fading with response cost. In: Handbook of Behavioral Sleep Treatment in Children on the Autism Spectrum. Springer, Cham. https://doi.org/10.1007/978-3-030-99134-0_10

Silva, G. E., Goodwin, J. L., Sherrill, D. L., Arnold, J. L., Bootzin, R. R., Smith, T., Walsleben, J. A., Baldwin, C. M., & Quan, S. F. (2007). Relationship between reported and measured sleep times: The sleep heart health study (SHHS). *Journal of Clinical Sleep Medicine, 3*(6), 622-630. https://doi.org/10.5664/jcsm.26974

Singareddy, R., Moole, S., Calhoun, S., Vocalan, P., Tsaoussoglou, M., Vgontzas, A. N., & Bixler, E. O. (2009). Medical complaints are more common in young school-aged children with parent reported insomnia symptoms. *Journal of Clinical Sleep Medicine, 5*(6), 549-553. https://doi.org/10.5664/jcsm.27656

Spielman, A. J., Caruso, L. S., & Glovinsky, P. B. (1987). A behavioral perspective on insomnia treatment. *Psychiatric Clinics of North America, 10*(4), 541-553. https://doi.org/10.1016/S0193-953X(18)30532-X

Ssegawa, J. K., & Muzinda, M. (2021). Feasibility assessment framework (FAF): A systematic and objective approach for assessing the viability of a project. *Procedia Computer Science, 181,* 377-385. https://doi.org/10.1016/j.procs.2021.01.180

Statistics Canada. (2022). *Canadian Internet Use Survey, 2022* (No. 11-001-X). https://www150.statcan.gc.ca/n1/en/daily-quotidien/230720/dq230720b-eng.pdf?st=wt0TYzt5

Statistics Canada. (2023). *Smartphone personal use and selected smartphone habits by gender and age group*. (No. 22-10-0143-01). https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=2210014301

Statistics Canada, (2011). *National Longitudinal Survey of Children and Youth*. www23.statcan.gc.ca/imdb-bmdi/instrument/3901_Q1_V4-eng.pdf

Stinson, K., Tang, N. K. Y., Harvey, A. G. (2006). Barriers to treatment seeking in primary insomnia in the united kingdom: a cross-sectional perspective. *Sleep, 29*(12), 1643-1646. https://doi.org/10.1093/sleep/29.12.1643

Still, B., & Crane, C. *Fundamentals of User-Centered Design: A practical Approach.* Bocca Raton, FL; CRC Press Taylor & Francis, 2017.

Stores G. (1996) Practitioner review: assessment and treatment of sleep disorders in children and adolescents. *Journal of Child Psychology Psychiatry, 37*(8)*, 907-25.* https://doi.org/10.1111/j.1469-7610.1996.tb01489.x

Stremler, R., Hodnett, E., Lee, K., MacMillan, S., Mill, C., Ongcangco, L., & Willan, A. (2006). A behavioral-educational intervention to promote maternal and infant sleep: A pilot randomized controlled trial. *Sleep, 29*(12), 1609-1615. https://doi.org/10.1136/bmj.f1164

Sullivan, S. S., & Cao, M. T. (2021). Sleep medicine exposure offered by United States residency training programs. *Journal of Clinical Sleep Medicine, 17*(4), 825-832. https://doi.org/10.5664/jcsm.9062

Sun, W., Ling, J., Zhu, X., Mei-Chun Lee, T., & Xin Li, S. (2019). Associations of weekday-to-weekend sleep difference with academic performance and health-related outcomes in school-age children and youths. *Sleep Medicine Reviews, 46,* 27-53. https://doi.org/10.1016/j.smrv.2019.04.003

Sung, V., Hiscock, H., Sciberras, E., & Efron, D. (2008). Sleep problems in children with attention-deficit / hyperactivity disorder: Prevalence and the effect on the child and family. *Archives of Pediatric and Adolescent Medicine, 162,* 336-342. https://doi.org/10.1001/archpedi.162.4.336

Sutherland, R., Nathan, N., Brown, A., Yoong, S., Finch, M., Lecathelinais, C., Reynolds, R., Walton, A., Janssen, L., Desmet, C., Gillham, K., Herrmann, V., Hall, A., Wiggers, J., & Wolfenden, L. (2019). A randomized controlled trial to assess the potential efficacy, feasibility and acceptability of an m-health intervention targeting parents of school aged children to improve the nutritional quality of foods packed in the lunchbox 'SWAP IT'. *International Journal of Behavioural Nutrition and Physical Activity, 16*(54), 1-13. https://doi.org/10.1186/s12966-019-0812-7

Tan, E., Healey, D., Gray, A. R., Galland, B. C. (2012). Sleep hygiene intervention for youth aged 10 to 18 years with problematic sleep: a before and after pilot study. *BMC Pediatrics, 12*(189), 1-9. https://doi.org/10.1186/1471-2431-12-189

Tan-MacNeill, K. M., Smith, I. M., & Corkum, P. V. (2023). Acceptability of an online intervention for insomnia in children with neurodevelopmental disorders. *Research in Developmental Disabilities, 134*, 104423. https://doi.org/10.1016/j.ridd.2023.104423

Tan-MacNeill, K. M., Smith, I. M., Weiss, S. K., Johnson, S. A., Chorney, J., Constantin, E., Shea, S., Hanlon-Dearman, A., Brown, C. A., Godbout, R., Ipsiroglu, O., Reid, G. J., & Corkum, P. V. (2020). An eHealth insomnia intervention for children with neurodevelopmental disorders: results of a usability study. *Research in Developmental Disabilities, 98*, 103573. https://doi.org/10.1016/j.ridd.2020.103573

Tarnowski, K. J., Simonian, S. J., Park, A., & Bekeny, P. (1992). Acceptability of treatments for child behavioral disturbance. *Child and Family Behavior Therapy, 14*(1), 25-37. https://doi.org/10.1300/J019v14n01_03

Tarnowski, K. J., Simonian, S. J. (1992). Assessing treatment acceptance: the abbreviated acceptability rating profile. *Journal of Behavioural Therapy and Experimental Psychiatry, 23*(2), 101-106. https://doi.org/10.1016/0005-7916(92)90007-6

Thomas, J. H., Moore, M., & Mindell, J. A. (2014). Controversies in behavioural treatment of sleep problems in young children. *Sleep Medicine Clinics, 9*(2), 251-259. https://doi.org/10.1016/j.jsmc.2014.02.004

Thomas, A. Grandner, M., Nowakowski, S., Nesom, G., Corbitt, C., Perlis, M. L. (2016). Where are the behavioural sleep medicine providers and where are they needed? A geographic assessment. *Behavioral Sleep Medicine, 14*(6), 687-698. https://doi.org/10.1080/15402002.2016.1173551

Tougas, M., Rigney, G., Chambers, C., Smith, I., Mugford, J., Keeler, L., Rajda, M., & Corkum, P. (2023). Focus groups to inform user-centered development of an eHealth sleep intervention for adolescents: perspectives of youth with insomnia symptoms with and without pain. *Children, 10*(1), 1692. https://doi.org/10.3390/children10101692

Tomaso, C. C., Johnson, A. B., & Nelson, T. D. (2021). The effect of sleep deprivation and restriction on mood, emotion, and emotion regulation: three meta-analyses in one. *Sleep, 44*(6). https://doi.org/10.1093/sleep/zsaa289

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. *International journal for quality in health care*, *19*(6), 349-357. https://doi.org/10.1093/intqhc/mzm042

Tunis, S. R., Stryer, D. B., Clancey, C. M. (2003). Practical Clinical Trials: Increasing the value of clinical research for decision making in clinical and health policy. *JAMA: The Journal of the American Medical Association, 290*(12), 1624-1632. https://doi.org/10.1001/jama.290.12.1624

Tryon, W. W. (2004). Issues of validity in actigraphic sleep assessment. *Sleep, 27*(1), 158-165. https//doi.org/10.1093/sleep/27.1.158

Van Dyk, T. R., Simmons, D. M., Durracio, K., Becker, S. P., & Byars, K. C. (2024). The role of psychiatric symptoms, sociodemographic factors, and baseline sleep variables on pediatric insomnia treatment outcomes in a clinically referred population. *Journal of Clinical Sleep Medicine,* jcsm-11232.

Vriend, J. L., Davidson, F. D., Corkum, P. V., Rusak, B., McLaughlin, & Chambers, C. T. (2012). Sleep quantity and quality in relation to daytime functioning in children. *Children's Health Care, 41,* 204-222. https://doi.org/10.1080/02739615.2012.685039

Weiss, S. K., & Corkum, P. (2012). Pediatric Behavioural Insomnia - "Good Night, Sleep Tight" for Child and Parent. *Insomnia Rounds*, *1*(5).

Werner, H., Molinari, L., Guyer, C., & Jenny, O. G. (2008). Agreement rates between actigraphy, diary, and questionnaire for children's sleep patterns. *Archives Pediatrics & Adolescent Medicine, 162*(4), 350-358. https://doi.org/10.1001/archpedi.162.4.350

Werner-Seidler, A., Johnston, L., & Christensen, H. (2018). Digitally-delivered cognitive-behavioural therapy for youth insomnia: a systematic review. *Internet Interventions, 11*(), 71-78. https://doi.org/10.1016/j.invent.2018.01.007

Whitehead, A. L., Sully, B. G. O., Campbell, M. J. (2014). Pilot and feasibility studies: is there a difference from each other and from a randomised controlled trial? *Contemporary Clinical Trials, 38*(1), 130-133. https://doi.org/10.1016/j.cct.2014.04.001.

