

**“Sleep is healthy for your body and brain”: Use of student-centred photovoice to explore the translation of sleep promotion at school to sleep behaviour at home**

**Bird, M., McKernan, C., Montemurro, G., Brown, C., Flynn, J., Neely, K.C., Sobierajski, F., Sulz, L., Storey, K.**

**Authors and institutional addresses:**

**1. Melissa Bird, MSc**

School of Public Health, University of Alberta, 3-50 University Terrace, 8303-112 Street, Edmonton, AB, T6G 2T4, Canada  
mbird@ualberta.ca

**2. Christine McKernan, MSc**

Alberta Health Services, Calgary, Canada  
Alberta Health Services, 10101 Southport Road SW, Calgary AB, T2W 3N2, Canada  
christine.mckernan@albertahealthservices.ca

**3. Genevieve Montemurro, MSc**

School of Public Health, University of Alberta, 3-50 University Terrace, 8303-112 Street, Edmonton, AB, T6G 2T4, Canada  
grs@ualberta.ca

**4. Dr. Cary Brown, PhD**

Department of Occupational Therapy, Faculty of Rehabilitation Medicine, University of Alberta, 2-64 Corbett Hall, Edmonton, Alberta, T6G 2G4, Canada  
cary1@ualberta.ca

**5. Jenn Flynn, Executive Director at APPLE Schools**

APPLE Schools, 3-50 University Terrace, 8303-112 Street, Edmonton, AB, T6G 2T4, Canada  
jenn.flynn@appleschools.ca

**6. Dr. Kacey C Neely, PhD**

Faculty of Health Sciences & Sport, University of Stirling, J12 Pathfoot, Stirling, FK84LA, United Kingdom  
kacey.neely@stir.ac.uk

**7. Frances Sobierajski, MPH**

School of Public Health, University of Alberta, 3-50 University Terrace, 8303-112 Street, Edmonton, AB, T6G 2T4, Canada  
fsobiera@ualberta.ca

**8. Dr. Lauren Sulz, PhD**

Department of Secondary Education, Faculty of Education, University of Alberta, 350 Education Centre – South, 11210 - 87 Ave NW, Edmonton AB, T6G 2G5, Canada  
lsulz@ualberta.ca

**9. (Corresponding author) Dr. Kate Storey, PhD, RD**

School of Public Health, University of Alberta, 3-50 University Terrace, 8303-112 Street, Edmonton, AB, T6G 2T4, Canada  
PH: 780-492-9609  
kate.storey@ualberta.ca

**Word Count: 5051**

**Abstract (word count: 242)**

**Study Objectives:** Schools are an important setting to teach and reinforce positive health behaviours such as sleep, however, research that incorporates the student perspective of school-based sleep promotion initiatives is limited. This study explored student's perceptions of sleep behaviour (how they understood and valued positive and negative sleep behaviours) and determined if and how students translate school-based sleep promotion to the home.

**Methods:** 45 grade 4 and 5 children (aged 9-11 years) were purposefully sampled from three schools participating in the Alberta Project Promoting healthy Living for Everyone in schools (APPLE) in Edmonton, Canada. Using focused ethnography as the method and photovoice as a data generating strategy, qualitative in-depth information was generated through photo-taking and one-on-one interviews. Data were analyzed in an iterative, cyclical process using latent content analysis techniques.

**Results:** Four themes related to students' perception of sleep behaviour within the context of a school-based sleep promotion initiative were identified: sleep is "healthy for your body and brain," sleep habits are rooted in the home environment, school experiences shape positive sleep habits at home, and students translate sleep promotion home if they think it is useful or would be acceptable to the family.

**Conclusion and implications:** School-based sleep promotion interventions that are grounded in the comprehensive school health (CSH) approach hold promise for successfully shaping student sleep behaviour. To promote health and academic success in children, future interventions should include home-school partnerships that address child sleep across multiple critical learning environments.

**Keywords:** Comprehensive school health, student-centred, school-based sleep promotion, home environment, home school interaction, photovoice, school-based health promotion, qualitative

### **List of Abbreviations**

APPLE: A Project Promoting healthy Living for Everyone in schools

CSH: Comprehensive School Health

## 1 **Background**

2 Adequate, quality sleep is required for healthy growth and development in  
3 children with the majority of school-aged children requiring 9-11 hours of uninterrupted  
4 sleep each night.<sup>1,2</sup> However, approximately 30% of Canadian school-aged children are  
5 not getting adequate sleep and may suffer adverse physical and psychosocial health  
6 outcomes as a result.<sup>3</sup> Inadequate sleep in children has been associated with childhood  
7 obesity, insulin resistance, and hypertension.<sup>4,5</sup> It has also been associated with  
8 behavioural impairments such as daytime sleepiness, hyperactivity, impulsivity, memory,  
9 and attention issues.<sup>6,7</sup> Children with poor sleep may suffer additional health  
10 consequences stemming from decreases in physical activity and unhealthy eating  
11 behaviours.<sup>8,9</sup> These physical and psychosocial outcomes are detrimental to children's  
12 academic performance<sup>10-12</sup> and quality of life.<sup>13</sup> Clearly, children's sleep is a public health  
13 issue that requires intervention to prevent adverse health and academic outcomes.

14 It is well-known that multiple critical learning environments shape children's  
15 sleep behaviour. Parent-child relationships, parenting practices, and role modelling  
16 profoundly affect child sleep patterns throughout development, whereas neighbourhoods  
17 and socioeconomic status (SES), school policy, and academic commitments influence  
18 child sleep behaviour in differing ways.<sup>14</sup> A "school learning community" promotes  
19 collaboration across multiple learning environments, emphasizing the relationships  
20 between educators, students, parents, and community partners as central to improving  
21 children's health and academic achievement.<sup>15</sup> Given that sleep is a behaviour that is  
22 shaped by multiple environments, it is reasonable that investment in sleep promotion  
23 initiatives should include both the school and home.

