The use of social marketing theory as a frame work to promote uptake of sleep-conducive music by post-secondary students

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Abstract

Background*:** Sleep deficiency (SD) is a prevalent problem among post-secondary students (PSS) and has serious negative consequences for physical, cognitive, and psychological well-being. In a survey of 1,294 University of Alberta students, 30.5% reported sleeping 6.5 hours or less. The use of pharmacological sleep interventions (PSIs) to assist with sleep, such as hypnotics, has side effects including tolerance, dependency, withdrawal, rebound insomnia, anterograde amnesia, and daytime dysfunction. The use of non-pharmacological sleep interventions (NPSIs) such as sleep behaviour changes has been studied and demonstrates validity in improving sleep patterns in individuals with SD as well as being rated as more acceptable than PSIs. However, influencing sleep behaviour change is not a straightforward process. The use of a social marketing theory as a framework for delivering a NPSI, while focusing on a strength-based approach building on students' existing sleep related practices, appears to present an evidence-based approach to foster beneficial sleep behaviour change. ***Objectives: The primary objective of this study is to 1) evaluate the outcome of a social marketing strategy to recruit PSSs to a website that provides sleep-conducive music (SCM). Secondary objectives are 1) to evaluate the rate of uptake for the SCM, 2) students' adherence to the SCM, 3) students' evaluation of the SCM, and 4) to compare self-reported sleep quality in students and sleep beliefs before and after SCM use. ***Methods***: This study employed a campus-wide longitudinal prospective design with a pre- and post-test survey. Participants were recruited through social marketing strategies involving offline printed posters and online email invitations. Poster recruitment occurred for four weeks, followed by a wash out period of two weeks. Then email invitations were sent out campus-wide for four weeks. Posters and email invitations directed participants to an online survey. After completion of the survey, participants were

directed to a website containing three SCM for download. Follow-up data collection was done one week after initial participation with a second follow-up, three weeks after initial participation. Follow-up data collection was sent out through email, including a follow-up survey to evaluate the uptake and adherence of SCM use, students' sleep beliefs using the SBS, and the PSQI and ESS to measure sleep quality in participants. ***Data analysis:*** data analysis utilized the IBM SPSS statistical analysis software and included descriptive statistics, paired t-tests, Friedman test, and content analysis to analyse descriptive data. ***Discussion*****:** a higher uptake rate of the SCM was seen in the online advertisement strategy compared to the poster advertisement strategy. Despite evidence-based research suggesting the popularity and effectiveness of using printed posters as a recruitment tool, this study faced uncontrollable external factors, which may have affected the effectiveness of the posters. Additionally, while the online invitation was able to recruit more participants, challenges were faced with delivering the campaign message on a campus-wide level. ***Conclusion:*** The results from this study suggests that the use of social marketing and using an online platform is a feasible delivery tool and SCM appears to be accepted among PSSs. The results also suggests that the use of a strength-based approach is promising the SCM may be useful to improve self-reported sleep quality in PSSs. Future study should look at using multiple platforms to build more evidence for the use of social marketing.

Preface

This thesis is an original work by Yuluan Wang. The research project, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, project name “The use of social marketing theory as a frame work to promote uptake of sleep-conducive music as a non-pharmacological sleep intervention by post-secondary students,” No. Pro00074467, September 29, 2017.

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CHAPTER 1. INTRODUCTION

1.1 Problem statement

Sleep deficiency (SD) is a pervasive problem, which affects post-secondary students (PSSs) (Lund Reider, Whiting, & Prichard, 2010). According to the National Institutes of Health (2012), SD is defined as being when sleep deprivation, sleep irregularity, insufficient sleep quality, or an untreated sleep disorder occurs, impairing optimal performance levels. A cross-campus survey conducted with PSSs at the University of Alberta reported that of the 1,293 students that responded to the survey, 394 students (30.5%) reported they achieved less than 6.5 hours of sleep (Brown, Qin, & Esmail, 2017). Similarly, Coren (1994) studied sleep in 2,782 PSSs from the University of British Columbia and found that 32.1% reported sleeping difficulties. Sleep deficiency in PSSs has been shown to have a negative impact on learning and memory consolidation leading to poorer academic performances in students (Buboltz, Brown, & Soper, 2001). Sleep deficiency has also been found to increase an individual's risk of chronic conditions including obesity, diabetes, cardiovascular diseases and psychological abnormalities (Chang, et al., 2016). Due to the importance of sleep in physiological, psychological, and physical processes such as neural detoxification, cognition, mood, metabolic functions, and overall physical health, the role of sleep is important to enhance quality of life (Huang, Chang, & Lai, 2016; Kadam, Patil, Waghachavare, & Gore, 2016).