Wilson, K. E., Miller, A. L., Bonuck, K., Lumeng, J. C., & Chervin, R. D. (2014). Evaluation of a sleep education program for low-income preschool children and their families. *Sleep*, *37*(6), 1117-1125. https://doi.org/10.5665/sleep.3774

Wing, Y. K., Chan, N. Y., Wai Man Yu, M., Ping Lam, S., Zhang, J., Xin Li, S., Pik Shan Kong, A., Martin Li, A. (2015). A school-based sleep education program for adolescents: A cluster randomized trial. *Pediatrics, 135*(3), e637. https://doi.org/10.1542/peds.2014-2419

Wosik, J., Fudim, M., Cameron, B., Gellad, Z. F., Cho, A., Phinney, D., Curtis, S., Roman, M., Poon, E. G., Ferranti, J., Katz, J. N., & Tcheng, J. (2020). Telehealth transformation: COVID-19 and the rise of virtual care. *Journal of the American*

Medical Informatics Association, 27(6), 957-962. https://doi.org/10.1093/jamia/ocaa067

Yoshizaki, A., Ikuko, M., Yamamoto, T., Shirota, A., Okada, S., Murata, E., Hoshino, K., Kato-Nishimura, K., Matsuzawa, S., Kato, T., & Taniike, M. (2020). An interactive smartphone app, nenne navi, for improving children's sleep: Pilot usability study. *JMIR Pediatric Parent, 3*(2): e22102. https://doi.org/10.2196/22102

Yoshizaki, A., Murata, E., Yamamoto, T., Fujisawa, T. X., Hanaie, R., Hirata, I., Matsumoto, S., Mohri, I., & & Taniike, M. (2023). Improving children's sleep habits using an interactive smartphone app: Community-based intervention study. *JMIR mHealth uHealth, 11*: e40836. https://doi.org/10.2196/40836

Zhai, S., Chu, F., Tan, M., Chi, N., Ward, T., & Weichao, Y. (2023). Digital health interventions to support family caregivers: An updated systematic review. *Digital Health, 9*, 1-49. https://doi.org/10.1177/20552076231171967

Zhang, L., Yang, Y., Luo, Y., Liu, Z., Jia, C., & Liu, X. (2022). A longitudinal study of insomnia, daytime sleepiness, and academic performance in Chinese adolescents. *Behavioural Sleep Medicine, 20*(6)*, 798-808. https://doi.org/10.1080/15402002.2021.2021.202

Zhou, E. S., Mazzenga, M., Gordillo, M. L., Meltzer, L. J., Long, K. A. (2021). Sleep education and training among practicing clinical psychologists in the United States and Canada. *Behavioural Sleep Medicine, 19*(6), 744-753. https://doi.org/10.1080/15402002.2020.1860990

Zhou, E. S., & Owens, J. (2016). Behavioral treatments for pediatric insomnia. *Current Sleep Medicine Reports, 2,* 127-135. https://doi.org/10.1007/s40675-016-0053-0

Zhu, H., Xiao, L., & Tu, A. (2022). Effectiveness of technology-based interventions for improving sleep among children: a systematic review and meta-analysis. *Sleep Medicine, 91*, 141-150. https://doi.org/10.1016/j.sleep.2022.02.013

Appendix A

Study 1 Measures

Measure 1: Eligibility Questionnaire (EQ)

"Thank you for your interest in the *ABCs of SLEEPING* feasibility study. The first step is to make sure that you and your child meet the criteria to participate in the study. You will be asked to answer 12 questions that will take no more 5 minutes. All questions must be answered in order to complete this section. Please complete the questions thinking about the child you would like to have involved in this study." [All screening questions are mandatory]

1. Are you the legal and primary caregiver to the child who you would like to enroll in this study? [Yes/No] [Inclusion criteria - Yes response required]
2. Do you live in Canada? [Yes/No] [Inclusion criteria - Yes response required]
3. In which province/territory do you live? [Drop down menu of province and territories][Sample description factor - Not inclusion / exclusion criteria]
4. What are the first 3 digits of your postal code? [Not inclusion / exclusion criteria]
5. Do you have regular access to a high-speed internet connection? [Yes/No] [Inclusion criteria - Yes response required]
6. Are you comfortable communicating in English for day-to-day tasks (e.g., listening to the news on the radio or watching TV, reading books, magazines, etc.)? [Yes/No] [Inclusion criteria - Yes response required]
7. Is your child between 6 and 12 years old (i.e., has not turned 13 yet)? [Yes/No] [Inclusion criteria - Yes response required]
8. Has your child been diagnosed with a significant medical disorder that would impact sleep (e.g., Asthma causing night wakings, Cerebral Palsy)? [Yes/No] [Exclusion criteria – No response required]
9. Has your child been diagnosed with a significant mental health disorder (e.g., anxiety, depression), neurodevelopmental disorder (e.g., attention-deficit hyperactivity disorder, autism spectrum disorder) or a medically-based sleep disorder (e.g., sleep apnea) [Yes/No] [Exclusion criteria – No response required]
10. Does your child have one of the following sleep problems relevant to this study?
    a. Does your child have problems falling asleep? ("Problems falling asleep" means lying awake in bed after lights out for an extended period of time (20 minutes or more), calling out to parents, or getting out of bed. Some children may also cry at bedtime.) [Yes/No]

b. Does your child have problems staying asleep? ("Problems staying asleep" mean frequent night-wakings and difficulty falling back to sleep after a night-waking. This may also happen when children wake up their parents to get help falling back to sleep, or sneaking into their parents' bed.) [Yes/No]
c. Does your child have problems following bedtime routines? ("Problems following bedtime routines" means difficulty following parents' requests, resistance to parents' requests, difficulty following a schedule, needing constant reminders for each task during the bedtime routine, etc.) [Yes/No]

[Inclusion criteria - Yes response required for any of the following: 10 a, b, or c]

12. How did you hear about The *ABCs of SLEEPING* feasibility study? (Check all that apply) [Not inclusion / exclusion criteria]
    a. Google search
    b. Family doctor
    c. Pediatrician
    d. Psychologist
    e. Family member
    f. Friend
    g. Colleague
    h. National advertisement
    i. Local advertisement [If selected, text box appears:]
    j. Facebook
    k. Twitter
    l. Magazine [If selected, textbox appears for name of magazine]
    m. Other [if selected, textbox appears to specify source]

Measure 2: Demographic Questionnaire (DQ)

The following questions allow us to describe the children and their families who participate in the study. This will allow us to compare the families participating in our study to the general Canadian population. We never report on an individual's data but rather we will report on group data (e.g. "On average the families who participated in this study had more/less children than the average").

1. How would you describe the community where you live?
    - Rural
    - Town
    - City under 500,000 people
    - City over 500,000 people

2. How many children (biological, step, adopted or foster children) currently live in your home? What are their ages and sex? Children in joint custody should be included in the home of the parent where they live most of the time.
    [Drop down Menu: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10+children]
    [Textbox: Child's age]
    [1-10 textboxes depending on # of children]
    [Radio Button: Boy, Girl, Other]
    [1-10 radio buttons depending on # of children]

3. How many adults (who are not your children) currently live in your home? [Textbox]

4. What is **your** relationship to your child who is participating in this study?
    - Biological Mother
    - Biological Father
    - Adoptive Mother
    - Adoptive Father
    - Step Mother
    - Step Father
    - Foster Mother
    - Foster Father
    - Grandmother
    - Grandfather
    - Other (please specify): [Textbox]

5. Do you have a spouse or partner who lives in this home?
    - Yes [If Yes answer question 6. If No skip to Question 7.]
    - No

6. What is your spouse or partner's relationship to the child participating in the study?
    - Biological Mother
    - Biological Father
    - Adoptive Mother
    - Adoptive Father
    - Step Mother
    - Step Father
    - Foster Mother
    - Foster Father
    - Grandmother
    - Grandfather
    - Other (please specify): [Textbox]

7. What is your current marital status?
    - Single, never married
    - Legally married (and not separated)
    - Common-law relationship (Common-law refers to two people living together as a couple who are not legally married to one another)
    - Separated (but still legally married)
    - Divorced
    - Widowed

8. What is the primary language spoken at home to the child participating in this study? (The primary language spoken is the one you use most often when speaking to your child.)
    - English
    - French
    - Both English and French
    - Other (please specify): [Textbox]

9. Does your child speak any other languages (i.e., other than their primary language) **on a regular basis** at home?
    - English
    - French
    - Other (please specify): [Textbox]

10. Of what country is your child a citizen?
    - Canada, by birth
    - Canada, by naturalization [whereby an immigrant is granted Canadian citizenship, under the Citizenship *Act*]
    - Other [Textbox]

11. What is the hand preference of your child? (Hand participant/subject uses predominately, not necessarily hand he/she writes with exclusively)
   - Left
   - Right
   - Both Hands
   - Unknown

12. How would you best describe **your child's** ethnic or cultural heritage?
   - White/Caucasian
   - Black (e.g., African, Haitian, Jamaican, Somali)
   - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
   - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
   - Chinese
   - Filipino
   - Latin-American
   - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
   - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
   - West Asian (e.g., Iranian, Afghan, etc.)
   - Korean
   - Japanese
   - Other (Please Specify) [Textbox]

13. How would you best describe **your** ethnic or cultural heritage?
   - White/Caucasian
   - Black (e.g., African, Haitian, Jamaican, Somali)
   - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
   - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
   - Chinese
   - Filipino
   - Latin-American
   - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
   - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
   - West Asian (e.g., Iranian, Afghan, etc.)
   - Korean
   - Japanese
   - Other (Please Specify) [Textbox]

14. What is the highest level of education <u>you</u> have ever attained in your lifetime? Please select ONE:
- Less than Elementary/Junior High School / High school
- Some High School
- Completed High School (Or equivalent)
- Some Trade, Technical or Vocational School, or Business College
- Some Community College, CEGEP, or Nursing School
- Some University
- Diploma or Certificate from Community College, CEGEP, Nursing School or University
- Diploma or Certificate from Trade, Technical or Vocational School, or Business College
- Bachelors / Undergraduate Degree or Teacher's College (e.g., B.A., B.Sc., B.Ed.)
- Master's Degree (e.g., M.A., M.Sc., M.Ed.)
- Degree in Medicine (M.D.), Dentistry (D.D.S., D.M.D.), Veterinary Medicine (D.V.M.), Optometry (O.D.) or Law (LL.B)
- Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
- Other (Please specify) [Textbox]

15. How would you describe your current employment status?
- Full Time
- Part Time
- Unemployed
- Retired
- Student
- Self –employed
- Homemaker
- Other (Please specify) [Textbox]

16. Which of the following best describes the hours you usually work?
- Regular – daytime schedule or shift
- Regular – evening shift
- Regular – night shift
- Rotating Shift (change from days to evenings to nights)
- Split shift (A shift comprising of two or more separate periods of duty in a working day)
- On call (A time period in which you are not at work, but must make yourself available to go in)
- Irregular schedule (none of the above)
- Other (Please specify) [Textbox]

17. If you are currently employed (either part-time or full-time), what is the title of your position (e.g., Nurse, Carpenter, etc.) [Textbox]

18. Please estimate in which of the following groups your household income falls. (Stated as: Total Wages and Salaries, including commissions, bonuses, tips, taxable benefits, research grants, royalties, etc. before any deductions)
    * Under $5,000
    * $5,000 to $9,999
    * $10,000 to $14,999
    * $15,000 to $19,999
    * $20,000 to $29,999
    * $30,000 to $39,999
    * $40,000 to $49,999
    * $50,000 to $59,999
    * $60,000 to $79,999
    * $80,000 to $99,999
    * $100,000 to $124,999
    * $125,000 to $149,999
    * $150,000 and over
    * Prefer not to answer

If you live with a partner/spouse, please complete questions 19-23. If not, please skip to questions 24.