24 School-based health promotion interventions that are grounded within the  
25 comprehensive school health (CSH) approach are an increasingly favourable option to  
26 improve child health and academic outcomes.<sup>16-18</sup> CSH is an internationally recognized  
27 approach that promotes student health and academic outcomes through four key  
28 components to build a healthy school community – 1) social and physical environment,  
29 2) teaching and learning, 3) partnerships and services, and 4) healthy school policy. In  
30 Canada, the Pan-Canadian Joint Consortium for School Health was founded in 2005 to  
31 foster collaboration between health and education sectors and guides the implementation  
32 of CSH across Canada, and sleep education is currently integrated into learning outcomes  
33 within Alberta. Home-school collaboration is at the core of the CSH framework as  
34 partnerships between the home and school have proven more effective in promoting  
35 student academic outcomes than the school alone.<sup>19,20</sup> Students have previously been  
36 identified as the bridge that links the school and home environments and may promote  
37 home-school communication by initiating health behaviour changes in the home.<sup>21</sup>  
38 Surprisingly, there is minimal research on the effectiveness of school-based sleep  
39 promotion interventions that target school-aged children’s sleep. While a variety of  
40 research on school-based sleep education programs in child populations ~5-13 years  
41 exists <sup>22-25</sup>, such interventions tend to focus on in-class educational components and  
42 behavioural change strategies, revealing a paucity of data on school-based sleep  
43 promotion interventions that utilize a whole-school approach. For the purposes of this  
44 paper, the term “school-based sleep promotion” will refer to interventions that implement  
45 CSH or a whole-school approach. A search of “school-based sleep promotion”,  
46 “comprehensive school health”, and “school-based health promotion” yielded only one

47 study in adolescents.<sup>26</sup> The overwhelming lack of evidence of school-based sleep  
48 promotion interventions that utilize the CSH approach underscores the need for additional  
49 data on sleep promotion in schools. As well, current evidence from sleep promotion  
50 interventions limited to school settings demonstrate minimal sustained behavioural  
51 change in children and adolescents, warranting a need for more nuanced study to  
52 determine effective interventions.<sup>25,26</sup>

53 Schools can be useful settings to teach and reinforce positive sleep behaviours  
54 across a 24-hour span. Sleep education may include information on consistent bed/wake  
55 up times to ensure adequate sleep duration, having a bedtime routine, limiting digital  
56 devices/technology use, physical activity and healthy eating practices throughout the day,  
57 and promoting environments that are conducive to sleep (dark, quiet, comfortable, and  
58 cool). In addition to traditional educational approaches, healthy sleep practices may be  
59 reinforced in the school through positive conversations about sleep, consideration  
60 towards school policy (e.g., school start times), and health-focused partnerships and  
61 services. To the researcher's knowledge no research exists that assesses the effectiveness  
62 of school-based sleep promotion utilizing the CSH approach, emphasizing relationships  
63 between educators, students, parents, and community partners, however, it is promising  
64 that research that has incorporated the family and community has resulted in extended  
65 sleep duration and sleep efficiency in school-aged children.<sup>27,28</sup> Methods to involve the  
66 family and community included: letters sent home to parents with suggested discussion  
67 topics, information sessions, parental involvement in homework activities, and staff  
68 workshops with information on child sleep.<sup>28</sup> Additional research is required to  
69 understand how interventions guided specifically by CSH affect child sleep behaviours.

70 Given that the student perspective is essential to the success of such initiatives, it was a  
71 key focus within this research. This study sought to examine student's perceptions of  
72 sleep behaviour (how they understood and valued positive and negative sleep behaviours)  
73 and to determine if and how they translate school-based sleep promotion to the home.

74

## 75 **Methods**

### 76 **Methodology**

77 This research was guided by qualitative inquiry.<sup>29</sup> Framed within a constructivist  
78 perspective, knowledge acquired from interactions between participants and researchers  
79 were viewed as products of mutual understanding and the result of a co-creation of  
80 knowledge. Focused ethnography was used to guide this research and is a targeted form  
81 of ethnography that seeks to understand a specific social or cultural setting. Focused  
82 ethnography has been successfully utilized in various applied health settings and has  
83 utility in school contexts<sup>21,30</sup> and was paired with photovoice as data generating strategy  
84 to allow students to convey their knowledge and expertise through visual representation.  
85 This study was coordinated by a graduate student (School of Public Health) with the  
86 support and guidance of an experienced qualitative researcher with input from a research  
87 team with relevant expertise and knowledge fitting the research scope.

88

### 89 **Setting: APPLE Schools**

90 APPLE Schools is a school-focused health promotion initiative that exists in 75  
91 elementary school communities in Alberta, Northwest Territories, Manitoba, and British  
92 Columbia and impacts the lives of 20,000 Canadian students annually. As an evidence-

93 based, innovative, and globally recognized health promotion intervention, APPLE  
94 Schools utilizes the CSH approach to create, support, and sustain healthy school  
95 communities. APPLE Schools serves vulnerable school communities across British  
96 Columbia, northern Alberta, Northwest Territories, and Manitoba. The three schools that  
97 participated in this research project were located in Edmonton, in Alberta, Canada.  
98 Schools were all K-6 Schools and student population ranged from 219-306 students in the  
99 2018/2019 school year. APPLE Schools provides opportunities for sleep promotion such  
100 as monthly campaigns ‘Be A Sleep Star’, ‘Sweat, Step, Sleep, Sit’, and ‘Don’t be the  
101 Walking Dead’ that include daily announcements, interactive family-based games, parent  
102 newsletters, and in-class lessons.

