



# Beliefs about Healthy Sleep Habits in Adults with Diabetes Compared to Adults without Diabetes: A Reasoned Action Approach Elicitation Study

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## Abstract

**Objective** Sleep is part of a healthy lifestyle and in adults with diabetes, inadequate sleep is associated with risks of developing complications. The objective was to compare beliefs about healthy sleep habits (HSHs) in adults with versus without diabetes based on the Reasoned Action Approach.

**Methods** A total of 56 adults with and 98 without diabetes answered open-ended questions regarding their beliefs about: avoiding screen use in bed; having a regular sleep schedule; or avoiding caffeine, alcohol, and cigarettes before bedtime. A qualitative content analysis was used to identify the most important beliefs, similarities, and differences between both groups.

**Results** Both groups reported that adopting HSHs could improve sleep. Having a regular sleep schedule was perceived to facilitate diabetes management in adults with diabetes. Negative consequences specific to adopting each HSH were identified in both groups. Adopting HSHs was associated with mainly negative emotions (e.g., stress, anxiety, fear) in both groups. Avoiding screen use in bed was associated with anxiety of not knowing blood glucose levels at night in adults with diabetes. Partners, parents, and friends were considered the most important individuals who would approve of adopting HSHs, but they were often perceived as unlikely to adopt HSHs themselves in both groups. Adults with diabetes perceived more barriers to adopting HSHs. Facilitating factors for both groups included removing triggers of *unhealthy* sleep habits, behavior substitution, using reminders, time management, and social support.

**Discussion** These beliefs can guide the development of behavioral sleep interventions, including interventions specifically for adults with diabetes.

## Keywords

- ▶ beliefs
- ▶ sleep
- ▶ adults
- ▶ diabetes
- ▶ reasoned action approach

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## Introduction

Sleep is part of a healthy lifestyle and certain behaviors, such as avoiding screen use in bed, as well as caffeine, alcohol, and nicotine before bedtime, and having a regular sleep schedule, are considered healthy sleep habits (HSHs) as they can promote sleep. Mobile device-based electronic social media in bed is associated with short sleep duration, and nearly 70% of adults recently mentioned engaging in this *unhealthy* sleep habit.<sup>1</sup> Caffeine consumption before bedtime can result in sleep disturbances (e.g., waking up to use the restroom at night).<sup>2</sup> Alcohol and nicotine consumption within 4 hours of bedtime can affect sleep efficiency (i.e., ratio of time spent asleep over total time spent in bed),<sup>3</sup> and 45.0%, 19.8%, and 9.2% of adults reported consuming caffeine, alcohol, or nicotine, respectively, before bedtime.<sup>4</sup> Some adults do not have a regular sleep schedule and sleep longer on weekends. Recently, 34.5% of adults reported a weekend sleep duration of over 1 hour longer compared with weekdays,<sup>5</sup> and sleep variability (i.e., changes in sleep duration between weekdays and the weekend) is associated with risk of developing obesity in adults.<sup>6</sup> Additionally, a recent systematic review found that consistent bedtimes and wake up times favored health in adults.<sup>7</sup>

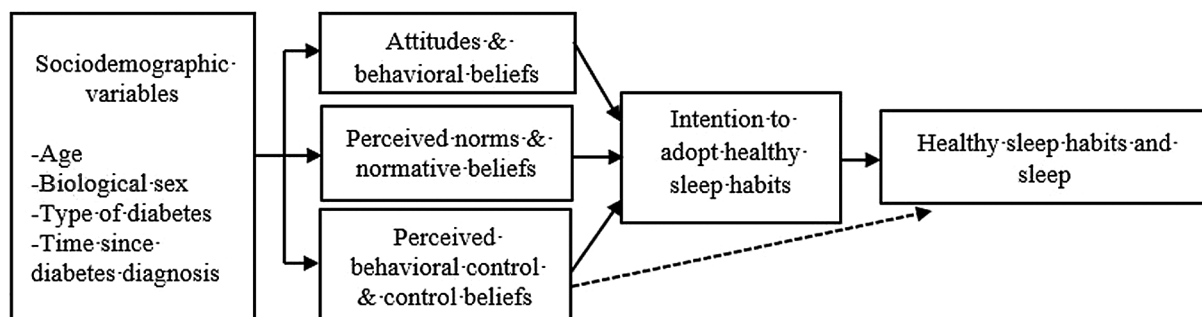
The Canadian Society for Exercise Physiology recommends that adults aged 18 to 64 years sleep 7 to 9 hours/night.<sup>8</sup> Among adults with type 2 diabetes (T2D), both inadequate sleep duration and poor sleep quality were associated with risks of developing complications.<sup>9</sup> Evidence suggests that adults with type 1 diabetes (T1D) have poor sleep quality, which is associated with risks of developing complications.<sup>10</sup> A recent study reported that adults with diabetes, especially those with T2D, were at higher risk for short and poor sleep quality and clinical insomnia compared with adults without diabetes.<sup>11</sup> These results suggest the need to develop interventions to improve the sleep of adults with diabetes and prevent risks of developing complications.

Adults with diabetes could be more at risk for poor sleep quality because of comorbidity with periodic limb movement disorder,<sup>12,13</sup> depression and/or anxiety,<sup>14</sup> which are all highly prevalent in this population. Type of diabetes is also likely to affect sleep quality. In adults with T1D, sleep can be disrupted because of behavioral and physiological aspects of

diabetes management,<sup>15</sup> such as having to wake up at night because of hypoglycemia and the need to treat it or hyperglycemia and the need to inject doses of insulin. Unlike T1D, T2D does not necessarily require insulin injections, and the first line of treatment recommended in Canada is adopting a healthy lifestyle (e.g., healthy diet, regular physical activity, and smoking cessation),<sup>16</sup> which can be less disruptive for sleep. In fact, having a healthy diet (e.g., high consumption of fruits and vegetable and whole grains)<sup>17</sup> and regular physical activity<sup>18</sup> can improve sleep quality, while smoking cessation could also result in better sleep quality since nicotine use before bedtime negatively affects sleep quality.<sup>4</sup> Nonetheless, there are strong associations between T2D and obesity<sup>19</sup> and also between obesity and sleep,<sup>20</sup> especially as adults with obesity are at higher risk for sleep apnea.<sup>21</sup>

One of the first steps in developing effective behavioral interventions is to identify factors that can influence behavior.<sup>22</sup> Psychosocial theories aimed at predicting behavior—such as the Theory of Planned Behavior<sup>23</sup> and its more recent version, the Reasoned Action Approach (RAA)<sup>24</sup>—can guide the development of targeted behavioral interventions.<sup>25,26</sup> The usefulness of the RAA to predict various health behaviors was confirmed in a meta-analysis.<sup>27</sup> Yet, few psychosocial studies have identified beliefs about sleep and HSHs, particularly in specific populations, such as adults with diabetes. To our knowledge, only three studies based on the RAA, all conducted among university students, have identified beliefs about sleep<sup>28</sup> or HSHs (e.g., having a regular sleep schedule)<sup>29</sup> and intention to adopt HSHs.<sup>30</sup> Identifying beliefs about sleep is a promising avenue to design public health interventions aimed at improving sleep and health quality.<sup>31</sup>

According to the RAA, the adoption of a health behavior is predicted by intention and perceived behavioral control (PBC)<sup>24</sup> (see ►Fig. 1). Intention represents one's motivation to adopt a given behavior and PBC refers to one's perceived control over adopting the behavior. Intention is predicted by attitudes, perceived norms and PBC. Each construct of intention is linked to a specific set of beliefs. Attitudes are associated with behavioral beliefs, which are the anticipated consequences (cognitive attitude) and emotions (affective attitude) following behavior adoption. Perceived norms are associated with normative beliefs, which refer to individuals who would approve or not behavior adoption (injunctive norm) and the perceived prevalence of behavior adoption



**Fig. 1** Reasoned Action Approach (Fishbein & Ajzen, 2010) model used in the present study.

(descriptive norm). Perceived behavioral control (PBC) is associated with control beliefs regarding the factors that can facilitate (facilitating factors) or hinder (barriers) behavior adoption.