19. What is the highest level of education **your partner/spouse** has ever attained in his/her lifetime?
    * Less than Elementary/Junior High School/High school
    * Some High School
    * Completed High School (Or equivalent)
    * Some Trade, Technical or Vocational School, or Business College
    * Some Community College, CEGEP, or Nursing School
    * Some University
    * Diploma or Certificate from Community College, CEGEP, Nursing School or University
    * Diploma or Certificate from Trade, Technical or Vocational School, or Business College
    * Bachelors / Undergraduate Degree or Teacher's College (e.g., B.A., B.Sc., B.Ed.)
    * Master's Degree (e.g., M.A., M.Sc., M.Ed.)
    * Degree in Medicine (M.D.), Dentistry (D.D.S., D.M.D.), Veterinary Medicine (D.V.M.), Optometry (O.D.) or Law (LL.B)
    * Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
    * Other (Please specify) [Textbox]

20. How would you best describe **your spouse's/partner's** ethnic or cultural heritage?
    - White/Caucasian
    - Black (e.g., African, Haitian, Jamaican, Somali)
    - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
    - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
    - Chinese
    - Filipino
    - Latin-American
    - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
    - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
    - West Asian (e.g., Iranian, Afghan, etc.)
    - Korean
    - Japanese
    - Other (Please Specify) [Textbox]

21. How would you describe **your partner/spouse's** current employment status?
    - Full Time
    - Part Time
    - Unemployed
    - Retired
    - Student
    - Self –employed
    - Homemaker
    - Other (Please specify) [Textbox]

22. Which of the following best describes the hours your partner/spouse usually work?
    - Regular – daytime schedule or shift
    - Regular – evening shift
    - Regular – night shift
    - Rotating Shift (Change from days to evenings to nights)
    - Split shift (A shift comprising of two or more separate periods of duty in a working day)
    - On call (A time period in which you are not at work, but must make yourself available to go in)
    - Irregular schedule (none of the above)
    - Other (Please specify) [Textbox]

23. If your partner/spouse is employed (either part-time or full-time), what is the title of his/her position (e.g., Nurse, Carpenter) [Textbox]

The following questions refer to a biological parent who is **not living in your house**. Please complete these questions about your child's other biological parent regardless of whether you live with someone else or if your child contact with his/her other biological parent on a regular basis.

24. Please check below to determine if these following questions apply to your family:
    - My child's other biological family lives with us in our home
    - My child's other biological parent has little/no contact with my child and I do not know this type of information
    - Although my child's other biological has contact with my child, I do not know this demographic   information about him/her
    - My child's other biological parent does not live with us, but I can answer these questions about him/her
    - I don't wish to share this information

[If #4, then Q25-Q29 will appear]
25. What is the highest level of education **your child's other biological parent** has attained in his/her lifetime? Please select ONE:
    - Less than Elementary / Junior High School / High school
    - Some High School
    - Completed High School (Or equivalent)
    - Some Trade, Technical or Vocational School, or Business College
    - Some Community College, CEGEP, or Nursing School
    - Some University
    - Diploma or Certificate from Community College, CEGEP, Nursing School or University
    - Diploma or Certificate from Trade, Technical or Vocational School, or Business College
    - Bachelors / Undergraduate Degree or Teacher's College (e.g., B.A., B.Sc., B.Ed.)
    - Master's Degree (e.g., M.A., M.Sc., M.Ed.)
    - Degree in Medicine (M.D.), Dentistry (D.D.S., D.M.D.), Veterinary Medicine (D.V.M.), Optometry (O.D.) or Law (LL.B)
    - Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
    - Other (Please specify) [Text box]

26. How would you describe your child's other biological parent's current employment status?
    - Full Time
    - Part Time
    - Unemployed
    - Retired
    - Student
    - Self-employed
    - Homemaker
    - Other (Please specify) [Text box]

27. If your child's other biological parent is employed (either part-time or full-time), what is the title of their position? (e.g., Nurse, Carpenter) [Text box]

28. How would you best describe **your child's other biological parent's** ethnic or cultural heritage?
    - White/Caucasian
    - Black (e.g., African, Haitian, Jamaican, Somali)
    - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
    - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
    - Chinese
    - Filipino
    - Latin-American
    - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
    - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
    - West Asian (e.g., Iranian, Afghan, etc.)
    - Korean
    - Japanese
    - Other (Please Specify) [Textbox]

29. How much contact does your child have with his/her biological father/mother?
    - Daily
    - More than once per week
    - Once per week
    - A few times per month
    - Once per month
    - Less than once per month
    - Once per year
    - Less often than once per year (rarely has contact)
    - Never

Measures 3-5

Due to copyright restrictions, copies of the following questionnaire are not able to be shared. However, you may access these questionnaires online with permission at the links provided below.

Measure 3: Children's Sleep Habits Questionnaire (CSHQ):
https://depts.washington.edu/dbpeds/Screening%20Tools/ScreeningTools.html

Measure 4: Bedtime Routines Questionnaire (BRQ):
https://link.springer.com/article/10.1007/s10862-009-9143-3#appendices

Measure 5: Pediatric Insomnia Severity Index (PISI)
https://academic.oup.com/view-large/figure/73910087/jsw077f1.tif

Measure 6: Acceptability Questionnaire (AQ)

The following questions will ask you to report your satisfaction with the *ABCs of SLEEPING* tool. Please think about your general feelings towards this tool's suitability for you and your child and how satisfied you were with the tool. This questionnaire will take 10 minutes to complete.

(1 = Strongly Disagree, 2= Disagree, 3= Neutral, 4 = Agree, 5 = Strongly Agree): [Provide options 1-5 for each question]

When a participant selects their answer, a drop-down box will appear requiring them to provide a reason why.

1. I was satisfied with the *ABCs of SLEEPING* Check-in

2. I was satisfied with the *ABCs of SLEEPING* Sleep Tips

3. I was satisfied with the *ACBs of SLEEPING* Sleep Report

4. The sleep recommendations were suitable for my child's sleep problems

5. The sleep recommendations were suitable for my child's age

6. The *ABCs of SLEEPING* tool was easy to use [if disagree, why?]

7. I intend on continuing to implement the sleep tips

8. I see myself using the sleep tips 6 months from now

9. Please provide any additional feedback that you may have on our tool (e.g., the language used in the program) **[Textbox for response]**

Measure 7: Fidelity Survey (FS)

The following questions will ask you to report how often you used the information in the *ABCs of SLEEPING* sleep tips. Please think about how often you used this information over the past week. This questionnaire will take 5 minutes to complete.

1. This week, how many days did you use the information in the *ABCs of SLEEPING* sleep tips to help improve your child's sleep?
   Response format:
   7 (7 days this week), 6 (6 days this week), 5 (5 days this week), 4 (4 days this week), 3 (3 days this week), 2 (2 days this week), and 1 (1 day this week)

2. Thinking of this week, what made the *ABCs of SLEEPING* sleep tips easy to use? **[Textbox for response]**

3. Thinking of this week, what made the *ABCs of SLEEPING* sleep tips hard to use? **[Textbox for response]**

Study 2 Measures

Measure 1: Eligibility Questionnaire (EQ)

Thank you for your interest in the *ABCs of SLEEPING* study. The first step is to make sure that you and your child meet the criteria to participate in the study. You will be asked to answer 14 questions that will take no more 5 minutes. All questions must be answered to determine eligibility to participate in this study. If you have more than one child, please complete the following questions thinking about the one child you would like to have involved in this study. [All screening questions are mandatory]

1. Are you the legal and primary caregiver to the child who you would like to enroll in this study? [Yes/No] [Inclusion criteria - Yes response required]
2. Is your child between 6 and 12 years old (i.e., has not turned 13 yet)? [Yes/No] [Inclusion criteria - Yes response required]
3. Does your child have one of the following sleep problems relevant to this study?
   a. Does your child have problems falling asleep? ("Problems falling asleep" means lying awake in bed after lights out for an extended period of time (20 minutes or more), calling out to parents, or getting out of bed. Some children may also cry at bedtime.) [Yes/No]
   b. Does your child have problems staying asleep? ("Problems staying asleep" mean frequent night-wakings and difficulty falling back to sleep after a night-waking. This may also happen when children wake up their parents to get help falling back to sleep, or sneaking into their parents' bed.) [Yes/No]
   c. Does your child have problems following bedtime routines? ("Problems following bedtime routines" means difficulty following parents' requests, resistance to parents' requests, difficulty following a schedule, needing constant reminders for each task during the bedtime routine, etc.) [Yes/No]
   [Inclusion criteria - Yes response required for any of the 10 a, b, or c]
4. Do you live in Canada? [Yes/No] [Inclusion criteria - Yes response required]
   a. In which province/territory do you live? [Drop down menu of province and territories][Sample description factor - Not inclusion / exclusion criteria]
   b. What are the first 3 digits of your postal code? [Not inclusion / exclusion criteria]
5. Do you have access to either a laptop, computer and/or tablet? [Yes/No] [Inclusion criteria - Yes response required]
6. Do you have regular access to a smartphone that has an App-store (e.g., Apple or Android device)? [Yes/No] [Inclusion criteria - Yes response required]