103

#### 104 **Participants**

105 Fifty-three Grade 4 and Grade 5 students were purposely sampled from two grade  
106 4/5 split classrooms and one grade 5 classroom from three APPLE Schools within  
107 Edmonton, Canada. Schools were recruited in partnership with the APPLE Schools  
108 management team. Students in these grades were chosen as children approximately 9-11  
109 years of age have the cognitive ability to explain concepts to the researcher, engage in  
110 operational thinking, and provide assent.<sup>31</sup> All students received hard copy parent consent  
111 letters that were sent home by the school, and completed a student assent to participate in  
112 the study form. Written assent and consent was obtained by students and their parents,  
113 respectively. Ethical approval was granted by the University of Alberta Human Research  
114 Ethics Board [Pro00078831].

115

**116 Procedure**

117 To initiate the photovoice project, students participated in an in-class presentation  
118 and brainstorming session led by the research team. Students partook in individual, small,  
119 and large group work to conceptualize how the knowledge acquired through school  
120 experiences may affect their sleep at home. All students had previously participated in the  
121 school-based sleep promotion campaign ‘Be A Sleep Star’ which included classroom  
122 lessons, interactive activities (e.g., bulletin board; brainstorming activities), daily  
123 announcements, and parent newsletters. Students were asked to take photos of what ‘Be  
124 A Sleep Star’ looked like at home, were given a 27-exposure disposable camera, and  
125 shown how to operate the camera safely and directed to avoid taking photos of people.  
126 Every student was reminded that they had control over what they decided to photograph.  
127 Students were given 1 week to take photos and return cameras to their teacher, and were  
128 scheduled for a one-on-one interview with a member of the research team. To avoid  
129 feelings of exclusion, all students were included in the photo-taking activity and received  
130 a copy of their photos, however, only students with parental consent were interviewed.

131 Aligned with the photovoice process, the purpose of the individual interview was  
132 to select, contextualize, and codify their photos. First, students selected 5-6 photos that  
133 best represented what ‘Be A Sleep Star’ looked like at home. . Second, students were  
134 asked to contextualize these selected photos. Last, students codified all their photos by  
135 categorizing their photos into groups and naming the groupings. Students were asked  
136 questions relating to framing their photos (e.g., what do you see here, what is happening)  
137 and questions relating their photos to school experiences (e.g., how does this relate to ‘Be  
138 A Sleep Star’?). Nearing the end of the interview, time was given for students to speak

139 towards the meaning of all of their photos and students discussed contextual information  
140 on their sleep routine, home environment, and interactions with family members.  
141 Examples of these interview questions are: a) “what does your sleep routine look like”  
142 and b) “Is there anything else that you would like to add?”. Within 4 weeks of the initial  
143 interview, the research team returned to each classroom to conduct a member-check.  
144 Preliminary research findings were presented to each classroom in the form of a  
145 PowerPoint presentation and students provided feedback in a large group setting.

146

#### 147 **Data Analysis**

148 Each interview was recorded and transcribed verbatim by a professional  
149 transcription service. Data were then imported into NVivo12 software and analyzed.  
150 Latent content analysis was used to identify meaningful units and describe student’s  
151 understanding of the translation of school learned sleep promotion to the home. Using  
152 data from student contextualization of 5-6 photos and initial coding of data with all their  
153 photos, transcripts were first read line by line to identify initial codes. Codes were then  
154 arranged to fit within categories, and these categories were reorganized and/or dissolved  
155 as new relationships were identified in the data. Last, overarching themes were  
156 established that provided a rich and descriptive account of student experiences. Four  
157 researchers conducted the interviews and one researcher completed the data analysis. To  
158 ensure consistency, peer debriefing occurred after each interview. Records of researcher  
159 reflections, feelings, ideas, and interpretations informed data analysis by providing  
160 context and allowing researcher reflexivity.

161

## 162 **Results**

### 163 **Participant characteristics**

164 A total of 45 grade 4 and grade 5 students participated in photo-taking and  
165 interviews. Of the 45 students (n=19 male, n=26 female), 10 were from School A, 18  
166 were from School B, and 17 were from School C. The average age of students was 9.75  
167 years (range 9-11 years) and most students (n=27) were in grade 5 (1 grade 5 class, 2  
168 grade 4/5 split classes). 29 students attended their school since Kindergarten, 10 attended  
169 for the last 2-3 years, and 6 only attended within the last year. Living arrangements varied  
170 and students reported living in a house (n=26), townhouse/condo/duplex (n=15), or  
171 apartment (n=4). Out of the 45 students, 29 students had their own room and slept alone,  
172 while 16 slept in the same room as siblings (of which 8 slept in the same bed or a bunk  
173 bed). Students reported average wake-up times (6:45 am on weekdays, 8:15 am on  
174 weekends) and average bedtimes (8:30 pm on weekdays, 9:45 pm on weekends).  
175 Bedtimes were enforced by only mom (n=20), only dad (n=5), a combination of  
176 mom/dad (n=6), by grandparents or older siblings (n=8), and no enforced bedtime (n=6).

177 Four themes were identified: 1) sleep is “healthy for your body and brain,” 2)  
178 sleep habits are rooted in the home environment, 3) sleep-related experiences at school  
179 helped shape positive sleep habits at home, and 4) students translate sleep promotion  
180 home if they think it is useful to the family. Quotes have an assigned participant number,  
181 school letter, and relevant demographic information.

182

### 183 **Theme 1. Sleep is “healthy for your body and brain”**

184           Students perceived that sleep was healthy for the brain. Students explained that  
185 sleep was important for them to think clearly and process information, and helped with  
186 memory, focus, attention, and mood. One student indicated that if they did not sleep they  
187 would not be able to “think [and their] brain’s not going to be able to process” (P11,  
188 School A, Male, Age: 11, Grade: 5). The impact of sleep on memory, focus, and attention  
189 was often described as relating to feeling prepared for school and having energy to  
190 participate in class.