The study objective was to compare beliefs about HSHs in adults with diabetes versus in adults without diabetes using the RAA to determine if behavioral sleep interventions need to target different beliefs for both groups. The HSHs were: 1) avoiding screen use in bed; 2) having a regular bedtime and wake up time even on weekends (i.e., regular sleep schedule); and 3) avoiding caffeine, alcohol, and cigarettes before bedtime. These HSHs were selected because many adults do not adopt them and they can affect sleep.<sup>1,4,5</sup>

## Material and Methods

### Study Design and Sample Size

According to the RAA, formative qualitative research (i.e., elicitation study) is needed to identify the behavioral, normative, and control beliefs.<sup>24</sup> This is known as an elicitation study as it involves eliciting beliefs from participants. The RAA recommends a sample of 25 to 30 participants to obtain data saturation (i.e., no new ideas mentioned by participants).<sup>24</sup> Given that in the present study there are 3 HSHs, the goal was to recruit a minimum of 25 participants per HSH for a total of 75 adults with diabetes and the same number of adults without diabetes to compare if the presence of diabetes influenced beliefs. The aim was also to recruit both adults with T1D and T2D. The inclusion criteria were: 1) being an adult between the ages of 18 and 64 years; and 2) having or not a diagnosis of T1D or T2D. The exclusion criteria included pregnant women and shift workers as these two factors can influence sleep.

### Data Collection

The project was approved by the Research Ethics Committee of Université Laval (2019–340 A-1/30–01–2020). Participants were recruited throughout the province of Québec, Canada, between January 13 and March 19, 2020, through emails and online advertisement. Adults with diabetes were recruited using two local associations, Diabète Québec (Province of Québec) and Les diabétiques de Québec (region of Québec City). Recruitment stopped on March 19, 2020, because of the coronavirus disease 2019 (COVID-19) pandemic, which could affect and modify sleep and HSHs.<sup>32,33</sup>

All participants were invited to answer a Web-based questionnaire on the secure online platform of the Institut sur la nutrition et les aliments fonctionnels of Université Laval. There were six versions of the questionnaire, one for each of the three HSH, and versions for adults with and without diabetes. Participants could select the HSH questionnaire they wanted to complete and were advised to choose the one pertaining to the HSH they would like to improve. The questionnaires contained five sections. Only the results on the beliefs are reported here. Detailed results on sleep and insomnia according to presence of diabetes, type of diabetes, and biological sex are already published.<sup>11</sup> Completion of the questionnaires took ~ 20 to 30 minutes.

Participants had a chance to win a CAD\$ 100 gift card from a local book store. Written informed consent to participate in the study was obtained from each participant.

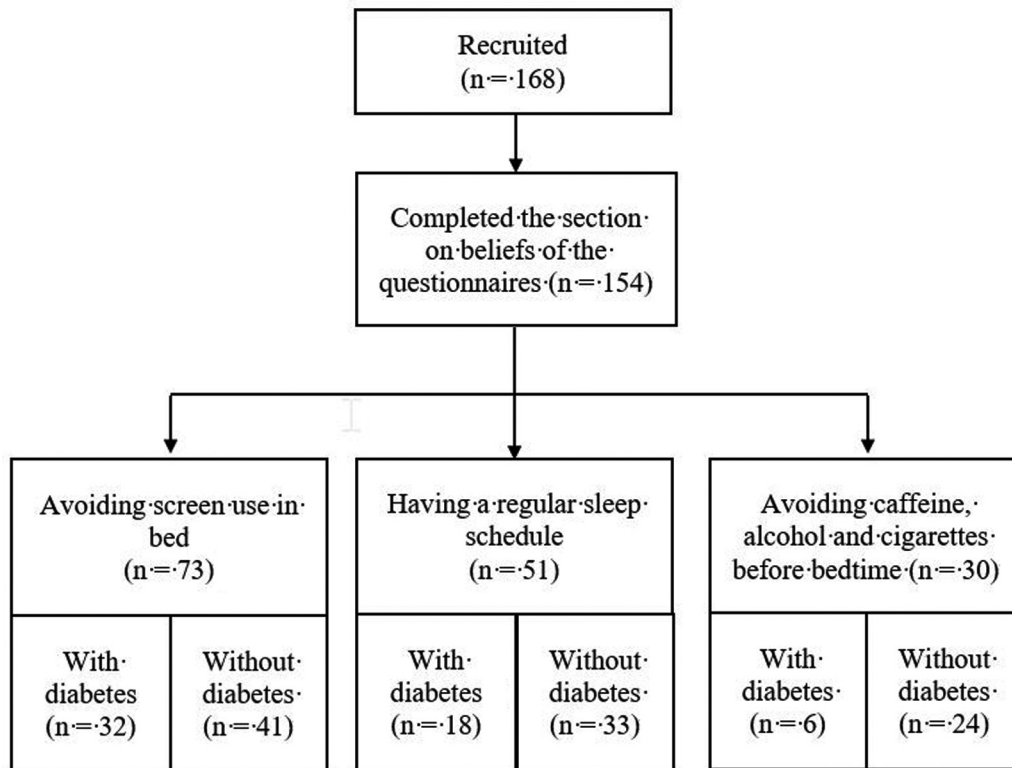
Participants' beliefs regarding one of the 3 HSHs were measured using 10 open-ended questions on behavioral, normative, and control beliefs. Avoiding screen use in bed was defined as avoiding watching television or using a cell phone/smartphone and/or a laptop/tablet in bed. Having a regular sleep schedule was defined as going to bed and waking up with more or less 20 to 30 minutes of difference from day to day even on weekends. Avoiding caffeine, alcohol, and cigarettes before bedtime was defined as avoiding beverages that contain caffeine (e.g., coffee, tea, energy drinks, and soft drinks), alcohol (e.g., beer, wine, or alcoholic beverages) and smoking cigarettes within 4 hours of going to bed.

Cognitive behavioral beliefs were measured by asking participants the benefits and disadvantages of adopting the HSHs. Affective behavioral beliefs were measured by asking participants' positive and negative feelings about adopting the HSHs. Injunctive normative beliefs were measured by asking which individuals participants thought would encourage and discourage them from adopting the HSHs. Descriptive normative beliefs were measured by asking participants which individuals they thought adopted and did not adopt the HSHs. Control beliefs were measured by asking participants about what could facilitate and hinder adopting the HSHs. Sociodemographic and health data were also collected to describe the sample. The version for adults with diabetes included additional questions, such as type of diabetes, time since diabetes diagnosis and use of medication to control diabetes.