7. Do you have regular access to a high-speed internet connection? [Yes/No] [Inclusion criteria - Yes response required]
8. Do you have access to an email address that you regularly check? [Yes/No] [Inclusion criteria - Yes response required]
9. Are you comfortable communicating in English for day-to-day tasks (e.g., listening to the news on the radio or watching TV, reading books, magazines, etc.)? [Yes/No] [Inclusion criteria - Yes response required]
10. Has your child been diagnosed with a significant medical disorder that would impact sleep (e.g., Asthma causing night wakings, Cerebral Palsy)? [Yes/No] [Exclusion criteria – No response required to be eligible]
11. Has your child been diagnosed with a significant mental health disorder (e.g., anxiety, depression), neurodevelopmental disorder (e.g., attention-deficit hyperactivity disorder, autism spectrum disorder) [Yes/No] [Exclusion criteria – No response required to be eligible]
12. Has your child been diagnosed with a medically-based sleep disorder (e.g., sleep apnea) or do you have concerns about your child's breathing while sleeping? [Exclusion criteria – No response required to be eligible]
13. Does your child currently take medication to treat their sleep problems (i.e., improve their sleep)? Or medications for other purposes that currently impact their sleep (e.g., stimulant medication that has caused impact to your child's sleep)? And would this be the case for the entire duration of the study (e.g., approximately 1.5 months)?
    - Yes, please specify [textbox]
    - No [Exclusion criteria – No response required to be eligible]

15. How did you hear about The *ABCs of SLEEPING* pilot study? (Check all that apply) [Not inclusion / exclusion criteria]
    a. Google search
    b. Family doctor
    c. Pediatrician
    d. Psychologist
    e. Family member
    f. Friend
    g. Colleague
    h. National advertisement
    i. Local advertisement [If selected, text box appears:]
    j. Facebook
    k. Twitter
    l. Other [if selected, textbox appears to specify source]

Measure 2: Demographic Questionnaire (DQ)

The following questions allow us to describe the children and their families who participate in the study. This will allow us to compare the families participating in our study to the general Canadian population. We never report on an individual's data but rather we will report on group data (e.g. "On average the families who participated in this study had more/less children than the average").

1. How would you describe the community where you live?
   - Rural
   - Town
   - City under 500,000 people
   - City over 500,000 people

2. How many children (biological, step, adopted or foster children) currently live in your home? What are their ages and sex? Children in joint custody should be included in the home of the parent where they live most of the time.
   [Drop down Menu: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10+children]
   [Textbox: Child's age]
   [1-10 textboxes depending on # of children]
   [Radio Button: Boy, Girl, Other]
   [1-10 radio buttons depending on # of children]

3. How many adults (who are not your children) currently live in your home? [Textbox]

4. What is **your** relationship to your child who is participating in this study?
   - Biological Mother
   - Biological Father
   - Adoptive Mother
   - Adoptive Father
   - Step Mother
   - Step Father
   - Foster Mother
   - Foster Father
   - Grandmother
   - Grandfather
   - Other (please specify): [Textbox]

5. Do you have a spouse or partner who lives in this home?
   - Yes [If Yes answer question 6. If No skip to Question 7.]
   - No

6. What is your spouse or partner's relationship to the child participating in the study?
   - Biological Mother
   - Biological Father
   - Adoptive Mother
   - Adoptive Father
   - Step Mother
   - Step Father
   - Foster Mother
   - Foster Father
   - Grandmother
   - Grandfather
   - Other (please specify): [Textbox]

7. What is your current marital status?
   - Single, never married
   - Legally married (and not separated)
   - Common-law relationship (Common-law refers to two people living together as a couple who are not legally married to one another)
   - Separated (but still legally married)
   - Divorced
   - Widowed

8. What is the primary language spoken at home to the child participating in this study? (The primary language spoken is the one you use most often when speaking to your child.)
   - English
   - French
   - Both English and French
   - Other (please specify): [Textbox]

9. Does your child speak any other languages (i.e., other than their primary language) **on a regular basis** at home?
   - English
   - French
   - Other (please specify): [Textbox]

10. Of what country is your child a citizen?
    - Canada, by birth
    - Canada, by naturalization [whereby an immigrant is granted Canadian citizenship, under the Citizenship *Act*]
    - Other [Textbox]

11. What is the hand preference of your child? (Hand participant/subject uses predominately, not necessarily hand he/she writes with exclusively)
    - Left
    - Right
    - Both Hands
    - Unknown

12. How would you best describe **your child's** ethnic or cultural heritage?
    - White/Caucasian
    - Black (e.g., African, Haitian, Jamaican, Somali)
    - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
    - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
    - Chinese
    - Filipino
    - Latin-American
    - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
    - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
    - West Asian (e.g., Iranian, Afghan, etc.)
    - Korean
    - Japanese
    - Other (Please Specify) [Textbox]

13. How would you best describe **your** ethnic or cultural heritage?
    - White/Caucasian
    - Black (e.g., African, Haitian, Jamaican, Somali)
    - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
    - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
    - Chinese
    - Filipino
    - Latin-American
    - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
    - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
    - West Asian (e.g., Iranian, Afghan, etc.)
    - Korean
    - Japanese
    - Other (Please Specify) [Textbox]

14. What is the highest level of education <u>you</u> have ever attained in your lifetime? Please select ONE:
    - Less than Elementary/Junior High School / High school
    - Some High School
    - Completed High School (Or equivalent)
    - Some Trade, Technical or Vocational School, or Business College
    - Some Community College, CEGEP, or Nursing School
    - Some University
    - Diploma or Certificate from Community College, CEGEP, Nursing School or University
    - Diploma or Certificate from Trade, Technical or Vocational School, or Business College
    - Bachelors / Undergraduate Degree or Teacher's College (e.g., B.A., B.Sc., B.Ed.)
    - Master's Degree (e.g., M.A., M.Sc., M.Ed.)
    - Degree in Medicine (M.D.), Dentistry (D.D.S., D.M.D.), Veterinary Medicine (D.V.M.), Optometry (O.D.) or Law (LL.B)
    - Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
    - Other (Please specify) [Textbox]

15. How would you describe your current employment status?
    - Full Time
    - Part Time
    - Unemployed
    - Retired
    - Student
    - Self –employed
    - Homemaker
    - Other (Please specify) [Textbox]

16. Which of the following best describes the hours you usually work?
    - Regular – daytime schedule or shift
    - Regular – evening shift
    - Regular – night shift
    - Rotating Shift (change from days to evenings to nights)
    - Split shift (A shift comprising of two or more separate periods of duty in a working day)
    - On call (A time period in which you are not at work, but must make yourself available to go in)
    - Irregular schedule (none of the above)
    - Other (Please specify) [Textbox]

17. If you are currently employed (either part-time or full-time), what is the title of your position (e.g., Nurse, Carpenter, etc.) [Textbox]

18. Please estimate in which of the following groups your household income falls. (Stated as: Total Wages and Salaries, including commissions, bonuses, tips, taxable benefits, research grants, royalties, etc. before any deductions)
    - Under $5,000
    - $5,000 to $9,999
    - $10,000 to $14,999
    - $15,000 to $19,999
    - $20,000 to $29,999
    - $30,000 to $39,999
    - $40,000 to $49,999
    - $50,000 to $59,999
    - $60,000 to $79,999
    - $80,000 to $99,999
    - $100,000 to $124,999
    - $125,000 to $149,999
    - $150,000 and over
    - Prefer not to answer

If you live with a partner/spouse, please complete questions 19-23. If not, please skip to questions 24.

19. What is the highest level of education **your partner/spouse** has ever attained in his/her lifetime?
    - Less than Elementary/Junior High School/High school
    - Some High School
    - Completed High School (Or equivalent)
    - Some Trade, Technical or Vocational School, or Business College
    - Some Community College, CEGEP, or Nursing School
    - Some University
    - Diploma or Certificate from Community College, CEGEP, Nursing School or University
    - Diploma or Certificate from Trade, Technical or Vocational School, or Business College
    - Bachelors / Undergraduate Degree or Teacher's College (e.g., B.A., B.Sc., B.Ed.)
    - Master's Degree (e.g., M.A., M.Sc., M.Ed.)
    - Degree in Medicine (M.D.), Dentistry (D.D.S., D.M.D.), Veterinary Medicine (D.V.M.), Optometry (O.D.) or Law (LL.B)
    - Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
    - Other (Please specify) [Textbox]

20. How would you best describe **your spouse's/partner's** ethnic or cultural heritage?
    - White/Caucasian
    - Black (e.g., African, Haitian, Jamaican, Somali)
    - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
    - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
    - Chinese
    - Filipino
    - Latin-American
    - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
    - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
    - West Asian (e.g., Iranian, Afghan, etc.)
    - Korean
    - Japanese
    - Other (Please Specify) [Textbox]

21. How would you describe **your partner/spouse's** current employment status?
    - Full Time
    - Part Time
    - Unemployed
    - Retired
    - Student
    - Self –employed
    - Homemaker
    - Other (Please specify) [Textbox]

22. Which of the following best describes the hours your partner/spouse usually work?
    - Regular – daytime schedule or shift
    - Regular – evening shift
    - Regular – night shift
    - Rotating Shift (Change from days to evenings to nights)
    - Split shift (A shift comprising of two or more separate periods of duty in a working day)
    - On call (A time period in which you are not at work, but must make yourself available to go in)
    - Irregular schedule (none of the above)
    - Other (Please specify) [Textbox]

23. If your partner/spouse is employed (either part-time or full-time), what is the title of his/her position (e.g., Nurse, Carpenter) [Textbox]

The following questions refer to a biological parent who is **not living in your house**. Please complete these questions about your child's other biological parent regardless of whether you live with someone else or if your child contact with his/her other biological parent on a regular basis.