Brown's et al. (2017) cross-campus survey identified a number of strategies students at the University of Alberta used to help improve sleep. One intervention identified by 31.1% of students was the application of music to induce sleep. The use of music as a non-pharmacological sleep intervention (NPSI) for SD could promote student sleep from a strength-based approach. While traditional models for change looks at identifying deficits and providing recommendation for restoration to a more normalized state, a strength-based paradigm emphasizes individuals' knowledge, competencies, capabilities, and resources, aiming to promote independence and building on strengths that individuals possess to meet needs and goals, and to promote well-being (Powell, Batche, Ferro, Fox, & Dunlap, 1997). Musical elements such as sound, rhythm, melody and harmony have been shown to alter psychological and physiological responses by promoting parasympathetic nervous system responses and alpha brain wave frequency to lower heart rate and blood pressure, and increase deep breathing and

muscular relaxation (Solanki, Zafar, & Rastogi, 2013). A review by Harris (2014) reported that listening to relaxing music for 20 to 45 minutes before sleep, with a tempo between 60 and 80 beats per minute (bpm), is conducive to sleep induction. A study by Harmat, Takacs, and Bodizs (2007) found that PSSs who listened to music 45 minutes before bed for 3 weeks showed better overall sleep quality from the second week onward. Using music as a sleep-promoter appears to show physiological and psychological benefits.

Brown et al. (2017) suggests that an intervention involving music would be well received and relevant as many students at the University of Alberta already identified and use music as a sleep intervention. This study tested the use of social marketing theory as a framework to deliver a campus-wide NPSI for sleep based on music to promote sleep in students.

1.2 Statement of aim

In a survey with University of Alberta students, 30.5% reported sleeping 6.5 hours or less, and 66.5% perceived not receiving sufficient sleep (Brown et al., 2017). One popular strategy identified by students of the University of Alberta was the application of music to help them sleep. The survey showed 31.3% reported listening to music four or more times a week to promote sleep (Brown et al., 2017). However, evidence-based research has shown that only music that fits certain criteria has beneficial physiological effects on sleep. These criteria are detailed in the following Methods section.

This study is based on the following assumptions:

1) A significant number of students will be interested in improving their sleep.
2) Applying social marketing principles will increase the likelihood that students will access the music-based sleep intervention provided to download from the study website.
3) Because many PSSs already use music, the intervention can be considered strength-based, and this will prove attractive to students.
4) There is sufficient evidence-based to justify the marketing of SCM strategies

The aims of the study, therefore, were to evaluate 1) the success of using social marketing to recruit PSSs to a website that provides the SCM, 2) the uptake of the SCM from the

website, 3) the perceived changes in sleep PSSs attribute to the SCM, 4) the acceptability of SCM, and 5) students' adherence to the uses of the SCM.

1.3 Research questions

1) Are posters designed with evidence-based principles an effective method to recruit PSSs to a website that provides the SCM?

2) Are email invitations a more effective method to recruit PSSs to the website that provides the SCM compared to the offline method of printed posters?

3) Will PSSs uptake and adhere to the SCM intervention for the duration of the study?

4) Do PSSs' self-reported sleep characteristics and practice change after the SCM intervention?

5) What are PSSs' attitudes toward the SCM?

CHAPTER 2. LITERATURE REVIEW

This chapter introduces sleep deficiency (SD) in the post-secondary student (PSS) population, including the meaning of SD, the relationship between SD and PSSs, interventions for SD, in particular, the use of sleep-conducive music (SCM) as a non-pharmacological sleep intervention (NPSI), and social marketing theory as an NPSI delivery vehicle.