### Data Analyses

Both quantitative and qualitative analyses were used in the present study. Quantitative analyses were used to verify differences between adults with and without diabetes. Descriptive analyses, including means and percentages, were computed. The equivalence of the two groups was verified using the *t*-test and chi-squared analyses for continuous and dichotomous variables, respectively. Alpha level was set at  $p < 0.05$ , and the quantitative analyses were performed using SAS University Edition (SAS Institute, Cary, NC, United States).

A multistep qualitative content analysis was performed by an expert (L. A. V. I.)<sup>34,35</sup> and validated by two other experts (A. L.<sup>36</sup> and S. D.<sup>37</sup>). Disagreements were resolved by discussion between L. A. V. I. and A. L. until consensus was reached, and a third party (S. D.) was available to resolve potential disagreements. First, the beliefs were grouped into three lists for each of the three HSHs: behavioral, normative, and control beliefs. Second, beliefs expressing the same or a similar idea within the same list were regrouped and listed in decreasing order of number of citations. Third, to identify the most important beliefs (known as modal salient beliefs), a 75% cumulative frequency of mention was used as recommended by the RAA.<sup>24</sup> A belief expressing the same or a similar idea cannot be present in more than one list. When a



**Fig. 2** Flow of participants.

same or similar idea was present in more than one list, the belief was kept in the list where most participants had listed it. Fourth, the modal salient beliefs in adults with diabetes were compared with those in adults without diabetes to identify similarities and differences between both groups and inform targeted behavioral sleep interventions for both groups.

## Results

### Characteristics of Participants

A total of 168 adults were recruited, and 154 completed the section on beliefs of the questionnaires (91.7%). The majority of participants with and without diabetes selected the questionnaire about avoiding screen use in bed, followed by having a regular sleep schedule, and avoiding caffeine, alcohol, and cigarettes before bedtime (see ► **Fig. 2**). Among the sample, 56 were adults with diabetes (T1D=31; T2D=24; missing data=1) and 98 were adults without diabetes. Compared with adults without diabetes, those with diabetes tended to be older, most were men, most were workers and had a higher income, and they reported a higher body mass index (see ► **Table 1**). The majority of adults with diabetes (53.7%;  $n=29$ ) had a diabetes diagnosis for more than 10 years and 87.5% ( $n=21$ ) of adults with T2D were taking medication to control their diabetes.

### Behavioral Beliefs

Between 2 and 7 modal salient *cognitive* behavioral beliefs were identified for each HSH in both groups (see first section of ► **Table 2**). Positive consequences in both groups were

mainly how adopting the HSHs could improve different aspects of sleep, such as falling asleep faster (latency), sleep quality, less sleep disturbances, and daytime functioning (e.g., having more energy). In adults with diabetes, having a regular sleep schedule was perceived to facilitate diabetes management, including taking insulin: “*Easier to manage my diabetes (insulin)* (147-man-50 years-T1D).” Negative consequences were specific to each HSH in both groups. Both groups mentioned that avoiding screen use in bed meant not consulting emails, text messages, phone calls or social media and communicating with relatives, as well as less entertainment. Both groups reported that having a regular sleep schedule involved going to bed and waking up early on weekends and not sleeping longer on weekends. Adults with diabetes also thought this meant less flexibility in their schedule.

Between two and eight modal salient *affective* behavioral beliefs were identified for each HSH in both groups (see second section of ► **Table 2**). Both groups identified many negative emotions, such as stress, anxiety, fear, and that the HSHs felt restrictive and unpleasant. In adults with diabetes, avoiding screen use in bed was associated with anxiety of not knowing blood glucose levels at night: “*Anxiety related to my blood glucose levels [at night]* (001-woman-30 years-T1D).” In both groups, avoiding screen use in bed was associated with fear of not being able to empty one’s mind or think about something else before going to sleep, of missing out and/or of not being able to adopt the behavior or to fall asleep. Both groups identified similar positive emotions, such as feeling calm and relaxed, and well-being.

**Table 1** Characteristics of participants ( $n = 151$ †).

Variables	M ± SD or %		P-value
	With diabetes ( $n = 54$ )	Without diabetes ( $n = 97$ )	
Age (years)	42.3 ± 11.8	30.2 ± 10.6	< 0.0001
Biological sex, %			
• Men	29.6	14.4	0.02
• Women	70.4	85.6	
Level of education, %			
• Less than high school	3.7	0	N/A‡
• High school diploma or professional diploma	18.5	4.1	
• Preuniversity or technical diploma	33.3	38.1	
• College degree	25.9	39.2	
• Masters' degree	13.0	18.6	
• Doctoral degree and/or postdoctoral fellowship	5.6	0	
Ethnicity, %			
• Caucasian or White	96.2	92.8	0.38
• African or Black	1.9	1.0	
• Asian	0	2.1	
• Hispanic or Latin	1.9	0	
• Native	0	0	
• Mixed origins	0	3.1	
• Others	0	1.0	
Occupation, %			
• Worker	79.3	36.5	< 0.0001
• Student	7.5	53.1	
• Retired	7.5	2.1	
• Others	5.7	8.3	
Gross annual household income (CAD \$), %			
• Less than 20,000	7.5	29.9	0.001
• Between 21,000 and 40,000	20.8	11.3	
• Between 41,000 and 60,000	17.0	11.3	
• Between 61,000 and 80,000	22.6	6.2	
• Between 81,000 and 100,000	15.1	14.4	
• 101,000 and over	17.0	26.8	
Body mass index ( $\text{kg}/\text{m}^2$ )	29.3 ± 6.7	24.1 ± 4.3	< 0.0001
Type of diabetes§, %			
• Type 1	55.6	N/A	N/A
• Type 2	44.4	N/A	
Time since diabetes diagnosis§, %			
• Less than 1 year	5.6	N/A	N/A
• Between 1 and 5 years	22.2	N/A	
• Between 5 and 10 years	18.5	N/A	
• More than 10 years	53.7	N/A	
Adults with type 2 diabetes taking medication to control diabetes¶, %	87.5	N/A	N/A

Abbreviations: M, mean; N/A: not applicable; SD, standard deviation.

Note. †Characteristics of participants missing for two people with diabetes and one person without diabetes. ‡Result of the chi-squared analysis not reported since too many cells had < 5 participants making this analysis unsuitable. §Percentages only among adults with diabetes ( $n = 54$ ) and two people mentioned having diabetes during recruitment but did not specify which type; ¶Percentage only among adults with type 2 diabetes ( $n = 24$ ), since 100% of adults with type 1 diabetes ( $n = 30$ ) reported taking medication to control their diabetes.

**Table 2** Modal salient behavioral beliefs in adults with diabetes compared with adults without diabetes ( $n = 154$ ).