24. Please check below to determine if these following questions apply to your family:
    - My child's other biological family lives with us in our home
    - My child's other biological parent has little/no contact with my child and I do not know this type of information
    - Although my child's other biological has contact with my child, I do not know this demographic   information about him/her
    - My child's other biological parent does not live with us, but I can answer these questions about him/her
    - I don't wish to share this information

[If #4, then Q25-Q29 will appear]
25. What is the highest level of education **your child's other biological parent** has attained in his/her lifetime? Please select ONE:
    - Less than Elementary / Junior High School / High school
    - Some High School
    - Completed High School (Or equivalent)
    - Some Trade, Technical or Vocational School, or Business College
    - Some Community College, CEGEP, or Nursing School
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    - Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
    - Other (Please specify) [Text box]

26. How would you describe your child's other biological parent's current employment status?
    - Full Time
    - Part Time
    - Unemployed
    - Retired
    - Student
    - Self-employed
    - Homemaker
    - Other (Please specify) [Text box]

27. If your child's other biological parent is employed (either part-time or full-time), what is the title of their position? (e.g., Nurse, Carpenter) [Text box]

28. How would you best describe **your child's other biological parent's** ethnic or cultural heritage?
   - White/Caucasian
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   - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
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   - Chinese
   - Filipino
   - Latin-American
   - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
   - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
   - West Asian (e.g., Iranian, Afghan, etc.)
   - Korean
   - Japanese
   - Other (Please Specify) [Textbox]

29. How much contact does your child have with his/her biological father/mother?
   - Daily
   - More than once per week
   - Once per week
   - A few times per month
   - Once per month
   - Less than once per month
   - Once per year
   - Less often than once per year (rarely has contact)
   - Never

Measures 3-6

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https://depts.washington.edu/dbpeds/Screening%20Tools/ScreeningTools.html

Measure 4: Bedtime Routines Questionnaire (BRQ):
https://link.springer.com/article/10.1007/s10862-009-9143-3#appendices

Measure 5: Pediatric Insomnia Severity Index (PISI):
https://academic.oup.com/view-large/figure/73910087/jsw077f1.tif

Measure 6: Strengths and Difficulties Questionnaire (SDQ):
https://depts.washington.edu/dbpeds/Screening%20Tools/ScreeningTools.html

Measure 7: Philips Actiwatch 2 (Actigraphy)

Participants are instructed to have their child wear the Philips Actiwatch 2 (i.e., "actigraphy" also referred to as "actigraph") on their non-dominant hand continuously for a one-week period. During this one-week, participants should remove the actigraph if there is risk to damaging the device (e.g., bath-time, sports) or if their child needs a break (i.e., the child would like to not wear it for a time period that is documented in the Sleep Diary). If removing the actigraph, participants will be instructed to keep careful track of the device when it is not being worn.

The Philips Actiwatch 2 has various features that are detailed on the Philips website: https://www.usa.philips.com/healthcare/product/HC1044809/actiwatch-2-activity-monitor. These features include collecting various types of sleep data (e.g., sleep quantity), long-term battery life, etc. The device's specifications can also be found using this link. Please see below for an image of what this device looks like:

Actigraphy Information for Parents

Introduction

As part of your child's participation in the *ABCs of SLEEPING* study, your child will wear an "actigraph". An actigraph is a small device worn like a watch. It is battery operated and has a motion detector called an accelerometer and a small computer chip inside.

All actigraph files are encrypted and do not contain personal information. We will only use an identification number, actigraph serial number and the download date/time as identifiers. An actigraph does **not** contain a location tracking system (GPS).

What information does the actigraph capture?

When your child moves, those movements are recorded on the computer chip. The actigraph will estimate sleep based on movement. We will look at your child's actigraphy recordings to determine when they were awake and asleep.

> **Down for the Night** is the time that your child is supposed to fall asleep
> (i.e., the time you want or expect your child to fall asleep)

Event Select button

Press the "Event Select" button (silver button on the side of the actigraph) when your child is Down for the Night. Hold the button down for 1 second. You will not hear a click or see a flash but the event will be marked by the actigraph. This will help us to match the actigraphy data and your Sleep Diary data.

HOW TO WEAR THE ACTIGRAPH

- The actigraph should be worn on your child's least dominant hand (i.e., the hand not used to print/write with). So if your child is right-handed, he/she should wear the actigraph on their left wrist. *The actigraph should **NOT** be worn on the ankle*
- Strap should be snug (but not tight) on your child's wrist
- It is important that the actigraph does not move around
- If you are concerned about your child wearing the actigraph against their skin, you may place it on top of their sleeve
- Actigraphs are expensive! Please make sure your child understands how to wear the actigraph and coach your child on how to treat and wear the actigraph

When should the actigraph be worn?

- The actigraph should be worn continuously all day and night (24 hours)
- Remove the actigraph if in the shower, bath or pool. The actigraphy is water resistant but not waterproof
- Actigraphs are durable for everyday use, but should not be worn when playing roughly or during rough physical sports where it might fall off

- If the actigraph is removed for any length of time, it is very important that the times are recorded in your Sleep Diary

Returning the actigraph
We will let you know when to return the actigraph. It's very important that you have completed 7 days of Sleep Diary and actigraph together.

TROUBLE SHOOTING AND QUESTIONS

Is the Actigraph set up for me?
Yes. It is ready to be put on your child as soon as you receive it. The actigraph will automatically begin collecting information about your child's sleep.

My child or myself pressed the "Event Select" button multiple times
Try to press this button only once. Coach your child to not press the button. However, pressing the button multiple times will not hurt the actigraph, but makes it harder for us to interpret the sleep data.

I pressed the button at the wrong time
Make a note of this in the Sleep Diary under "Additional Information". Again, this does not hurt the actigraph, but makes it harder for us to interpret the sleep data; so try not to press it except at the requested times.

My child is refusing to wear the actigraph!
We understand that some children may find wearing the actigraphy to be strange and may refuse at first. Do your best to encourage your child to wear the actigraph. If it is itching or bothering your child, try placing it on top of a sleeve if your child is wearing the actigraphy on their wrist, or put it over a sock if your child is wearing on their ankle.

My child accidently napped in the car and I'm not sure how to record this in the Sleep Diary?
If your child doesn't normally nap but fell asleep during the day, this should be recorded in the Sleep Diary. Please answer Yes to the question "Did your child nap?" and answer all the questions about naps. In the "Additional Information" section, please note that the nap was accidental and in the car.

The actigraph was taken off (e.g., shower, sports game, swimming etc.) and I forgot to put it back on!
As soon as you remember, please put the actigraph on and record in the Sleep Diary for how long it was off and why.

> **TIP!**
> Set an alarm (e.g., phone, egg timer) when you take off the actigraph as a reminder to put it back on!

If you have any questions, please contact us at abcs@dal.ca.
Thank you for your participation

Measure 8: Sleep Diary (SLD; Corkum et al., 2018)

The following are sleep diary instructions as they appear in REDCap:

This Sleep Diary is a tool used to better understand your child's sleep behaviour. Please start once you receive your study package and fill out your Sleep Diary entries for 7 days.

It is important that you collect this information over a typical week. If something unusual occurred, for example you went on vacation or there was a holiday such as Christmas, it would be best to wait until you return to your normal routine. It is important that you keep up with your Sleep Diaries. Please try to enter your Sleep Diaries online at least once every 3 days. Please enter your Sleep Diaries in sequence.

- Fill out the Sleep Diary **each night** when your child goes to sleep and the **next morning** when your child wakes up. If your child naps, fill out the Sleep Diary **after each nap** as well
- It's important to fill out the Sleep Diary each day as **accurately** as you can. You can learn a lot about your child's sleep just by using the diary
- Each Sleep Diary entry will take about 5 minutes or less to complete
- We encourage you to complete the daily Sleep Diary in a way that works best for you and your lifestyle. There are 2 options:

  1. Login and complete online every day or multiple times per day **OR**

  2. Record 3 Sleep Diary entries with a pen on the provided template and enter online all at once. If you enter Sleep Diaries at a later date, we encourage you to use the Sleep Diary template as it's very important to be accurate.

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Down for the Night is the time that your child is supposed to fall asleep (i.e., the time you want or expect your child to fall asleep).

For example, this could be the time when:

- You have finished your child's bedtime routine (examples: brushed teeth, read books, said goodnight)
- You turn off your child's light
- You leave your child's room
- The time you have allowed for quiet time (e.g., reading in bed) is over

Up for the Day is the time that your child woke up and **did not** go back to sleep for at least the next hour.

Resistance means how much of a fight did your child put up (e.g., argue, refuse, become upset or angry, cry) when asked to get ready for bed and/or go to sleep, or when they were put into bed.

Actigraphy

- It is very important to have your child wear the actigraph during the 7 days that you complete the Sleep Diary
- If the actigraph is removed, please record **when**, **why** and for **how long** (there is a place on the Sleep Diary to record this)
- If you are unsure of an exact answer to a question, please use your best estimate to answer
- For every day that you submit a Sleep Diary and your child wears an actigraph, your name will be put in for a draw to win a tablet (so, if you complete 7 sleep diaries and your child wears the actigraph for these 7 days, then you will have 7 chances to win)

The following is a template for the Sleep Diary. This printed template is included in the study package so that parents who wish to record their sleep diaries using pen and paper may do so. Parents are instructed to later record their responses online (i.e., on REDCap). All questions below are identical to that of the online REDCap sleep diary.

Sleep Diary Template

QUESTIONS	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Date:							
1. Please indicate how you are recording this Sleep Diary entry.							
2. What time did you ask your child to start getting ready for bed (begin the sleep routine)?							
3. What time did your child get into bed?							
4. What time was your child Down for the Night?							
5. How many times did your child call to you, cry, or get up from bed before falling asleep **after** your child was Down for the Night (i.e., after you expected your child to try to go to sleep)?							
6. How much resistance did your child put up from being first asked to get ready for bed to falling asleep for the night? (0 – None, 1 – A little bit, 2 – A medium amount, 3 – Quite a bit, 4 – A lot)							
7. What time did your child fall asleep at bedtime?							
7a. Did your child fall asleep independently (i.e., without a parent or other person there while he/she fell asleep)?							
7b. Did your child sleep through the night independently (i.e., they didn't go into your bed, or you into their bed)?							

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Question						
8. After falling asleep for 10 minutes or longer at bedtime, how many times did your child wake up again? (Record 0 if your child did not wake up during the night)						
8a. If you answered yes to Question 8, in total, how many minutes was your child awake throughout the night (across all night wakings)?						
9. What time was your child **Up for the Day**?						
9a. How do you feel about your child's wake up time? (0 – It is way to early, 1 – It is a bit early, 2 – It is OK, 3 – It is a bit late, 4 – It is very late)						
10. How much disruption for the family was associated with your child's morning awakening? (0 – None, 1 – A little bit, 2 – A medium amount, 3 – Quite a bit, 4 – A lot)						
11. How would you rate the quality of your child's sleep? (0 – Very Poor, 1 – Poor, 2 – Fair, 3 – Good, 4 – Very Good)						
12. When your child woke up, how rested or refreshed did your child seem? (0 – Not at all rested, 1 – Slightly rested, 2 – Somewhat rested, 3 – Well-rested, 4 – Very well-rested)						
13. Did your child nap?						
13a. If you answered Yes to Question 13, how many times did your child nap today?						