191

192           [Student] Yes because my teacher have taught – like another student brought up  
193 that if we don’t get like any sleep at all, we could possibly die or something like  
194 that, or it could affect our mood in school. Like if we don’t get enough sleep, we  
195 could be grumpy around others and maybe hurt their feelings. And I don’t want  
196 that to happen... The more you sleep it can heal your bones if they’re broken.  
197 And it keeps you healthy. And your brain and body to help you keep moving  
198 every day. (P51, School C, Female, Age: 10, Grade: 5)

199

200           Students described that sleep was healthy for their body. Students expressed that  
201 sleep was important for their body to grow and develop; one student described how sleep  
202 was important for them to avoid getting sick. Students recalled that if you did not sleep  
203 then you would not be able to grow or heal properly.

204

205   **Theme 2. Sleep habits are rooted in the home environment**

206 Students expressed that their sleep habits were rooted in experiences in the home.  
207 Students could easily recall their bedtime routine and described the consistency in their  
208 routine as they grew up. The majority of students indicated their parents set rules for  
209 them around bedtime and were involved in their bedtime routine (e.g., reading to them  
210 before bed), while others had more independence in determining activities before bed.  
211 One student discussed that her parent responded to her feeling afraid when trying to sleep  
212 and made her a dreamcatcher to help her feel safe:

213

214

**[Insert Figure 1. My Dreamcatcher]**

215

216

217 Cause I'm Metis so it's a part of my culture. And my mom made it so that –  
218 because I have nightmares, and it helps me sleep cause it – it's supposed to get rid  
219 of the nightmares and bring in dreams. So, I just took a picture cause it's one that  
220 my mom made, so it's memorable. I know that I'm safe because when I go to  
221 sleep (P5, School A, Female, Age: 9, Grade: 4). (Fig. 1)

222

223 Students also expressed that their sleep routine was influenced by what their  
224 parents or siblings were doing before bed. For example, if parents watched TV before  
225 bed, students would often watch as well.

226

227

**[Insert Figure 2. The Shaper]**

228

229

230

231 So this one is like a kind of bike and you like get it on and then you move your  
232 legs. But it doesn't go anywhere, and it also helps my legs and when I go to bed  
233 and stop moving them, they feel like relaxed and like all the energy is out when  
234 I'm done exercising. My – when my dad started doing it. Then I wanted to do it,  
235 and ever since then I've been doing it before bedtime. (P3, School A, Male, Age:  
236 10, Grade: 5). (Fig. 2)

237

### 238 **Subtheme 1: Technology use regulated in the home**

239 Technology use was strongly regulated by parental involvement. Although  
240 students were often aware of the negative effects on technology on their sleep, they  
241 would continue to use technology if permitted by their parents. Some students felt that  
242 using technology during their bedtime routine helped them to relax, and entertained them  
243 when they “had nothing else to do” (P27, School B, Female, Age: 10, Grade: 5). One  
244 student described his experience:

245

246

#### **[Insert Figure 3. I Have a TV That Helps Me Sleep]**

247

248

249 Because it helps me sleep kind of, in a way. If I have like nothing to do and I'm  
250 bored in my room and I can't sleep, I watch TV till I do...Say if you're tired like I

251 obviously could watch TV until you fall asleep, I guess. (P31, School B, Male,  
252 Age: 10, Grade: 5). (Fig. 3)

253

254 **Theme 3. Sleep-related experiences at school helped shape positive sleep habits at**  
255 **home**

256 Students described that their experiences at school helped them to build on their  
257 understanding of the importance of healthy sleep practices. ‘Be A Sleep Star’ was  
258 understood as “doing things that help you sleep” (P33, School C, Female, Age: 9, Grade:  
259 4) – students reflected on their current practices in their sleep routine and why these  
260 practices were important for their sleep. In particular, students discussed that school  
261 experiences helped them to reflect on embracing a healthy lifestyle. Students understood  
262 this healthy lifestyle as calming down before bed, being active, and choosing a healthy  
263 bedtime snack.

264

265 **Subtheme 1: Calming down**

266 Students recalled having learned to calm down before bed, but described that they  
267 learned in school about the importance of reading before bed as well. Students felt that  
268 they needed to calm down and relax before bed in order to have a good sleep and learned  
269 the importance of calming activities in school. Students recalled that journaling, making  
270 art, reading, and listening to music helped them to be mindful and calm, and would give  
271 them “nice dreams” (P20, School B, Male, Age: 10, Grade: 5).

272

273

274

**[Insert Figure 4. A Soothing Song]**

275

276

277 [Student] And the reason I took this, is because it soothes me. When I play the  
278 piano.

279 [Interviewer] Did you know, or did you think that maybe playing the piano  
280 affected your sleep at all, or no?