Adults with diabetes		Adults without diabetes	
Beliefs and example of quotes†	%	Beliefs and example of quotes†	%
<b>Cognitive behavioral beliefs (positive and negative consequences of adopting the healthy sleep habit)</b>			
<i>A) Avoiding screen use in bed (adults with diabetes: <math>n = 32</math> and adults without diabetes: <math>n = 41</math>)</i>			
1. Easier and faster to fall asleep (+) “Easier to fall asleep (006-man-31 years-T1D)”	26.3	1. Easier and faster to fall asleep (+) “Falling asleep faster (071-woman-46 years)”	23.2
2. Better sleep quality (+) “Sleep better (150-woman-63 years-T2D)”	17.5	2. Better sleep quality (+) “Better sleep quality in general (045-man-20 years)”	17.2
3. Cannot consult emails, text messages, phone calls or social media and communicate with relatives (-) “Cannot receive messages (001-woman-30 years-T1D)”	10.5	3. Less entertainment, such as watching television series, movies or videos or surfing on the Internet (-) “Less entertainment (watching series) in a comfortable place (034-woman-24 years)”	13.1
4. Less entertainment, such as watching television series or movies, surfing on the Internet or playing games on my electronic devices (-) “Less entertainment (018-woman-29 years-T1D)”	7.0	4. Cannot consult emails, text messages or social media and communicate with relatives (-) “Cannot communicate with my relatives (059-woman-19 years)”	8.1
5. Feel more rested (+) “More rested, more energy, etc. (168-man-54 years-T2D)”	5.3	5. Feel more rested (+) “More rested (134-woman-24 years)”	6.1
		6. Rest my eyes (+) “Rest my eyes (048-woman-39 years)”	4.0
		7. Less sleep disturbances (+) “It might prevent me from waking up [in the middle of the night] (160-woman-29 years)”	4.0
TOTAL:	66.6	TOTAL:	75.7
<i>B) Having a regular sleep schedule (adults with diabetes: <math>n = 18</math> and adults without diabetes: <math>n = 33</math>)</i>			
1. Having more energy and feeling more rested (+) “Feel more rested (135-man-38 years-T1D)”	33.3	1. Having more energy and feeling more rested (+) “I would have more energy the next day (011-woman-29 years)”	26.5
2. Few or less flexibility in my schedule (-) “Less flexible schedule (153-woman-41 years-T1D)”	10.0	2. Represents stability, routine, and regularity (+) “Stability (013-woman-53 years)”	12.0
3. Easier to fall asleep (+) “Less difficult to fall asleep when it is regular (124-woman-50 years-T2D)”	10.0	3. Easier to wake up and can wake up earlier in the morning (+) “Easy to wake up in the morning (082-woman-20 years)”	8.4
4. Having to go to bed and wake up early on weekends, so less sleep on weekends (-) “Cannot use weekends to rest (152-woman-45 years-T1D)”	6.7	4. Having to go to bed and wake up early on weekends, so less sleep on weekends (-) “Have to wake up early on weekends and go to bed earlier (072-woman-21 years)”	7.2
5. Better concentration (+) “Better concentration (009-woman-38 years-T2D)”	6.7	5. Easier to fall asleep (+) “Easier to fall asleep (063-man-26 years)”	6.0
6. Regularity and easier to manage diabetes (+) “Better regularity in the time I take my medication (116-woman-39 years-T2D)”	6.7	6. Better sleep quality (+) “Sleep better (066-woman-36 years)”	4.8
		7. Better sleep hygiene and life habits (+) “Better life hygiene (082-woman-20 years)”	4.8
TOTAL:	73.4	TOTAL:	69.7
<i>C) Avoiding caffeine, alcohol, and cigarettes before bedtime (adults with diabetes: <math>n = 6</math> and adults without diabetes: <math>n = 24</math>)</i>			
1. Better sleep quality (e.g., deeper sleep) (+) “Quality of sleep (138-woman-64 years-T2D)”	25.0	1. Better sleep quality (e.g., deeper and more restorative sleep) (+) “Better sleep quality (028-woman-34 years)”	27.7

(Continued)

**Table 2** (Continued).

Adults with diabetes		Adults without diabetes	
Beliefs and example of quotes†	%	Beliefs and example of quotes†	%
2. Less sleep disturbances (e.g., waking up to use the restroom at night) (+) “Avoiding having to go to the bathroom every night (126-man-54 years-T2D)”	25.0	2. Easier and faster to fall asleep (+) “Easier to fall asleep faster (021-woman-55 years)”	27.7
		3. Less sleep disturbances (e.g., waking up at night, nightmares, having to use the restroom at night) (+) “Less disturbed sleep (040-woman-20 years)”	12.8
		4. No caffeine or alcohol at dinner or in the evening (-) “No little glass of wine at dinner! (024-woman-47 years)”	10.6
TOTAL:	50.0	TOTAL:	78.8
<b>Affective behavioral beliefs (positive and negative emotions associated with adopting the healthy sleep habit)</b>			
<i>A) Avoiding screen use in bed (adults with diabetes: n = 32 and adults without diabetes: n = 41)</i>			
1. Calm, serenity, relaxed (+) “Better relaxation (112-woman-42 years-T2D)”	29.7	1. Calm, serenity, relaxed (+) “Calm, relaxed (089-woman-22 years)”	40.4
2. Stress, anxiety, agitated (-) “Anxiety (004-woman-41 years-T2D)”	29.7	2. Fear‡ (-) “Afraid of thinking too much before sleeping (049-woman-20 years)”	15.8
3. Fear‡ “Fear of missing out (112-woman-42 years-T2D)”	18.9	3. Stress, agitated (-) “Cannot stop feeling stressed out (049-woman-20 years)”	10.5
TOTAL:	78.3	TOTAL:	66.7
<i>B) Having a regular sleep schedule (adults with diabetes: n = 18 and adults without diabetes: n = 33)</i>			
1. Calm, relaxed (+) “More relaxed (156-man-64 years-T1D)”	26.7	1. Good mood, more patient (+) “Be in a better mood (072-woman-21 years)” / “More patience (166-woman-26 years)”	16.1
2. Stress, anxiety (-) “Stress if I have to force myself to go to bed if I am not done with my evening activities (005-woman-52 years-T1D)”	20.0	2. Stress, anxiety (-) “Very strong anxiety (063-man-26 years)”	12.9
3. Loss of freedom, restrictive (-) “Less freedom (009-woman-38 years-T2D)”	20.0	3. Loss of freedom, restrictive (-) “Feeling restricted in my evening and social activities (011-woman-29 years)”	12.9
4. Well-being (+) “Well-being (009-woman-38 years-T2D)”	13.3	4. Pride (+) “Proud to have a better sleep routine, better sleep quality and falling asleep more easily (011-woman-29 years)”	12.9
		5. Calm (+) “Calm (037-woman-41 years)”	9.7
		6. Feeling in control of myself and my life (+) “Have control over my life (162-woman-39 years)”	6.5
		7. Fear of not getting enough sleep (-) “Fear of not getting enough sleep (014-man-41 years)”	6.5
		8. Unpleasant (-) “Less fun (066-woman-36 years)”	6.5
TOTAL:	80.0	TOTAL:	84.0
<i>C) Avoiding caffeine, alcohol, and cigarettes before bedtime (adults with diabetes: n = 6 and adults without diabetes: n = 24)</i>			
1. Unpleasant (-) “Less pleasure associated with the consumption of these substances (118-woman-35 years-T1D)”	50.0	1. Unpleasant (-) “Not drinking at night is unpleasant (069-man-22 years)”	17.4