Question							
14. Did your child take any medication to help them fall asleep (including Melatonin and any other sleep promoting medication or supplement)?							
14a. If you answered yes to Question 14, what medication or supplement did your child take?							
14b. If you answered yes to Question 14, what time was the medication or supplement taken?							
14c. If you answered yes to Question 14, what was the dose of the medication or supplement?							
15. Additional Information: Did anything unusual happen in the last 24 hours that may have changed your child's sleep pattern? (For example, your child had a cold or flu, immunization, a friend visited overnight, your family was on vacation, your child attended a birthday party)							
15a. If you answered Yes to Question 15, please include a few notes about what happened							
15b. How much of an impact did this have on your child's sleep? (0 – None, 1 – A little bit, 2 – A medium amount, 3 – Quite a bit, 4 – A lot)							
16. Was the actigraph removed at any time for any reason?							
16a. If you answered Yes to Question 16, what was the reason?							
16b. If you answered Yes to Question 16, from when to when was the actigraph removed?							

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Appendix C

Study 3 Measures

Measure 1: Eligibility Questionnaire for Parents (EQ)

Thank you for your interest in the *ABCs of SLEEPING* study. The first step is to make sure that you and your child meet the criteria to participate in the study. You will be asked to answer 14 questions that will take no more 5 minutes. All questions must be answered to determine eligibility to participate in this study. If you have more than one child, please complete the following questions thinking about the one child you would like to have involved in this study. [All screening questions are mandatory]

14. Are you the legal and primary caregiver to the child who you would like to enroll in this study? [Yes/No] [Inclusion criteria - Yes response required]
15. Is your child between 6 and 12 years old (i.e., has not turned 13 yet)? [Yes/No] [Inclusion criteria - Yes response required]
16. Does your child have one of the following sleep problems relevant to this study?
    a. Does your child have problems falling asleep? ("Problems falling asleep" means lying awake in bed after lights out for an extended period of time (20 minutes or more), calling out to parents, or getting out of bed. Some children may also cry at bedtime.) [Yes/No]
    b. Does your child have problems staying asleep? ("Problems staying asleep" mean frequent night-wakings and difficulty falling back to sleep after a night-waking. This may also happen when children wake up their parents to get help falling back to sleep, or sneaking into their parents' bed.) [Yes/No]
    c. Does your child have problems following bedtime routines? ("Problems following bedtime routines" means difficulty following parents' requests, resistance to parents' requests, difficulty following a schedule, needing constant reminders for each task during the bedtime routine, etc.) [Yes/No]
    [Inclusion criteria - Yes response required for any of the 10 a, b, or c]
17. Do you live in Canada? [Yes/No] [Inclusion criteria - Yes response required]
    a. In which province/territory do you live? [Drop down menu of province and territories][Sample description factor - Not inclusion / exclusion criteria]
    b. What are the first 3 digits of your postal code? [Not inclusion / exclusion criteria]
18. Do you have access to either a laptop, computer and/or tablet? [Yes/No] [Inclusion criteria - Yes response required]
19. Do you have regular access to a smartphone that has an App-store (e.g., Apple or Android device)? [Yes/No] [Inclusion criteria - Yes response required]

20. Do you have regular access to a high-speed internet connection? [Yes/No] [Inclusion criteria - Yes response required]

21. Do you have access to an email address that you regularly check? [Yes/No] [Inclusion criteria - Yes response required]

22. Are you comfortable communicating in English for day-to-day tasks (e.g., listening to the news on the radio or watching TV, reading books, magazines, etc.)? [Yes/No] [Inclusion criteria - Yes response required]

23. Has your child been diagnosed with a significant medical disorder that would impact sleep (e.g., Asthma causing night wakings, Cerebral Palsy)? [Yes/No] [Exclusion criteria – No response required to be eligible]

24. Has your child been diagnosed with a significant mental health disorder (e.g., anxiety, depression), neurodevelopmental disorder (e.g., attention-deficit hyperactivity disorder, autism spectrum disorder) [Yes/No] [Exclusion criteria – No response required to be eligible]

25. Has your child been diagnosed with a medically-based sleep disorder (e.g., sleep apnea) or do you have concerns about your child's breathing while sleeping? [Exclusion criteria – No response required to be eligible]

26. Does your child currently take medication to treat their sleep problems (i.e., improve their sleep)? Or medications for other purposes that currently impact their sleep (e.g., stimulant medication that has caused impact to your child's sleep)? And would this be the case for the entire duration of the study (e.g., approximately 1.5 months)?
    - Yes, please specify [textbox]
    - No [Exclusion criteria – No response required to be eligible]

16. How did you hear about The *ABCs of SLEEPING* pilot study? (Check all that apply) [Not inclusion / exclusion criteria]
    a. Google search
    b. Family doctor
    c. Pediatrician
    d. Psychologist
    e. Family member
    f. Friend
    g. Colleague
    h. National advertisement
    i. Local advertisement [If selected, text box appears:]
    j. Facebook
    k. Twitter
    l. Other [if selected, textbox appears to specify source]

Measure 2: Eligibility Questionnaire for Healthcare Providers (EQ)

Thank you for your interest in the *ABCs of SLEEPING* study. The first step is to make sure that you meet the criteria to participate in the study by completing this short eligibility questionnaire. You will be asked to answer 4 questions that will take no more 5 minutes or less. All questions must be answered to determine eligibility to participate in this study.
[All screening questions are mandatory. HCPs must answer yes to all questions in order to be eligible to participate].

1. Do you practice within Canada? Yes/no

[No= ineligible]

2. Are you a healthcare provider? Yes/no

Please select what best describes your profession:
- Physician
  > Family physician / general practitioner
  > Paediatrician
  > Paediatric subspecialist
  > Neurologist
  > Psychiatrist
- Nurse
- Clinical Psychologist
- Social Worker
- Occupational Therapist

[No= ineligible]

3. Is part of your practice seeing children aged 6-12 years that have sleep problems (e.g., have you seen school-aged patient/clients that have difficulties either falling asleep, staying asleep, and/or wake too early in the morning)? Yes/no

[No= ineligible]

4. Do you have access to a computer and email? Yes/No

[No= ineligible]

Measure 3: Demographic Questionnaire for Parents (DQ)

The following questions allow us to describe the children and their families who participate in the study. This will allow us to compare the families participating in our study to the general Canadian population. We never report on an individual's data but rather we will report on group data (e.g. "On average the families who participated in this study had more/less children than the average").

30. How would you describe the community where you live?
    - Rural
    - Town
    - City under 500,000 people
    - City over 500,000 people

31. How many children (biological, step, adopted or foster children) currently live in your home? What are their ages and sex? Children in joint custody should be included in the home of the parent where they live most of the time.
    [Drop down Menu: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10+children]
    [Textbox: Child's age]
    [1-10 textboxes depending on # of children]
    [Radio Button: Boy, Girl, Other]
    [1-10 radio buttons depending on # of children]

32. How many adults (who are not your children) currently live in your home? [Textbox]

33. What is **your** relationship to your child who is participating in this study?
    - Biological Mother
    - Biological Father
    - Adoptive Mother
    - Adoptive Father
    - Step Mother
    - Step Father
    - Foster Mother
    - Foster Father
    - Grandmother
    - Grandfather
    - Other (please specify): [Textbox]

34. Do you have a spouse or partner who lives in this home?
    - Yes [If Yes answer question 6. If No skip to Question 7.]
    - No

35. What is your spouse or partner's relationship to the child participating in the study?
    - Biological Mother
    - Biological Father
    - Adoptive Mother
    - Adoptive Father
    - Step Mother
    - Step Father
    - Foster Mother
    - Foster Father
    - Grandmother
    - Grandfather
    - Other (please specify): [Textbox]

36. What is your current marital status?
    - Single, never married
    - Legally married (and not separated)
    - Common-law relationship (Common-law refers to two people living together as a couple who are not legally married to one another)
    - Separated (but still legally married)
    - Divorced
    - Widowed

37. What is the primary language spoken at home to the child participating in this study? (The primary language spoken is the one you use most often when speaking to your child.)
    - English
    - French
    - Both English and French
    - Other (please specify): [Textbox]

38. Does your child speak any other languages (i.e., other than their primary language) **on a regular basis** at home?
    - English
    - French
    - Other (please specify): [Textbox]

39. Of what country is your child a citizen?
    - Canada, by birth
    - Canada, by naturalization [whereby an immigrant is granted Canadian citizenship, under the Citizenship *Act*]
    - Other [Textbox]

40. What is the hand preference of your child? (Hand participant/subject uses predominately, not necessarily hand he/she writes with exclusively)
- Left
- Right
- Both Hands
- Unknown

41. How would you best describe **your child's** ethnic or cultural heritage?
- White/Caucasian
- Black (e.g., African, Haitian, Jamaican, Somali)
- Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
- South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
- Chinese
- Filipino
- Latin-American
- Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
- South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
- West Asian (e.g., Iranian, Afghan, etc.)
- Korean
- Japanese
- Other (Please Specify) [Textbox]

42. How would you best describe **your** ethnic or cultural heritage?
- White/Caucasian
- Black (e.g., African, Haitian, Jamaican, Somali)
- Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
- South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
- Chinese
- Filipino
- Latin-American
- Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
- South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
- West Asian (e.g., Iranian, Afghan, etc.)
- Korean
- Japanese
- Other (Please Specify) [Textbox]

43. What is the highest level of education <u>you</u> have ever attained in your lifetime? Please select ONE:
- Less than Elementary/Junior High School / High school
- Some High School
- Completed High School (Or equivalent)
- Some Trade, Technical or Vocational School, or Business College
- Some Community College, CEGEP, or Nursing School
- Some University
- Diploma or Certificate from Community College, CEGEP, Nursing School or University
- Diploma or Certificate from Trade, Technical or Vocational School, or Business College
- Bachelors / Undergraduate Degree or Teacher's College (e.g., B.A., B.Sc., B.Ed.)
- Master's Degree (e.g., M.A., M.Sc., M.Ed.)
- Degree in Medicine (M.D.), Dentistry (D.D.S., D.M.D.), Veterinary Medicine (D.V.M.), Optometry (O.D.) or Law (LL.B)
- Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
- Other (Please specify) [Textbox]

44. How would you describe your current employment status?
- Full Time
- Part Time
- Unemployed
- Retired
- Student
- Self –employed
- Homemaker
- Other (Please specify) [Textbox]

45. Which of the following best describes the hours you usually work?
- Regular – daytime schedule or shift
- Regular – evening shift
- Regular – night shift
- Rotating Shift (change from days to evenings to nights)
- Split shift (A shift comprising of two or more separate periods of duty in a working day)
- On call (A time period in which you are not at work, but must make yourself available to go in)
- Irregular schedule (none of the above)
- Other (Please specify) [Textbox]

46. If you are currently employed (either part-time or full-time), what is the title of your position (e.g., Nurse, Carpenter, etc.) [Textbox]

47. Please estimate in which of the following groups your household income falls. (Stated as: Total Wages and Salaries, including commissions, bonuses, tips, taxable benefits, research grants, royalties, etc. before any deductions)
- Under $5,000
- $5,000 to $9,999
- $10,000 to $14,999
- $15,000 to $19,999
- $20,000 to $29,999
- $30,000 to $39,999
- $40,000 to $49,999
- $50,000 to $59,999
- $60,000 to $79,999
- $80,000 to $99,999
- $100,000 to $124,999
- $125,000 to $149,999
- $150,000 and over
- Prefer not to answer

If you live with a partner/spouse, please complete questions 19-23. If not, please skip to questions 24.