281 [Student] No not until I started to be very aware of what my sleep schedule was  
282 [from school]. Then it started to affect my sleep, in a good way. Yeah I practice  
283 more because my hands would probably get fidgety in my sleep. And when I play  
284 piano it usually drains [the energy] out. (P6, School A, Female, Age: 9, Grade: 4).  
285 (Fig. 4)

286

**287 Subtheme 2: Being Active**

288 Students remembered learning in school about the importance of physical activity  
289 to help them sleep . Physical activity was an important part of their sleep routine as it  
290 made them tired, worn out, and relaxed. One student described how physical activity is  
291 part of their lifestyle and they now understand how it affects their sleep:

292

293

**[Insert Figure 5. Doing Exercise Before Bed]**

294

295

296 Those are my shoes I wear when I go play badminton on Wednesday's and [I took  
297 this photo] because it's like getting exercise. So then I get tired and it seems to  
298 help me fall asleep faster. Same thing with swimming. Yeah [I learned from  
299 school that] doing exercise before you go to bed and you'd be more tired. (P4,  
300 School A, Female, Age: 10, Grade: 5). (Fig. 5)

301

### 302 **Subtheme 3: Choosing a Healthy Bedtime Snack**

303 Students recalled having a bedtime snack before bed since they were young, but  
304 learned about the importance of eating a healthy snack before bed from school recalling  
305 that "you can't really sleep, without enough food" (P15, School B, Female, Age: 10,  
306 Grade: 5). One student described why they had a healthy snack before bed and learning  
307 about it at school:

308

309

310

**[Insert Figure 6. Bedtime Snack]**

311

312

313

314 I think because it's good to have an apple before you go to bed because it has lots  
315 of vitamins and helps your body grow more, [and] because your body grows more  
316 by sleeping than being awake...I've been doing this since I learned [from school].  
317 (P7, School A, Female, Age: 10, Grade: 5). (Fig. 6)

318

319 **Theme 4. Students translate sleep promotion home if they think it is useful or would**  
320 **be acceptable to the family**

321 While some students shared what they learned at school with their family, others  
322 chose not to. Some students expressed that they shared information about sleep at home  
323 to help their family have healthier sleep so that they could be more healthy overall, and  
324 also described why they chose not to share what they learned at school.

325

326 **Subtheme 1: Wanting their family to be healthy**

327 Several students identified unhealthy sleep practices in the home and were willing  
328 to share healthier sleep habits with their family. To improve family sleep behaviours, one  
329 student recommended that their family “read books before they go to bed instead of  
330 watching [the] TVs” (P23, School B, Female, Age: 10, Grade: 5). The awareness of  
331 healthy sleep practices helped students to translate and communicate these ideas home.

332

333 **Subtheme 2: Choosing not to share**

334 Students who did not share what they learned at school with their family often indicated  
335 that it was not relevant to their family. One student described that they chose not to share  
336 about the effect of technology on sleep with their family because their family did not use  
337 technology before bed. Other students discussed not sharing with family because they  
338 felt their family already had healthy sleep habits, or they felt their parents would not  
339 listen to them and make changes to their sleep routine. Students also felt that younger  
340 siblings who had sleep behaviours that were different from theirs would not benefit from  
341 their knowledge of healthy sleep habits. If students had older siblings they often felt that

342 their siblings would not listen to them, or that they were already practicing healthy sleep  
343 habits. One student recalled their experiences sharing with a family member:

344

345         With my brother cause usually he stays up on his phone till my mom goes to bed,  
346         so then he could go downstairs and watch TV. But then I told him he shouldn't do  
347         that because then you're not getting enough minutes/hours of sleep that you do  
348         need...And you should not go on the TV because that's just a bigger and brighter  
349         screen. Usually he doesn't really listen to me. (P30, School B, Female, Age: 10,  
350         Grade: 5)

351

## 352 **Discussion**

353         There is insufficient evidence to support school-based sleep interventions that  
354         only target individual behaviours and do not consider the wider influences of the school  
355         and home. For this reason, school-based sleep promotion initiatives that take a CSH  
356         approach may be more effective in addressing child sleep by cultivating home, school,  
357         and community partnerships. Recent research indicates that involving family,  
358         community, and school staff has promising results in altering student sleep behaviour.<sup>28</sup>  
359         Therefore, the CSH framework has potential to encourage students to make positive  
360         lifestyle changes in the home environment. Students have also been shown to drive  
361         changes in the lifestyle behaviours (e.g., healthy eating and physical activity) of family  
362         members and actively involve parents in their health decisions.<sup>21</sup> The idea that students  
363         can bring information from the school to the home is well-established; however, what is  
364         novel is understanding how students initiate change in the home and involve their

365 families in this process. This concept has yet to be explored within the realm of school-  
366 based sleep promotion. Thus, the present study sought to examine student's perceptions  
367 of sleep behaviour (how they understood and valued positive and negative sleep  
368 behaviours) and to determine if and how they translate school-based sleep promotion to  
369 the home. Our findings demonstrated that students have knowledge of the importance of  
370 sleep and reflected on their current sleep practices in light of school experiences. The  
371 home environment strongly influenced the extent to which healthy sleep behaviours were  
372 carried out in the home.

373         In our study, we found that students were knowledgeable about the broad effects  
374 of sleep on their health and could explain the importance of sleep for attention, focus,  
375 school performance, mood, peer relationships, and physical development. Students  
376 attributed this knowledge to experiences both in school and at home. Due to the paucity  
377 of data in school-aged children, we can compare these findings with previous reviews of  
378 school-based sleep interventions in adolescents – most studies demonstrated  
379 improvements in sleep knowledge but little to no change in sleep behaviour, with few  
380 exceptions.<sup>25,26</sup> We suggest that translating school-learned sleep behaviour to the home is  
381 subject to different barriers when compared to similar interventions with a focus on  
382 physical activity or healthy eating. It has been shown that role modelling is an important  
383 component of school-based health promotion interventions.<sup>32</sup> However, healthy sleep  
384 behaviours cannot typically be directly modelled at school as common behavioural  
385 change strategies such as role modelling, and praise and reinforcement are most typically  
386 implemented in the home.<sup>33</sup> Our study provides a possible explanation for why sleep  
387 education programs have demonstrated little to no change in sleep behaviours. Indeed,

388 our study supports the need to move beyond the school to include the home environment.  
389 The findings of this study suggest that school-based sleep promotion initiatives using the  
390 Comprehensive school health approach may result in positive improvements in student  
391 knowledge of sleep and sleep behaviour.