2.1 The relationship between sleep deficiency and post-secondary students

Human sleep is comprised of two main stages each with its own distinct physiological and neurological features: non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep (Carskadon & Dement, 2011). Non-rapid eye movement sleep is then further divided into three additional sub-stages: N1, N2, and N3-N4. The NREM N3-N4 sleep stage is also known as slow wave sleep (SWS) (Shi, Shang, Ma, Sun, & Yeh, 2017). Sleep begins at NREM and moves to REM sleep and then back to NREM stages N1, N2, and N3-N4. In adults, the NREM and REM sleep cycle occurs four to six times continuously throughout the night with one cycle lasting approximately 90-110 minutes (Carskadon & Dement, 2011). The length of NREM and REM sleep also changes throughout the night, with NREM sleep dominating the first half, and REM sleep dominating the latter half of the adult human sleep period (Carskadon & Dement, 2011). Studies have shown a relationship between learning and memory consolidation with REM sleep. It is reported that students who obtained a significant increase in REM sleep following an intensive learning task performed significantly better on examinations (Buboltz et al., 2001).

As previously mentioned, sleep is an important aspect of health and it is responsible for several physiological processes such as learning and memory, neural detoxification and metabolism. Sleep-dependent memory processing has been widely studied and it has been shown that SWS sleep is linked to declarative memory, while REM sleep is linked to procedural memory (Walker & Stickgold, 2004). It has been suggested that the combination of undisturbed SWS and REM sleep may contribute to the consolidation of complex declarative and procedural memories and thus offers maximum benefits in learning and memory. (Curcio, Ferrara, & deGennaro, 2006; Walker & Stickgold, 2004; Hershner & Chervin, 2014). In addition to the regulation of memory, SWS is characterized by several important physiological activities including regulation of blood pressure, heart rate, blood glucose metabolism, and hormonal and

neural processing (van Cauter, Spiegel, Tasali, & Leproult, 2008). This regulation includes decreased brain glucose metabolism, decreased hypothalamic-pituitary-adrenocortical system hormones and increased secretion of human growth hormone (van Cauter et al., 2008). During sleep, changes in neural activity and the neuroendocrine system are also observed. The neurotransmitter noradrenaline has been found to cause arousal by exciting the hypocretin/orexin neurons associated with the maintenance of the waking state. Sleepiness is caused by the inhibition of noradrenaline leading to the decreased efficacy of the hypocretin/orexin system responsible for wakefulness (Grivel et al., 2005). Furthermore, sleep has been shown to be important for detoxification processes of the brain. A study conducted by Xie et al. (2013) showed a positive correlation between quality sleep and neural detoxification. In patients with neurodegenerative diseases, metabolic by-products and proteins such as amyloid and tau accumulation have been shown to be removed by an increased circulation of cerebrospinal fluid that occurs during recovery sleep (Xie et al., 2013).

With sleep occupying nearly one third of human life, it is an essential process for optimal performance and health (Kadam et al., 2016). Sleep deficiency has been shown to be a risk factor for many health issues including obesity, diabetes, cardiovascular disease, and mental health concerns such as depression and anxiety, as well as cognitive and psychological well-being (Huang et al., 2016; Hershner & Chervin, 2014). The disruption of restorative and psychological processes regulated by sleep leads to negative consequences for individual health and performance (Killgore et al., 2008).

2.1.1 Prevalence of sleep deficiency in post-secondary students

Hicks, Fernandez, and Pellegrini (2001) found the average amount of sleep among PSSs has declined by one hour in the last 20 years, with the average hours of sleep dropping from 7.5 hours of sleep to 6.5 hours of sleep per night. The decline in sleep in this 2001 study shows the pervasive problems of SD especially in PSSs. In recent studies of sleep in PSSs, Brown et al. (2017) found 30.25% of University of Alberta students were sleeping 6.5 hours or less. Similarly, Agarwal, Eryuzlu, and Chawla (2015) found that in 337 McMaster University students, 29.1% reported sleeping an average of six hours per night. A cross-sectional online survey of 1,125 students located in a Midwestern American university showed 25% of students getting 6.5 hours of sleep or less (Lund et al., 2010), and a cross-sectional study conducted on

890 students at a university in India showed 45.8% of students reported getting less than seven hours of sleep per night (Kadam et al., 2016). In addition, 20% of post-secondary students reported staying up the entire night at least once per month, and 35% of students reported staying up until three in the morning at least once per week (Lund et al., 2010).