**Table 2** (Continued).

Adults with diabetes		Adults without diabetes	
Beliefs and example of quotes†	%	Beliefs and example of quotes†	%
2. Calm, relaxed (+) “Not having any stimulation (133-woman-44 years-T2D)”	33.3	2. Calm, relaxed (+) “Calm (050-woman-24 years)”	13.0
		3. Well-being (+) “Well-being (126-man-54 years)”	13.0
		4. Feels restrictive (-) “Restricted in my freedom (084-woman-21 years)”	8.7
		5. Hopeful of improving my sleep (+) “Hope to improve my sleep (161-woman-39 years)”	8.7
		6. Satisfying (+) “The satisfaction of having better habits (161-woman-39 years)”	8.7
		7. Bad mood, irritable, frustrated (-) “Bad mood, irritable (039-woman-22 years)” / “Frustration (085-woman-20 years)”	8.7
		8. Less relaxing (-) “Less relaxing dinner (024-woman-47 years)”	8.7
TOTAL:	83.3	TOTAL:	86.9

Note. (+) represents positive consequences (cognitive behavioral beliefs) or emotions (affective behavioral beliefs) of behavior adoption; (-) represents negative consequences (cognitive behavioral beliefs) or emotions (affective behavioral beliefs) of behavior adoption; T1D: type 1 diabetes; T2D: type 2 diabetes; †Free translation from French; ‡Fear of not being able to empty my mind or think about something else before going to sleep, of missing out and/or of not being able to adopt the behavior or to fall asleep.

### Normative Beliefs

Between three and eight modal salient *injunctive* normative beliefs were identified for each HSH in both groups (see first section of ►Table 3). Participants' partner was the most frequently cited individual for all three HSHs in both groups. The partner was usually thought to approve if participants adopted the HSHs. Friends and parents (especially the mother) were usually the second most frequently cited individuals for all three HSHs in both groups. Adults without diabetes systematically perceived that their friends would disapprove if they adopted the HSHs and their family would approve, while this was more variable in adults with diabetes. Adults with diabetes also identified their children and their doctors as individuals who would approve if they had a regular sleep schedule: “My doctors and specialists at the hospital, especially my endocrinologist who would like if managing my diabetes was easier (127-woman-25 years-T2D).”

Between two and nine modal salient *descriptive* normative beliefs were identified for each HSH in both groups (see second section of ►Table 3). The behavior of the partner was systematically mentioned more frequently by adults with diabetes, while in adults without diabetes, parents and friends were sometimes the most frequently cited individuals for all three HSHs. The behavior of the partner was a positive influence for adults with diabetes only regarding having a regular sleep schedule. Adults without diabetes systematically perceived that their friends did not adopt the three HSHs, while adults with diabetes thought their friends avoided caffeine, alcohol, and cigarettes before bedtime.

### Control Beliefs

Between 4 and 12 modal salient control beliefs were identified for each HSH in both groups (see ►Table 4). Adults with diabetes systematically identified more barriers than facilitating factors for each HSH (5 out of 7 control beliefs for avoiding screen use in bed; 5 out of 7 control beliefs for having a regular sleep schedule; and 3 out of 4 control beliefs for avoiding caffeine, alcohol, and cigarettes before bedtime) while this was not the case for adults without diabetes (2 out of 5 control beliefs for avoiding screen use in bed; 4 out of 12 control beliefs for having a regular sleep schedule; and 5 out of 10 control beliefs for avoiding caffeine, alcohol, and cigarettes before bedtime). Adults with diabetes were also the only ones to report lack of motivation as a barrier to avoiding screen use in bed. Adults with diabetes mentioned needing their electronic devices (e.g., Dexcom – Dexcom, Inc., San Diego, CA, United States) to monitor their blood glucose levels at night as a barrier to avoiding screen use in bed: “Have to wake up in the middle of the night because of my glucose levels to see how they are (017-woman-21 years-T1D).” Frequent barriers in both groups were the habit of using electronic devices in bed or of consuming caffeine, alcohol, and cigarettes before bedtime, and having too many things to do and social activities in the evening. Social activities in the evening were a barrier to both having a regular sleep schedule and avoiding caffeine, alcohol, and cigarettes before bedtime. Adults with diabetes mentioned wanting to use their electronic devices before going to sleep and coffee consumption as barriers to having a regular sleep schedule.



**Table 3** Modal salient normative beliefs in adults with diabetes compared with adults without diabetes (n = 154).

Adults with diabetes		Adults without diabetes	
Beliefs and example of quotes†	%	Beliefs and example of quotes†	%
<b>Injunctive normative beliefs (people who would approve or not if the person adopted the healthy sleep habit)</b>			
<i>A) Avoiding screen use in bed (adults with diabetes: n = 32 and adults without diabetes: n = 41)</i>			
1. My partner (+) "My girlfriend (030-man-20 years-T1D)"	47.2	1. My partner (+) "My partner (012-woman-36 years)"	38.6
2. My friends (+) "My friends (026-woman-38 years-T2D)"	13.9	2. My friends (-) "My friends who are contacting me or using social media (089-woman-22 years)"	15.8
3. My parents, especially my mother (+) "My mother (112-woman-42 years-T2D)"	11.1	3. My parents, especially my mother (+) "My parents (046-woman-31 years)"	15.8
4. My family (+) "Probably my family (026-woman-38 years-T2D)"	11.1		
TOTAL:	83.3	TOTAL:	70.2
<i>B) Having a regular sleep schedule (adults with diabetes: n = 18 and adults without diabetes: n = 33)</i>			
1. My partner (+) "My partner (152-woman-45 years-T1D)"	36.4	1. My partner (+) "My husband (014-man-41 years)"	39.7
2. Myself (+) "Myself (142-woman-52 years-T2D)"	13.6	2. My friends (-) "My friends who would not understand why I do not allow myself (020-woman-33 years)"	20.7
3. My children (+) "My child (129-woman-42 years-T1D)"	13.6	3. My parents, especially my mother (+) "My parents only (041-man-24 years)"	15.5
4. My family (-) "My family (146-woman-29 years-T1D)"	9.1		
5. My doctor (+) "Family doctor (156-man-64 years-T1D)"	9.1		
TOTAL:	81.8	TOTAL:	75.9
<i>C) Avoiding caffeine, alcohol, and cigarettes before bedtime (adults with diabetes: n = 6 and adults without diabetes: n = 24)</i>			
1. My partner (+/-) "My wife (126-man-54 years-T2D)"	36.4	1. My partner (+) "My partner (032-woman-25 years)"	30.0
2. My friends (+/-) "Friends (138-woman-64 years-T2D)"	18.2	2. Myself (+) "Myself (100-woman-22 years)"	13.3
3. My parents, especially my mother (+/-) "My mom (119-woman-26 years-T1D)"	18.2	3. My friends (-) "My friends (078-man-22 years)"	10.0
		4. My mother (+) "My mother (078-man-22 years)"	6.7
		5. My children (+) "My children (023-woman-45 years)"	6.7
		6. My family (+) "All my family since they are already trying to adopt this habit (101-woman-19 years)"	6.7
		7. My roommate (+) "My roommate (088-woman-22 years)"	6.7
		8. Doctors (+) "Doctors (069-man-22 years)"	6.7
TOTAL:	72.8	TOTAL:	86.8
<b>Descriptive normative beliefs (people who are perceived to adopt or not the healthy sleep habit)</b>			
<i>A) Avoiding screen use in bed (adults with diabetes: n = 32 and adults without diabetes: n = 41)</i>			
1. My partner (-) "My partner in the first place (139-man-37 years-T1D)"	28.6	1. My friends (-) "The majority of my friends use it [screens] in their bed (093-woman-23 years)"	23.2