392         Students expressed that they expanded their knowledge of sleep through their  
393 experiences with ‘Be A Sleep Star’. Importantly, students attributed sleeping well to  
394 embracing a healthy lifestyle. Students described that it was important for them to calm  
395 down before bed and feel safe, comfortable, and secure; these findings are supported by  
396 other research where children described that they needed a comfortable bedroom and  
397 parental soothing to sleep well.<sup>34</sup> Students also described healthy eating and physical  
398 activity as an important part of their sleep, and we found that students understood the  
399 impact of such behaviours on their sleep. Emerging research emphasizes the importance  
400 of the entire movement continuum throughout the whole day.<sup>35,36</sup> The Canadian 24-hour  
401 Movement Guidelines are grounded in a holistic perception of health and recognize the  
402 relationship between sleep, sedentary behaviour, and physical activity. This  
403 conceptualization aligns with findings from the present study as students described their  
404 sleep health in the relation to other health behaviours. Importantly, students in the present  
405 study may benefit from a more nuanced understanding of the impact of physical activity  
406 and sleep. For example, while increased daytime activity is thought to improve sleep  
407 outcomes, sleep onset is negatively impacted by physical activity too close to bedtime  
408 due to physiological responses.<sup>37</sup> Our results indicated that students understand physical  
409 activity as important for their sleep, however, students may not understand that physical  
410 activity too close to bed may make falling asleep more difficult.

411 Technology use at bedtime is pervasive in Canada, with well-established negative  
412 effects on children's sleep.<sup>38,39</sup> In our study, students were knowledgeable about the  
413 effects of technology in keeping them awake and engaged. However, students frequently  
414 used technology at bedtime if permitted by their parents, regardless of their knowledge  
415 that technology had a negative effect on their sleep. This finding is consistent with  
416 previous literature describing that parents are strong mediators of their children's  
417 technology use in the home; children tend to use screens more often when they have  
418 fewer rules around electronics.<sup>40,41</sup> In our study, students described that they primarily  
419 used technology before bed to avoid boredom and to help them relax, and indicated that  
420 they did not want to watch TV before bed because it could scare them or give them  
421 nightmares, headaches and eye strain. This finding is similar to a study completed by He  
422 et al.<sup>41</sup> where children engaged in screen-related activities for entertainment, spending  
423 time with family, and to reduce boredom.

424

### 425 **Strengths and Limitations**

426 This research was limited by the timeframe of the project which may have  
427 resulted in recall errors by students. Students participated in the first researcher-led  
428 brainstorming activity approximately 2-3 weeks prior to their interview. Due to the length  
429 of time between the phototaking to the interview, students may have experienced recall  
430 errors in describing their photos. Students may have also been subject to desirability bias  
431 and varied their reporting of health behaviours and attitudes, as demonstrated in previous  
432 studies on self-reported diet and physical activity.<sup>42</sup> Member-checks were performed in  
433 the classroom setting and students may have not felt comfortable speaking in front of

434 their peers and may have altered their responses or chose to not participate in group  
435 discussions. Due to limitations within photovoice methodology, students were unable to  
436 take photos on the absence of sleep behaviours, therefore students may be more likely to  
437 have taken photos of positive sleep events or behaviours. Lastly, we recognize that the  
438 researcher situated themselves within a westernized lens and promoted sleep practice  
439 guidelines that best suit a Eurocentric worldview. We recognize that children's sleep is  
440 shaped by various socio-political and environmental factors (e.g., socio-economic status,  
441 race/ethnicity, gender, cultural and family traditions) and the diverse cultural  
442 heterogeneity within the Canadian population results in varying perceptions of sleep that  
443 are not represented within this research project. Alternatively, this research demonstrates  
444 strength through qualitative inquiry into the lived experiences of students. Minimal  
445 amounts of school-based sleep promotion research exist to highlight the voice of school-  
446 aged students and qualitative research was required to address gaps in understanding the  
447 nuances of student sleep behaviour in the home. The findings of this research gave  
448 considerable depth and understanding into the translation of sleep promotion knowledge  
449 from the school to sleep behaviour in the home through the use of photovoice as a data  
450 generation strategy.

451

## 452 **Conclusions and Implications**

453 Our findings give direction for future school-based sleep promotion initiatives. As  
454 students described that their family played a vital role in shaping their sleep behaviours, it  
455 is recommended that future school-based sleep promotion initiatives incorporate learning  
456 resources that actively engage the whole family (e.g. interactive games/home sleep

457 challenges). By taking an additional step to involve parents, these activities may improve  
458 parent participation in such initiatives and may strengthen the utility of current school-  
459 based sleep promotion initiatives. Specifically, our study found that parents are key in  
460 regulating technology use in children. As such, learning resources that include a focus on  
461 child/parent technology use may be useful. Additional research is required to better  
462 understand teachers' perspectives of potential barriers to the implementation of school-  
463 based sleep promotion in schools. In addition, broad societal influences on sleep such as  
464 socioeconomic status, and neighbourhood qualities should be incorporated into future  
465 research on sleep promotion interventions. In sum, further research is warranted to build  
466 upon the strengths of the CSH approach with regards to children's sleep, and to  
467 investigate the effects of school-based sleep promotion interventions that are able to  
468 innovatively engage parents to promote sleep learnings beyond the school walls.

## **Declarations**

### **Submission Declaration**

This manuscript work has not been published previously and is not under consideration for publication elsewhere. This publication has been approved by all authors and if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder.

### **Ethics approval and consent to participate**

Ethics approval was received from the University of Alberta Human Research Ethics Board (Pro00078831). Ethics approval to work with students in Edmonton Public Schools was received by the University of Alberta Faculty of Education Cooperative Activities Program. Written parental consent and written student assent was gathered from all study participants.