2.1.2 Consequences of sleep deficiency on post-secondary students

The recommended hours of sleep for adults are seven to eight hours per night (Anothaisintawee, Reutrakul, van Cauter, & Thakkinstian, 2015). Sleep deficiency in PSSs is associated with decreased academic performance, neurocognitive deficits, lowered levels of alertness during the day, physical health risks and reduced psychological well-being (Thacher, 2008; Wong *et al.,* 2013). Student sleep habits are seen to worsen over time and even a limited exposure to SD may have significant effects on health (Milojevich & Lukowski, 2016). A study by Brown, Buboltz, and Soper (2002) found that even in students who maintain a regular eight hours of sleep per night, a minimum shift of two hours in their sleep schedule could impact their concentration, reasoning, and psychological health. In a study by Harrison and Horne (1999), participants engaged in a marketing and profit simulation program, where one night of complete sleep deprivation showed reduced sensitivity to changes, inability to develop new strategies, and failure to produce solutions, leading to bankruptcy in the simulation. A study conducted by Pilcher and Walters (2010) with 44 PSSs found that sleep deprived students showed poor cognitive performances despite reporting high levels of self-perceived concentration, effort, and overall performance. This discrepancy between self-reported performance and actual performance showed that students may often be unaware of how SD influences their cognitive functioning and SD may thus have altered students' recognition of internal effort (Pilcher & Walters, 2010).

A study conducted by Wong et al. (2013) with 1,195 PSSs from 16 universities in China showed that sufficient sleep is vital in the processing and evaluation of emotion and SD strongly correlates with negative processing of mood and self-esteem. Further research has found that the prefrontal cortex, responsible for emotional regulation, social behavior, decision making, and planning complex cognitive behaviors could be vulnerable to effects of SD (Anderson & Platten, 2011). A study conducted with 32 young adults showed that insufficient sleep is associated with impulsivity toward negative stimuli and instability of mood (Anderson & Platten, 2011). Killgore

et al., (2008) further found in 26 young adults that SD also produced changes consistent with mild prefrontal lobe dysfunction such as reduced self-awareness, interpersonal skills, coping skills, and stress management skills and changes in cerebral metabolism, cognition, emotion and other behavioral processes.

Health risks associated with SD include obesity, diabetes, cardiovascular diseases, and mortality risks (Agarwal et al., 2015). There is strong evidence linking SD to chronic illnesses such as diabetes and cardiovascular diseases. A systematic meta-analysis conducted by Anothaisintawee et al., (2015) compared the risks of SD to traditional risk factors for diabetes and concluded that SD is a significant risk factor that is comparable to traditional risk factors for type 2 diabetes. The suppression of SWS due to SD leads to a decrease in insulin sensitivity and reduced glucose tolerance, thus, leading to an increased risk for type 2 diabetes (van Cauter et al., 2008). Sleep deficiency is also a risk factor for cardiovascular disease. Organisms having their circadian rhythm synchronized with the natural light-dark cycle have been shown to possess greater fitness. Students who experience a shift in their circadian system are at an elevated risk for chronic illnesses such as cardiovascular diseases (Agarwal et al., 2015). Another risk factor of SD is obesity. Hormones such as insulin and leptin have inhibitory effects on food intake while another hormone, ghrelin, has an appetite stimulating effect. In a literature review, ghrelin and leptin have been found to influence bodily functions such as eating, wakefulness and energy expenditure. Restriction in sleep has been found to be associated with a significant decrease in leptin levels and a significant increase in ghrelin levels (van Cauter et al., 2008). A literature review by Huang, Ramsey, Marcheva, and Bass (2011) discussed the correlation between sleep duration and weight loss and found that compared to individuals with healthy sleep patterns, individuals with poor sleep patterns showed increased weight loss difficulties, greater body mass index and incidences of obesity. A randomly selected sample of 25 McMaster University students found only seven students (28%) were aware of the relationship between sleep and risk factors such as cardiovascular disease. These survey results suggest that the student population may be unaware or lack knowledge on the health risks associated with SD (Agarwal et al., 2015).