**Table 3** (Continued).

Adults with diabetes		Adults without diabetes	
Beliefs and example of quotes†	%	Beliefs and example of quotes†	%
2. My parents, especially my mother (+) “My mother does not use a lot her electronic devices, even less in bed (112-woman-42 years-T2D)”	20.6	2. My partner (-) “My girlfriend (045-man-20 years)”	20.2
3. My friends (-) “All my girlfriends (112-woman-42 years-T2D)”	19.0	3. My parents, especially my mother (+) “My parents (052-woman-27 years)”	18.2
4. My children (-) “My children (008-woman-57 years-T2D)”	7.9	4. My brothers (-) “My 14-year-old brother (094-woman-21 years)”	11.1
TOTAL:	76.1	TOTAL:	72.7
<i>B) Having a regular sleep schedule (adults with diabetes: n = 18 and adults without diabetes: n = 33)</i>			
1. My partner (+) “Maybe my partner (147-man-50 years-T1D)”	25.0	1. My parents, especially my mother (+) “My parents have regular sleep habits (063-man-26 years)”	17.5
2. My children (+) “My daughter (151-man-50 years-T2D)”	15.6	2. My partner (-) “My husband (157-woman-28 years)”	14.6
3. My friends (-) “Close friends (005-woman-52 years-T2D)”	12.5	3. My friends (-) “The majority of my friends (041-man-24 years)”	13.6
4. My mother (-) “My mother (151-man-50 years-T2D)”	9.4	4. My children (+) “My son (015-woman-45 years)”	5.8
5. My co-workers (-) “Pretty much all my co-workers (116-woman-39 years-T2D)”	9.4	5. My co-workers (-) “My co-workers (103-woman-37 years)”	5.8
6. My family (-) “My family (152-woman-45 years-T1D)”	9.4	6. My sisters (-) “My sister (036-woman-21 years)”	4.9
		7. My brothers (-) “My little brother (041-man-24 years)”	4.9
		8. My roommate (+) “My roommate seems to have a regular sleep schedule, similar to mine (063-man-26 years)”	3.9
		9. Students (-) “Students (162-woman-61 years)”	3.9
TOTAL:	81.3	TOTAL:	74.9
<i>C) Avoiding caffeine, alcohol, and cigarettes before bedtime (adults with diabetes: n = 6 and adults without diabetes: n = 24)</i>			
1. My partner (-) “My wife (126-man-54 years-T2D)”	36.4	1. My partner (-) “Partner (wine, on weekends) (024-woman-47 years)”	22.4
2. My friends (+) “Certain friends (118-woman-35 years-T1D)”	27.3	2. My friends (-) “My close friends (100-woman-22 years)”	18.4
		3. My mother (+) “My mother (161-woman-39 years)”	12.2
		4. My father (-) “Sometimes my father (101-woman-19 years)”	12.2
		5. My family (+) “Family (102-woman-28 years)”	10.2
TOTAL:	63.7	TOTAL:	75.4

Note. (+) indicates the majority of these individuals approved (injunctive normative beliefs) or adopted (descriptive normative beliefs) the behavior; (-) indicates the majority of these individuals disapproved (injunctive normative beliefs) or did not adopt (descriptive normative beliefs) the behavior; (+/-) indicates the same number of these individuals approved and did not approve (injunctive normative beliefs) the behavior; T1D: type 1 diabetes; T2D: type 2 diabetes; †Free translation from French.

Both groups mentioned similar facilitating factors, such as removing triggers of the *unhealthy* sleep habits (e.g., putting electronic devices outside of the bedroom, not having beverages with caffeine or alcohol at home), replacing the

*unhealthy* sleep habits by more desirable behaviors (e.g., reading a book instead of screen use in bed, finding another comfortable place to watch television, drinking caffeine-free and alcohol-free beverages before bedtime), using reminders

**Table 4** Modal salient control beliefs in adults with diabetes compared with adults without diabetes (n = 154).

Adults with diabetes		Adults without diabetes	
Beliefs and example of quotes†	%	Beliefs and example of quotes†	%
<b>Control beliefs (facilitating factors and barriers to adopting the healthy sleep habit)</b>			
<i>A) Avoiding screen use in bed (adults with diabetes: n = 32 and adults without diabetes: n = 41)</i>			
1. Putting electronic devices outside of my bedroom or turning them off/removing notifications (+) "Not having a television in my bedroom and leaving my cell phone out of reach (002-man-48 years-T2D)"	23.3	1. Putting electronic devices outside of my bedroom or turning them off/removing notifications or using do not disturb mode (+) "Do not disturb mode when I go in my bedroom (160-woman-29 years)"	24.5
2. Reading a good book before going to sleep (+) "Having a good book on my nightstand (141-woman-42 years-T1D)"	18.3	2. Reading a good book before going to sleep (+) "Finding a book that I am passionate about (058-woman-34 years)"	19.6
3. Habit of using my electronic devices in bed (-) "Habit too ingrained (125-woman-29 years-T1D)"	8.3	3. Habit of using my electronic devices in bed (-) "Just a change of habits (143-woman-24 years)"	14.7
4. Needing electronic devices (e.g., Dexcom) to monitor my glucose levels at night (-) "No alerts when my glucose levels get high or low [at night] (122-woman-41 years-T1D)"	6.7	4. My cell phone is my alarm clock (-) "I need my cell phone in my bedroom because it is my alarm clock (067-woman-25 years)"	11.8
5. Lack of motivation and willpower (-) "Lack of determination in the morning when I wake up (125-woman-29 years-T1D)"	5.0	5. Finding another comfortable place to watch television, such as on the sofa in the living room (+) "Having another comfortable place to watch television shows (034-woman-24 years)"	5.9
6. Needing my cell phone for work (-) "Being on call (occasionally for work) (159-woman-33 years-T1D)"	5.0		
7. Getting text messages late in the evening (-) "Getting text messages late in the evening (159-woman-33 years-T1D)"	3.3		
TOTAL:	69.9	TOTAL:	76.5
<i>B) Having a regular sleep schedule (adults with diabetes: n = 18 and adults without diabetes: n = 33)</i>			
1. Too many things to do (e.g., work, studies, taking care of my children) in the evening (-) "Not enough time to do everything I would like (135-man-38 years-T1D)"	26.7	1. Social activities or wanting to spend time with my partner in the evening (-) "Social life on weekends (013-woman-53 years)" / "Be more often with my boyfriend (163-woman-22 years)"	17.0
2. Social activities in the evening (-) "Outings (154-woman-53 years-T1D)"	10.0	2. Too many things to do (e.g., work, studies) in the evening (-) "Too many things to do (014-man-41 years)"	13.0
3. Wanting to use my electronic devices before going to sleep (-) "Less television before going to bed (009-woman-38 years-T2D)"	10.0	3. Better time management, including for my activities in the evening (+) "Plan better my activities in the evening (015-woman-45 years)"	9.0
4. Having a routine before going to bed (e.g., meditation, relaxation, herbal tea) (+) "Meditation (135-man-38 years-T1D)" / "Relaxation (151-man-50 years-T2D)" / "Appropriate herbal tea (156-man-64 years-T1D)"	10.0	4. Wanting to use my electronic devices before going to sleep (-) "My urge to watch television (066-woman-36 years)"	7.0
5. My partner also has a regular bedtime and social support from my partner (+) "My partner (152-woman-45 years-T1D)"	6.7	5. Having a routine before going to bed (e.g., reading, stretching, relaxation, meditation) (+) "Pre-sleep habits (stretching, reading) (064-woman-20 years)"	6.0
6. Coffee consumption (-) "Coffee (156-man-64 years-T1D)"	6.7	6. My relatives and/or partner also have a regular bedtime and social support from my partner (+) "Simply going to bed at the same time as my partner since we wake up at the same time (110-woman-34 years)"	6.0
7. Pain, having a cold (-) "Back pain (009-woman-38 years-T2D)" / "Having a cold (142-woman-52 years-T2D)"	6.7	7. Having a regular schedule at work and/or at school (+) "Having a regular schedule at work and at school (063-man-26 years)"	4.0