### **Consent for publication**

All participants provided written consent for publication.

### **Availability of data and materials**

The data used in the current study is available from the corresponding author on reasonable request and conditional HREB approval.

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

The current work was generously supported by the Women and Children's Health Research Institute (Grant no. RES0036883) and the Canadian Institutes of Health Research (Grant no. RES0039994). KS is supported as a distinguished researcher, Stollery Children's Hospital Foundation, a member of the Women and Children's Health Research Institute and a CIHR new investigator.

### **Authors' contributions**

The lead author (MB) coordinated the study with support and guidance from the core research team (KS, GM). CM, CB, JF, KN, and LS collaborated in project planning and development from the preliminary stages of the project and provided their expertise and input throughout the duration of the research. KS, GM, FS, and MB conducted the interviews. MB was the sole data analyst and wrote the manuscript with assistance from KS and GM. All authors read and approved the final manuscript.

### **Acknowledgements**

The authors would like to thank each of the three APPLE Schools that participated in this research project and the students, teachers, and administrators who contributed to the research. As well, we would like to thank the APPLE Schools management team for their support.

## References

1. Carson V, Tremblay MS, Chastin SF: Cross-sectional associations between sleep duration, sedentary time, physical activity, and adiposity indicators among canadian preschool-aged children using compositional analyses. *BMC Public Health*. 2017;17(5):848. doi:10.1186/s12889-017-4852-0
2. Saunders TJ, Gray CE, Poitras VJ, et al: Combinations of physical activity, sedentary behaviour and sleep: Relationships with health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism*. 2016;41(6):S283-S293. <https://doi.org/10.1139/apnm-2015-0626>.
3. ParticipACTION. the role of the family in the physical activity, sedentary and sleep behaviours of children and youth. the 2020 ParticipACTION report card on physical activity for children and youth. toronto: ParticipACTION; 2020.
4. Hanlon EC, Dumin M, Pannain S: Sleep and obesity in children and adolescents. In: *Global perspectives on childhood obesity*. Elsevier; 2019:147-178. <https://doi.org/10.1016/B978-0-12-812840-4.00013-X>.
5. Sparano S, Lauria F, Ahrens W, et al: Sleep duration and blood pressure in children: Analysis of the pan-European IDEFICS cohort. *The Journal of Clinical Hypertension*. 2019;21(5):572-578. doi:10.1111/jch.13520
6. Alfano CA, Bower JL, Harvey AG, Beidel DC, Sharp C, Palmer CA: Sleep restriction alters children's positive emotional responses, but effects are moderated by anxiety. *Journal of Child Psychology and Psychiatry*. 2020. doi:10.1111/jcpp.13287
7. Palmer CA, Alfano CA: Sleep and emotion regulation: An organizing, integrative review. *Sleep medicine reviews*. 2017;31:6-16. <https://doi.org/10.1016/j.smr.2015.12.006>.
8. Fisher A, McDonald L, van Jaarsveld, C H M, et al: Sleep and energy intake in early childhood. *International journal of obesity (2005)*. 2014;38(7):926-929. <https://www.ncbi.nlm.nih.gov/pubmed/24667887>. doi: 10.1038/ijo.2014.50.
9. Stone MR, Stevens D, Faulkner GE: Maintaining recommended sleep throughout the week is associated with increased physical activity in children. *Prev Med*. 2013;56(2):112-117. <https://doi.org/10.1016/j.ypmed.2012.11.015>.
10. Sun W, Ling J, Zhu X, Lee TM, Li SX: Associations of weekday-to-weekend sleep differences with academic performance and health-related outcomes in school-age children and youths. *Sleep medicine reviews*. 2019;46:27-53. <https://doi.org/10.1016/j.smr.2019.04.003>.

11. Davidson F, Rusak B, Chambers C, Corkum P: The impact of sleep restriction on daytime functioning in school-age children with and without ADHD: A narrative review of the literature. *Canadian Journal of School Psychology*. 2019;34(3):188-214. <https://doi.org/10.1177/0829573518770593>.
12. Faught EL, Qian W, Carson VL, et al: The longitudinal impact of diet, physical activity, sleep, and screen time on canadian adolescents' academic achievement: An analysis from the COMPASS study. *Prev Med*. 2019;125:24-31. <https://doi.org/10.1016/j.ypmed.2019.05.007>.
13. Magee CA, Robinson L, Keane C: Sleep quality subtypes predict health-related quality of life in children. *Sleep Med*. 2017;35:67-73. <https://doi.org/10.1016/j.sleep.2017.04.007>.
14. Grandner M. *Sleep and health*. Academic Press; 2019.
15. Salinas KC, Epstein JL: Partnering with families and communities. *Educational Leadership*. 2004;61(8):12.
16. Fung C, Kuhle S, Lu C, et al: From "best practice" to "next practice": The effectiveness of school-based health promotion in improving healthy eating and physical activity and preventing childhood obesity. *The international journal of behavioral nutrition and physical activity*. 2012;9(1):27. <https://doi.org/10.1186/1479-5868-9-27>.
17. Kolbe LJ: School health as a strategy to improve both public health and education. *Annu Rev Public Health*. 2019;40:443-463. <https://doi.org/10.1146/annurev-publhealth-040218-043727>.
18. Langford R, Bonell CP, Jones HE, et al: The WHO health promoting school framework for improving the health and well-being of students and their academic achievement. *Cochrane database of systematic reviews*. 2014(4). <https://doi.org/10.1002/14651858.CD008958.pub2>
19. Epstein JL: *School, family, and community partnerships: Preparing educators and improving schools*. Routledge; 2018.
20. Patrikakou EN: Contexts of family–school partnerships: A synthesis. In: *Family-school partnerships in context*. Springer; 2016:109-120.
21. McKernan C, Montemurro G, Chahal H, Veugelers PJ, Gleddie D, Storey KE: Translation of school-learned health behaviours into the home: Student insights through photovoice. *Canadian Journal of Public Health*. 2019; 110(6):821-830. <https://doi.org/10.17269/s41997-019-00232-1>