48. What is the highest level of education **your partner/spouse** has ever attained in his/her lifetime?
- Less than Elementary/Junior High School/High school
- Some High School
- Completed High School (Or equivalent)
- Some Trade, Technical or Vocational School, or Business College
- Some Community College, CEGEP, or Nursing School
- Some University
- Diploma or Certificate from Community College, CEGEP, Nursing School or University
- Diploma or Certificate from Trade, Technical or Vocational School, or Business College
- Bachelors / Undergraduate Degree or Teacher's College (e.g., B.A., B.Sc., B.Ed.)
- Master's Degree (e.g., M.A., M.Sc., M.Ed.)
- Degree in Medicine (M.D.), Dentistry (D.D.S., D.M.D.), Veterinary Medicine (D.V.M.), Optometry (O.D.) or Law (LL.B)
- Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
- Other (Please specify) [Textbox]

49. How would you best describe **your spouse's/partner's** ethnic or cultural heritage?
   - White/Caucasian
   - Black (e.g., African, Haitian, Jamaican, Somali)
   - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
   - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
   - Chinese
   - Filipino
   - Latin-American
   - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
   - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
   - West Asian (e.g., Iranian, Afghan, etc.)
   - Korean
   - Japanese
   - Other (Please Specify) [Textbox]

50. How would you describe **your partner/spouse's** current employment status?
   - Full Time
   - Part Time
   - Unemployed
   - Retired
   - Student
   - Self –employed
   - Homemaker
   - Other (Please specify) [Textbox]

51. Which of the following best describes the hours your partner/spouse usually work?
   - Regular – daytime schedule or shift
   - Regular – evening shift
   - Regular – night shift
   - Rotating Shift (Change from days to evenings to nights)
   - Split shift (A shift comprising of two or more separate periods of duty in a working day)
   - On call (A time period in which you are not at work, but must make yourself available to go in)
   - Irregular schedule (none of the above)
   - Other (Please specify) [Textbox]

52. If your partner/spouse is employed (either part-time or full-time), what is the title of his/her position (e.g., Nurse, Carpenter) [Textbox]

The following questions refer to a biological parent who is **not living in your house**. Please complete these questions about your child's other biological parent regardless of whether you live with someone else or if your child contact with his/her other biological parent on a regular basis.

53. Please check below to determine if these following questions apply to your family:
    - My child's other biological family lives with us in our home
    - My child's other biological parent has little/no contact with my child and I do not know this type of information
    - Although my child's other biological has contact with my child, I do not know this demographic   information about him/her
    - My child's other biological parent does not live with us, but I can answer these questions about him/her
    - I don't wish to share this information

[If #4, then Q25-Q29 will appear]
54. What is the highest level of education **your child's other biological parent** has attained in his/her lifetime? Please select ONE:
    - Less than Elementary / Junior High School / High school
    - Some High School
    - Completed High School (Or equivalent)
    - Some Trade, Technical or Vocational School, or Business College
    - Some Community College, CEGEP, or Nursing School
    - Some University
    - Diploma or Certificate from Community College, CEGEP, Nursing School or University
    - Diploma or Certificate from Trade, Technical or Vocational School, or Business College
    - Bachelors / Undergraduate Degree or Teacher's College (e.g., B.A., B.Sc., B.Ed.)
    - Master's Degree (e.g., M.A., M.Sc., M.Ed.)
    - Degree in Medicine (M.D.), Dentistry (D.D.S., D.M.D.), Veterinary Medicine (D.V.M.), Optometry (O.D.) or Law (LL.B)
    - Earned Doctorate (e.g., Ph.D., D.Sc., Ed.D.)
    - Other (Please specify) [Text box]

55. How would you describe your child's other biological parent's current employment status?
    - Full Time
    - Part Time
    - Unemployed
    - Retired
    - Student
    - Self-employed
    - Homemaker
    - Other (Please specify) [Text box]

56. If your child's other biological parent is employed (either part-time or full-time), what is the title of their position? (e.g., Nurse, Carpenter) [Text box]

57. How would you best describe **your child's other biological parent's** ethnic or cultural heritage?
    - White/Caucasian
    - Black (e.g., African, Haitian, Jamaican, Somali)
    - Aboriginal person [Drop down menu: First Nations, Metis, Inuk]
    - South Asian (e.g., East Indian, Pakistani, Punjabi, Sri Lankan)
    - Chinese
    - Filipino
    - Latin-American
    - Arab/West Asian (e.g., Armenian, Egyptian, Iranian, Lebanese, Moroccan)
    - South East Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese)
    - West Asian (e.g., Iranian, Afghan, etc.)
    - Korean
    - Japanese
    - Other (Please Specify) [Textbox]

58. How much contact does your child have with his/her biological father/mother?
    - Daily
    - More than once per week
    - Once per week
    - A few times per month
    - Once per month
    - Less than once per month
    - Once per year
    - Less often than once per year (rarely has contact)
    - Never

Measure 4: Demographic Questionnaire for Healthcare Providers (DQ)

The following questions allow us to describe the HCPs who participate in the study. This will allow us to compare participants in our study to the general Canadian population. We never report on an individual's data but rather we will report on group data (e.g. "On average the HCPs who participated in this study had worked X years with children aged 6 to 12 years"). This questionnaire will take approximately 5 minutes or less to complete.

1. What is your sex?
                Prefer not to answer
                Male
                Female

2. Please select your current profession?
                Physician
                        > Family physician / general practitioner
                        > Paediatrician
                        > Paediatric Subspecialist
                        > Neurologist
                        > Psychiatrist
                Nurse
                Clinical Psychologist
                Social Worker
                Occupational Therapist
                Allied health professional

                If you selected "Paediatric Subspecialist" or "allied health professional" please specify what type of physician or allied health professional, you are: [text box]

3. What is your highest level of education obtained (e.g., MA, MSc, MSw, PhD, MD, MD/PhD, MD/MSc)?
                [open-ended]

4. Are you licensed to practice within Canada?
                Yes
                No

5. How many years have you been working professionally with children ages 6 – 12 years-old?

                [Drop down – select number]

6. From which of the sources listed below did you acquire your **sleep-related knowledge**?

You may select more than one response per row. <u>If you feel that you would benefit from more training on a topic, please ALSO select "would like more training".</u>

    No exposure or training on this topic
    At least some exposure or training from:
    Peer-reviewed journals/ practice guidelines/ textbooks
    Web resources for professionals
    Lectures/ grand rounds
    Workshops/ coursework (in person or on-line)
    Clinical placements (as trainee)
    Research involvement
    Consultation with colleagues
    Prefer not to answer
    Would like more training

7. Do any of the following inform your understanding of sleep and behavioural sleep problems in school-aged children? You may select more than one answer.
    Magazines, books for the general public (i.e., written for non-health professionals)
    On-line resources for the general public (i.e., written for non-health professionals)
    Own experience as a parent
    Personal experience, other than as a parent (e.g., own sleep difficulties, family, friends)
    Other
    Prefer not to answer

8. Please describe the practice area and in which you most frequently see children (aged 6 -12) for sleep problems.
    Primarily health
    Primarily mental health
    Approximately evenly split between health/ mental health

9. In your best estimate, what percent of patients in this setting have behavioural sleep problems, also known as *insomnia* (e.g., trouble falling asleep, trouble staying asleep, waking too early, not getting enough sleep)?

Please note: this estimate may not be the same as the percent of children who actually receive sleep-related services (e.g., screening, assessment, treatment) in this setting.
    Less than 20%
    20-40%
    40-60%
    60-80%
    Greater than 80%
    Prefer not to answer

Measure 5: Parent Interview Script

<u>Parent Interview Introduction</u>

Before we get started, I'm going to review some housekeeping items with you briefly. Sound good?

Okay! So as you know, my name is _____, and I am part of the research team examining the implementation of the *ABCs of SLEEPING*. Thank you for taking the time to answer some questions about the *ABCs of SLEEPING* smartphone app intervention. As a reminder, the purpose of this interview is to understand important factors about releasing the *ABCs of SLEEPING* smartphone app to the public. I will ask you questions about sleep smartphone applications in general, and then I'll spend the majority of time asking questions about the *ABCs of SLEEPING* app. I'll let you know what types of questions I'll be asking as we go through. The length of time you can expect for this interview is a maximum of <u>30 minutes</u> so there may be some instances where I may prompt you to move onto the next question, so that we are able to finish all questions within 30 minutes.

There are no known risks or harms to participants by taking part in this study. Our aim for this study is that what we learn from these interviews will help make sleep interventions more widely accessible to parents and families of children. OK?

Next, I will tell you about how the data will be handled. This interview will be audio recorded. We will not use any real names in our reports or publications from the interviews. All information you provide for this study will be kept confidential. These recordings will be stored securely at Dalhousie University and only study staff will have access. Recordings will be destroyed once the data analysis has been finalized. We may also use quotations from some interviews in publications, however they will be de-identified and there will be no reference to you or your child. You and your child will not be named in any reports or publications based on this research.

So, the last housekeeping item - Your participation in the current study is voluntary and you may withdraw up until data analysis has begun. When data analysis is beginning, your individual data is no longer separable from the entire sample of participants. To withdraw from this study, you need to contact the study researcher. There are no risks involved with withdrawing from this study.