**Table 4** (Continued).

Adults with diabetes		Adults without diabetes	
Beliefs and example of quotes†	%	Beliefs and example of quotes†	%
		8. Alarm on my cell phone to remind me to go to bed (+) “Setting an alarm 30 minutes before bedtime (061-woman-23 years)”	4.0
		9. Physical activity (+) “Daily physical exercise (063-man-26 years)”	4.0
		10. Being disciplined (+) “Discipline (149-man-31 years)”	3.0
		11. Using an alarm clock, even on weekends (+) “Using an alarm clock even on weekends (011-woman-29 years)”	3.0
		12. New routine, changing my habits (-) “Changing my weekend habits (013-woman-53 years)”	3.0
TOTAL:	76.8	TOTAL:	79.0
C) Avoiding caffeine, alcohol, and cigarettes before bedtime (adults with diabetes: n = 6 and adults without diabetes: n = 24)			
1. Drinking caffeine-free herbal tea, decaffeinated coffee, or sparkling water instead (+) “Drink decaffeinated coffee instead (119-woman-26 years-T1D)” / “Finding alternatives (sparkling water, etc.) (133-woman-44 years-T2D)”	20.0	1. Social activities (e.g., dinners, parties) where friends consume alcohol or caffeine (-) “Party between friends, other people around me consuming alcohol or caffeine (050-woman-24 years)”	24.0
2. Social activities in the evening (e.g., dinners, parties) where people consume alcohol or caffeine (-) “Going to social events/dinners/parties (116-woman-39 years-T1D)”	13.3	2. Drinking caffeine-free herbal tea, decaffeinated coffee, sparkling water, or alcohol-free cocktails instead (+) “Buying a box of herbal tea, I like flavored sparkling water so I should buy it. Or discover alcohol-free cocktails (161-woman-39 years)”	8.0
3. Involves changing my habits or routine (-) “Routine (167-woman-60 years-T1D)”	13.3	3. Involves changing my lifestyle or routine (-) “Change in my lifestyle (078-man-22 years)”	8.0
4. Behavior and/or pressure from my partner (-) “Pressure from my partner (133-woman-44 years-T2D)”	13.3	4. Difficult, challenging (-) “This might be a challenge and pretty difficult (100-woman-22 years)”	8.0
		5. Behavior of my partner (+) “That my partner does it with me (032-woman-25 years)”	6.0
		6. Not having beverages with caffeine or alcohol nor cigarettes at home (+) “Not having coffee in the apartment (088-woman-22 years)”	4.0
		7. Urge to drink a beverage with caffeine or alcohol in the evening (-) “Having to fight the urge to consume soft drinks or alcoholic beverages (078-man-22 years)”	4.0
		8. Work or studies (-) “An assignment that I procrastinated too much to do and that I have to hand in the next day and would require me to stay awake. I can easily get that with a little coffee (078-man-22 years)”	4.0
		9. Setting an alarm on my cell phone as a reminder (+) “Setting an alarm on my cell phone to remember it (031-woman-23 years)”	4.0
		10. Having dinner earlier (+) “Eating [dinner] one hour earlier (080-woman-23 years)”	4.0
TOTAL:	59.9	TOTAL:	74.0

Note. (+) represents a facilitating factor of behavior adoption; (-) represents a barrier to behavior adoption; T1D: type 1 diabetes; T2D: type 2 diabetes; †Free translation from French.

(of when to go to bed and to stop drinking caffeine and alcohol and smoking cigarettes before bedtime), and time management (e.g., eating dinner earlier). The behavior of the partner was frequently mentioned as a facilitating factor for

having a regular sleep schedule and avoiding caffeine, alcohol, and cigarettes before bedtime in both groups. It can also be a barrier to adopt these two HSHs, when adults without diabetes want to spend time with their partner in the

evening or when adults with diabetes see their partner smoke in the evening: “*Seeing my partner go out to smoke in the evening* (118-woman-35 years-T1D).” Other facilitating factors for having a regular sleep schedule were things that can help both groups fall asleep, such as having a routine before going to bed (e.g., meditation, relaxation, herbal tea, reading, stretching) and physical activity.

## Discussion

The present results suggest that avoiding screen use in bed might be a HSH to prioritize among adults with and without diabetes as the majority of participants selected this HSHs as one to improve. This is in agreement with a recent study reporting that nearly 70% of adults mentioned using mobile device-based electronic social media in bed.<sup>1</sup> The second most important HSH was having a regular sleep schedule. The least frequently selected HSH was avoiding caffeine, alcohol, and cigarettes before bedtime, suggesting this HSH was not perceived as much of a priority as the other two HSHs, probably because of its low prevalence in our participants.