22. Rossi CM, Campbell AL, Vo OT, Charron T, Marco CA, Wolfson AR. Middle school sleep-smart program: A pilot evaluation. 2002;25:A279.
23. Blunden SL, Chapman J, Rigney GA. Are sleep education programs successful? The case for improved and consistent research efforts. *Sleep medicine reviews*. 2021; 16(4): 355-370.
24. Rigney G, Blunden S, Maher C, et al: Can a school-based sleep education programme improve sleep knowledge, hygiene and behaviours using a randomised controlled trial. *Sleep Med*. 2015; 16(6):736-745. <https://doi.org/10.1016/j.sleep.2015.02.534>
25. Gruber R: School-based sleep education programs: A knowledge-to-action perspective regarding barriers, proposed solutions, and future directions. *Sleep medicine reviews*. 2017; 36:13-28 <https://doi.org/10.1016/j.smr.2016.10.001>
26. Cassoff J, Knäuper B, Michaelsen S, Gruber R: School-based sleep promotion programs: Effectiveness, feasibility and insights for future research. *Sleep medicine reviews*. 2013; 17(3):207-214. <https://doi.org/10.1016/j.smr.2012.07.001>
27. Rey AE, Guignard-Perret A, Imler-Weber F, Garcia-Larrea L, Mazza S. Improving sleep, cognitive functioning and academic performance with sleep education at school in children. *Learning and Instruction*. 2020;65:101270. <https://doi.org/10.1016/j.learninstruc.2019.101270>
28. Gruber R, Somerville G, Bergmame L, Fontil L, Paquin S. School-based sleep education program improves sleep and academic performance of school-age children. *Sleep Med*. 2016;21:93-100.
29. Mayan MJ: *Essentials of qualitative inquiry*. Routledge; 2009.
30. Oyarzún-Gómez D, de la Pava, Julián Loaiza: Exploring subjective well-being and school sense of community among high school students through photovoice. *Child Indicators Research*. 2019:1-25. <https://doi.org/10.1007/s12187-019-09706-7>
31. Burke TM, Abramovitch R, Zlotkin S: Children's understanding of the risks and benefits associated with research. *J Med Ethics*. 2005;31(12):715-720. doi: 10.1136/jme.2003.003228
32. Storey KE, Montemurro G, Flynn J, et al: Essential conditions for the implementation of comprehensive school health to achieve changes in school culture and improvements in health behaviours of students. *BMC Public Health*. 2016;16(1):1-11. doi:10.1186/s12889-016-3787-1
33. Nixon CA, Moore HJ, Douthwaite W, et al: Identifying effective behavioural models and behaviour change strategies underpinning preschool-and school-based obesity

- prevention interventions aimed at 4–6-year-olds: A systematic review. *obesity reviews*. 2012;13:106-117. <https://doi.org/10.1111/j.1467-789X.2011.00962.x>
34. Golem D, Eck KM, Delaney CL, et al: “My stuffed animals help me”: The importance, barriers, and strategies for adequate sleep behaviors of school-age children and parents. *Sleep Health*. 2019;5(2):152-160. <https://doi.org/10.1016/j.sleh.2018.11.003>
  35. Rollo S, Antsygina O, Tremblay MS: The whole day matters: Understanding 24-hour movement guideline adherence and relationships with health indicators across the lifespan. *Journal of Sport and Health Science*. 2020. <https://doi.org/10.1016/j.jshs.2020.07.004>
  36. Tremblay MS: Introducing 24-hour movement guidelines for the early years: A new paradigm gaining momentum. *Journal of Physical Activity and Health*. 2019;1(aop):1-4. <https://doi.org/10.1123/jpah.2019-0401>
  37. Master L, Nye RT, Lee S, et al: Bidirectional, daily temporal associations between sleep and physical activity in adolescents. *Scientific reports*. 2019;9(1):1-14. <https://doi.org/10.1038/s41598-019-44059-9>
  38. Chahal H, Fung C, Kuhle S, Veugelers PJ: Availability and night-time use of electronic entertainment and communication devices are associated with short sleep duration and obesity among Canadian children. *Pediatric obesity*. 2013;8(1):42-51. <https://doi.org/10.1111/j.2047-6310.2012.00085.x>
  39. Twenge JM, Hisler GC, Krizan Z: Associations between screen time and sleep duration are primarily driven by portable electronic devices: Evidence from a population-based study of US children ages 0–17. *Sleep Med*. 2019;56:211-218. <https://doi.org/10.1016/j.sleep.2018.11.009>
  40. Jago R, Stamatakis E, Gama A, et al: Parent and child screen-viewing time and home media environment. *Am J Prev Med*. 2012;43(2):150-158. <https://doi.org/10.1016/j.amepre.2012.04.012>
  41. He M, Piché L, Beynon C, Harris S: Screen-related sedentary behaviors: Children's and parents' attitudes, motivations, and practices. *Journal of nutrition education and behavior*. 2010;42(1):17-25. <https://doi.org/10.1016/j.jneb.2008.11.011>
  42. Klesges LM, Baranowski T, Beech B, et al. Social desirability bias in self-reported dietary, physical activity, and weight concerns measures in 8-to 10 year-old african-american girls: Results from the girls health enrichment multisite studies (GEMS). *Prev Med*. 2004;38:78-87. <https://doi.org/10.1016/j.ypmed.2003.07.003>