Did you have questions after having reviewed the consent form? Do you have any questions about the interview in general?

With all of this in mind, are you still interested in participating in the interview today?

With your consent, I will go ahead and start recording.
[If participant consents, start recording]

Prompts to move into next question:
- Thank you for answering this question, I appreciate you sharing all of this information with me. Due to time restraints, I am going to move onto the next question. We can come back to this issue/question at the end of the interview if time permits.
- Thank you for taking the time to answer this question. Because of the time constraint, I am going to have to move us along to the next question.

Parent Interview

I am going to ask you questions about three areas – the first being (1) what you think the demand is for the sleep apps and ABCs, then, (2) how you think *ABCs of SLEEPING* app can be used, and last, (3) barriers that would get in the way of using the *ABCs of SLEEPING* app. I'll start off by asking some questions about apps more generally and then we will focus most of our time talking about the *ABCs of SLEEPING* app.

If there is a question that you're not sure how to answer, no problem, just answer the questions that you have experience with. Do you have any questions before I start?

Before asking you about the *ABCs of SLEEPING* app, I have some questions about apps in general.

1. Have you ever used apps to help yourself (not including the *ABCs of SLEEPING* app)? What about to help your child?
   a. **If they do use apps:** What kinds of apps have you used? And why? What are the top three apps you use?
   b. **If no apps are used:** Why is that?
2. Have you ever tried looking for sleep apps (not the *ABCs for SLEEPING* app) for help with sleep problems? Was this for yourself or your child?
   a. **If they do use apps:** What kinds of apps have you used? Who for? For what reason?
   b. **If no apps are used:** Why is that?
3. Have you ever had a sleep app recommended to you, and did you use the app?

ABCs of SLEEPING App

Ok, now my questions will be specific to the *ABCs of SLEEPING* app.

First, I would like to learn more about the **demand** for the *ABCs of SLEEPING* app.
1. Do you think the *ABCs of SLEEPING* app should be available as an app for parents? Why?
2. What type of demand do you see for this app? For example, who might want to use it?
3. Do you see any benefits/ "pros" of using the *ABCs of SLEEPING* app when compared to other ways to receive treatment (e.g., face-to-face)?
4. Do you see any downsides/ "cons" of using the *ABCs of SLEEPING* app when compared to other ways to receive treatment (e.g., face-to-face)?

Now I will ask questions related to how and why parents would search and use the ABCs app **(integration)**.
1. At what stage of trying to help a child sleep better do you think this app would be best suited (e.g., before seeking out face-to-face intervention)?
2. What approach do/would you take while searching for an app like the *ABCs of SLEEPING*? (E.g., Where do you look? Do you search the app store and/or internet, ask a friend and/or healthcare provider? Do you look up certain key words?)
3. If you were searching for the *ABCs of SLEEPING* app in the App store to help your child's sleep problems, what search terms would you use to find the app?
4. If the *ABCs of SLEEPING* app was found in your search for sleep apps, would you download it? Why/Why not? What are some things that you take into consideration before doing so (e.g., cost, ratings)?
5. What would you find appealing about this app? What would you find unappealing?
6. What factors do/would you consider during your search? (E.g., Does it look nice? Does it look credible? Do you look at ratings?) Based on your experience with the app, what information is critical to convey to parents about this app?
7. Would using the *ABCs of SLEEPING* everyday be feasible in your daily life? (i.e., regular check-ins, daily use of recommended sleep tips from the app)?
   a. If no: What would need to change/be different for that to be feasible?
8. And how often did you use the ABCs app within the 1-month you had it? Can you describe how you used the app?
9. As you know, it is important to keep an app up-to-date and available. To do this, there is a cost, and we are trying to figure out the best way to do this. There are three models that exist, there's the 1-year subscription, one-time cost, or having a free basic version with the option to pay to unlock a premium version. What do you think of these options?

And last, I will now ask questions related to what barriers may prevent a parent from using the ABCs app **(practicality).**

1. What barriers do you see getting in the way of using the *ABCs of SLEEPING* app?
2. What facilitators do you see aiding the use of the *ABCs of SLEEPING* app?

That wraps up my questions - Is there any other information you would like to share about the *ABCs of SLEEPING* app (e.g., feedback)?

Thank you for answering all of these questions! Your answers will help us understand how best to get the *ABCs of SLEEPING* app to parents in the future.

Measure 6: Healthcare Provider Interview Script

HCP Interview Introduction

Before we get started, I'm going to review some housekeeping items with you briefly. Sound good?

Okay! So as you know, my name is _____, and I am part of the research team examining the implementation of the *ABCs of SLEEPING*. Thank you for taking the time to answer some questions about the *ABCs of SLEEPING* smartphone app intervention. As a reminder, the purpose of this interview is to understand important factors about releasing the *ABCs of SLEEPING* smartphone app to the public. I will ask you questions about sleep smartphone applications in general, and then I'll spend the majority of time asking questions about the *ABCs of SLEEPING* app. I'll let you know what types of questions I'll be asking as we go through. The length of time you can expect for this interview is a maximum of <u>30 minutes</u> so there may be some instances where I may prompt you to move onto the next question, so that we are able to finish all questions within 30 minutes.

There are no known risks or harms to participants by taking part in this study. Our aim for this study is that what we learn from these interviews will help make sleep interventions more widely accessible to healthcare providers and families with children. OK?

Next, I will tell you about how the data will be handled. This interview will be audio recorded. We will not use any real names in our reports or publications from the interviews. All information you provide for this study will be kept confidential. These recordings will be stored securely at Dalhousie University and only study staff will have access. Recordings will be destroyed once the data analysis has been finalized. We may also use quotations from some interviews in publications, however they will be de-identified and there will be no reference to you. You will not be named in any reports or publications based on this research.

So, the last housekeeping item - Your participation in the current study is voluntary and you may withdraw up until data analysis has begun. When data analysis is beginning, your individual data is no longer separable from the entire sample of participants. To withdraw from this study, you need to contact the study researcher. There are no risks involved with withdrawing from this study.

Did you have questions after having reviewed the consent form? Do you have any questions about the interview in general?

With all of this in mind, are you still interested in participating in the interview today?

With your consent, I will go ahead and start recording.
[If participant consents, start recording]

Prompts to move into next question:
- Thank you for answering this question, I appreciate you sharing all of this information with me. Due to time restraints, I am going to move onto the next question. We can come back to this issue/question at the end of the interview if time permits.
- Thank you for taking the time to answer this question. Because of the time constraint, I am going to have to move us along to the next question.

<div align="center">

HCP Interview

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I am going to ask you questions about three areas – the first being (1) what you think the demand is for sleep apps and the *ABCs of SLEEPING* among healthcare providers, then, (2) how you think *ABCs of SLEEPING* app can be searched for and recommended, and last, (3) barriers that would get in the way of recommending the *ABCs of SLEEPING* app. I'll start off by asking some questions about apps more generally and then we will focus most of our time talking about the *ABCs of SLEEPING* app.

If there is a question that you're not sure how to answer, no problem, just answer the questions that you have experience with. Do you have any questions before I start?

Before asking you about the *ABCs of SLEEPING* app, I have some questions about apps in general.

1. Have you ever recommended apps for families to use for treatment (not including sleep apps)?
   a. **If they do recommend apps:** What kinds of apps have you recommended? And why? What are the top three apps you recommend?
   b. **If no apps are recommended:** Why is that?
2. Have you ever tried looking for sleep apps (not the *ABCs for SLEEPING* app) to recommend for help with sleep problems?
   a. **If they do recommend apps:** What kinds of apps have you recommended? Who for? For what reason?
   b. **If no apps are recommended:** Why is that?

ABCs of SLEEPING App

Ok, now my questions will be specific to the *ABCs of SLEEPING* app.

First, I would like to learn more about the **demand** for the *ABCs of SLEEPING* app.
1. Do you think the *ABCs of SLEEPING* app should be available as an app for parents? Why?
2. What type of demand do you see for this app? For example, who might want to use it?
3. Do you see any benefits/ "pros" of recommending the *ABCs of SLEEPING* app when compared to other ways to receive treatment (e.g., face-to-face)?
4. Do you see any downsides/ "cons" of recommending the *ABCs of SLEEPING* app when compared to other ways to receive treatment (e.g., face-to-face)?

Now I will ask questions related to how and why healthcare providers would search and recommend an app.
(integration).
1. At what stage of trying to help a patient/client sleep better do you think app would be best suited (e.g., before trying more intensive approaches like specific behavioural interventions or medication)?
2. What approach do/would you take while searching for an app like the *ABCs of SLEEPING*? (E.g., Where do you look? Do you search the app store and/or internet? Ask a colleague? Do you look up certain key words?)
3. If you were searching for the *ABCs of SLEEPING* app in the App store to help with your patient/client's sleep problems, what search terms would you use to find the app?
4. If the *ABCs of SLEEPING* app was found in your search for sleep apps, would you download it? Why/Why not? What are some things that you take into consideration before doing so (e.g., cost, ratings)?
5. What factors do/would you consider during your search? (E.g., Does it look nice? Does it look credible? Do you look at ratings?)
6. Based on what you have seen with the app, what information is critical to convey to parents about this app?
7. What would you find appealing about this app? What would you find unappealing?
8. From your perspective, would recommending the use of the *ABCs of SLEEPING* everyday be feasible for families? (i.e., regular check-ins, daily use of recommended sleep tips from the app)?
    b. If no: What would need to change/be different for that to be feasible?
    c. How often do you think patients/clients would use the app?
9. As you know, it is important to keep an app up-to-date and available. To do this, there is a cost, and we are trying to figure out the best way to do this. There are three models that exist, there's the 1-year subscription, one-time cost, or having a free basic version with the option to pay to unlock a premium version. What do you think of these options?

And last, I will now ask questions related to what barriers may prevent you from recommending the *ABCs of SLEEPING* app **(practicality).**

1. Are there any factors that would make it hard for you to recommend a smartphone app (i.e., barriers)?
2. Are there any factors that make it easy for you to recommend a smartphone application (i.e., facilitators)?

That wraps up my questions - Is there any other information you would like to share about the *ABCs of SLEEPING* app (e.g., feedback)?

Thank you for answering all of these questions! Your answers will help us understand how best to get the *ABCs of SLEEPING* app to healthcare providers and to parents in the future.