Both groups identified several potential positive consequences associated with adopting HSHs, most notably improvements of different aspects of sleep. This suggests that adults with and without diabetes believe these HSHs are important for improving their sleep. In adults with diabetes, having a regular sleep schedule was perceived to facilitate diabetes management. In fact, higher sleep variability (i.e., changes in sleep duration between weekdays and the weekend) is associated with higher HbA1c in adults with T1D<sup>38</sup> and in adults with T2D.<sup>39</sup> Both groups also identified a few negative consequences specific to each HSH. Avoiding screen use in bed can result in less entertainment as electronic devices are used to consult social media and communicate with relatives, while having a regular sleep schedule implied not sleeping longer on weekends. Sleeping longer on weekends may be common among adults. Recently, 34.5% of adults reported a weekend sleep duration of over 1 hour longer compared with weekdays.<sup>5</sup>

Many negative emotions, such as stress, anxiety, fear, and a feeling that the HSH was restrictive and unpleasant, were identified for all three HSHs in both groups. This indicates that even though adults with and without diabetes think adopting the HSHs could improve their sleep, they perceived these HSHs would cause mainly negative emotions. In adults with diabetes, avoiding screen use in bed was associated with anxiety of not knowing blood glucose levels at night. Different fears were mentioned, such as of not being able to empty one’s mind or think about something else before going to sleep and of not being able to adopt the behavior. These fears were mentioned slightly more often in adults with diabetes than in adults without diabetes when it came to avoiding screen use in bed, suggesting that adults with diabetes were more worried about having trouble falling asleep. In a previous study, Canadian adults with T2D reported higher rates of insomnia compared with adults without diabetes, and sleep onset insomnia (i.e., trouble falling asleep) was

part of their sleep complaints.<sup>40</sup> There was also the fear of missing out as no screen use in bed meant not being able to consult social media and communicate with relatives. Fear of missing out is associated with anxiety and negative affect and is also linked to higher and problematic technology use.<sup>41</sup>

It seems the same individuals are important for approval and can serve as role models for adults with and without diabetes. The most important person in both groups was the partner, most likely a bed partner as well. In a study on screen use in bed, among the few adults who did *not* use screens in bed either,<sup>1</sup> suggesting that the behavior of the (bed) partner is important for this HSH. Friends were also often cited for all three HSHs in both groups. Adults without diabetes systematically perceived that their friends would disapprove and did not adopt the HSHs, while this was more variable in adults with diabetes. This may be a generational phenomenon, as adults with diabetes in the present study were older than adults without diabetes, and their friends are likely to be of similar age. Age was found to be a correlate of screen use in bed among adults, with younger adults being more likely to report this practice compared with older adults.<sup>1</sup>

Many barriers to all three HSHs were identified. In fact, adults with diabetes systematically reported more barriers than facilitating factors for each HSH compared with adults without diabetes, suggesting that adopting HSHs was perceived as more challenging among adults with diabetes. This is not surprising as the sleep of adults with diabetes is more likely to be disrupted or delayed—which would impact the HSH of having a regular sleep schedule—by diabetes management at night, especially for adults with T1D since they need insulin injections.<sup>15</sup> Also, the type of diabetes can influence sleep quality, since not all adults with T2D require insulin injections and may instead use oral medication that could be less disruptive or cause less delay in sleep at night. Adults with diabetes also had a barrier to avoiding screen use in bed specific to their condition, which was needing their electronic devices (e.g., Dexcom) to monitor their blood glucose levels at night. This belief is similar to the one that avoiding screen use in bed was associated with anxiety of not knowing blood glucose levels at night, suggesting that an exception should be made for electronic devices used to monitor blood glucose levels at night. In fact, adults with diabetes are more at risk for sleep disturbances since non-severe nocturnal hypoglycemic events and hypoglycemia can disrupt their sleep, affect their sleep quality and cause them to not be able to fall back asleep resulting in fatigue and poorer functioning the next day.<sup>42,43</sup> Young adults with T1D have also previously reported that managing diabetes at bedtime and overnight is challenging and can sometimes delay bedtime or disrupt sleep.<sup>44</sup> Interestingly, adults with diabetes mentioned wanting to use their electronic devices before going to sleep and coffee consumption as barriers to having a regular sleep schedule, suggesting all three HSHs can be related. Finally, it seems *not* adopting HSHs represented ingrained *unhealthy* habits with a degree of

automaticity (i.e., lack of awareness) in both groups, which can be especially hard to change.<sup>45</sup>

Both groups mentioned similar facilitating factors, and some could be included in behavioral sleep interventions to promote HSHs. Having electronic devices in the bedroom and beverages with caffeine and alcohol at home can act as “prompts/cues,” and removing those cues (e.g., putting electronic devices outside of the bedroom, not having beverages with caffeine and alcohol at home) could be appropriate to break the cycle of automaticity for these two habits.<sup>22</sup> Having alternatives to the *unhealthy* sleep habits (e.g., reading a book instead of screen use in bed, finding another comfortable place to watch television, drinking caffeine-free and alcohol-free beverages before bedtime) is considered behavior substitution since an unwanted behavior is replaced by a more desirable one.<sup>22</sup> Forgetting<sup>46</sup> and lack of time<sup>47</sup> are common barriers to many health behaviors. Therefore, using reminders (e.g., putting an alarm on cell phone of when to go to bed and to stop drinking caffeine and alcohol and smoking cigarettes before bedtime) and time management (e.g., eating dinner earlier) are often used to promote behavior change.<sup>48</sup> Finally, the behavior of other people (i.e., modeling) and enlisting social support, especially from the (bed) partner, in this case, are also techniques that can be used to promote behavior change.<sup>22,49</sup> Another behavior change technique that can be used specifically among adults with and without diabetes who have children is to inform them they can act as role models for their children.<sup>22</sup> In fact, some adults with diabetes mentioned their children would approve if they had a regular sleep schedule, and some adults without diabetes reported that their children would approve if they avoided caffeine, alcohol, and cigarettes before bedtime.

The present study has strengths and limitations. The strengths include using a psychosocial theory whose capacity to predict various health behaviors was recently confirmed by a meta-analysis<sup>27</sup> and the ability to compare beliefs about HSHs in adults with versus those without diabetes to determine if behavioral sleep interventions need to target different beliefs for both groups. Unfortunately, it was not possible to achieve the minimum of 25 adults with diabetes for each HSH because our recruitment stopped due to the COVID-19 pandemic. Also, it was not possible to verify if beliefs differed by type of diabetes because of our small sample size, while there is data suggesting that type of diabetes can affect sleep quality.<sup>11</sup> Another limitation is that letting participants select the HSHs questionnaire they wanted to complete could have introduced a selection bias. This was to ensure that participants answered questions for a HSH that is relevant to them and explore which HSH seemed most problematic in our sample. A last limitation is that since this was labeled as a study on sleep, it is possible that more adults with sleep issues decided to participate in the study hoping this would improve their sleep. In addition, the fact that our sample was mostly comprised of Caucasian women limits generalization of the present results to other groups.

To our knowledge, this is the first study to use the RAA to compare beliefs about HSHs in adults with and without diabetes. Beliefs specific to adults with diabetes were identified, such as having a regular sleep schedule, which was perceived to facilitate diabetes management, and avoiding screen use in bed, which was associated with anxiety of not knowing blood glucose levels at night as electronic devices (e.g., Dexcom) can be used to monitor blood glucose levels at night. Adults with diabetes perceived more barriers to adopting HSHs compared with adults without diabetes, such as lack of motivation. This suggests that adopting HSHs was perceived as more challenging among adults with diabetes and stresses the need to develop behavioral sleep interventions to help them adopt HSHs. The present results can guide the development of targeted behavioral sleep interventions, including interventions specifically for adults with diabetes to prevent risks of developing complications associated with inadequate sleep.

#### Conflict of Interests

The authors have no conflict of interests to declare.

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