The relationship between academic performance in PSSs and SD has been consistently shown to be correlated (Gomes, Tavares, & de Azevedo, 2011). The neurocognitive, behavioral, and physiological deficits associated with SD has important implications to academic

performances in PSSs (Thacher, 2008). Students with shorter sleep latency, earlier wake-up times, and less fragmented sleep reported higher grade point averages (GPA) compared to students with lower GPAs, who reported later bedtimes and wake up times (Curcio et al., 2006). It was also found that students who obtained less than 6 hours of sleep per night reported an average GPA of 2.74, whereas students who obtained more sleep reported an average GPA of 3.24 (Curcio et al., 2006). Similarly, research has found that lower GPAs were associated with late wake-up times, late bedtimes, and increased sleep latency. And with each hour of delay in reported rise times, the GPA was reported to decrease by 0.13 on a 4.0 scale (Tsai & Li, 2004; Trockel, Barnes, & Egget, 2006). A study conducted with 1,654 PSSs in Portugal also showed that students who failed their courses reported late rise time, and late bedtimes, while students who passed their courses reported earlier rise time and earlier bedtimes. Additionally, students with high previous GPAs reported better sleep quality, and a regular sleep schedule. This study offered several predictors of academic performance, including class attendance, sleep quality, sleep frequency, sleep quantity and late-night activities (Gomes et al., 2011). Studies with conditions focused on restricting sleep in participants tend to show reductions in neurocognitive and academic performances, whereas conditions that focus on optimizing sleep show improvement in neurocognitive and academic performances (Curcio et al., 2006).

Another predictor associated with low academic performance is the activity of "all-nighters" (Thacher, 2008). As previously mentioned, 20% of PSSs reported staying up all night at least once per month and 35% of PSSs reported staying up until three in the morning at least once per week (Lund et al., 2010). A study conducted by Thacher (2008) with 120 PSSs' self-reported sleep patterns, found that students with lower GPAs, ranging between 2.0 and 2.5, were more at risk of engaging in "all-nighter" activity, which may lead to increased sleep debt, missed classes, and late assignments, resulting in poorer academic standings (Thacher, 2008). As previously mentioned, REM sleep is a significant influence on the consolidation of new information. Studies have demonstrated that students who sleep late and rise early do not get the last few cycles of REM sleep. This leads to an impairment of memory and learning consolidation (Buboltz et al., 2001). Additionally, a study with 499 Canadian PSSs found that students who identify as being "evening types," had lower self-efficacy, maladaptive sleep practices, irregular sleep habits, and tended to go to bed with negative moods such as irritability, anger, nervousness, and stress (Digdon, 2010).

Sleep deficiency in PSSs is attributed to several factors; a leading influence being poor sleep hygiene or maladaptive practices (Hershner & Chervin, 2014). In Brown's et al. (2017) cross-campus survey conducted at the University of Alberta, 36.3% of students reported using alcohol as a sleep aid approximately 3 times per month. Researchers have shown that alcohol shortens sleep latency but increases fragmented sleep (Hershner & Chervin, 2014). Although the use of caffeine, energy drinks and stimulants lead to late sleep onset and fragmented sleep, they are used by PSSs to increase sleep latency, reduce sleepiness, and increase concentration to help compensate for insufficient sleep (Hershner & Chervin, 2014). Sleep disorders are another common cause of SD in students. A study conducted with 1,845 PSSs showed that 27% of students were at risk for a sleep disorder such as insomnia and hypersomnia (Hershner & Chervin, 2014). The effect of light exposure from electronic devices such as cellphones and computers used before bed, has also been associated with drowsiness, difficulty falling asleep, fragmented sleep, and less restful sleep (Hershner & Chervin, 2014). This will be discussed in more detail in the next section.

Overall, SD is associated with negative moods, physical health risks and lower academic performance. With academic standing being a demand for PSSs, a lower academic performance is likely to increase the use of unhealthy methods to induce sleep.

2.2 Interventions for sleep deficiency

Pharmacological sleep interventions (PSIs) and non-pharmacological sleep interventions (NPSIs) are two identified categories for sleep improvement. While PSIs such as hypnotics and melatonin have been shown to provide some benefits, NPSIs has been suggested to be as effective as hypnotics, more accessible to PSSs, and do not carry side effects seen in PSI use (Raymann, 2008).

2.2.1 Pharmacological sleep interventions

While PSIs are common and accessible, the use of hypnotics has been found to lead to many side effects including tolerance, dependency, withdrawal, rebound insomnia, anterograde amnesia, and daytime dysfunction (Tsoi, 1991; Maczaj, 1993). Chronic users of PSIs report sleep impairments such as decreased quality and quantity of sleep compared to individuals with insomnia who do not take hypnotics (Kripke, 2000; Wagner & Wagner, 2000). Melatonin has

been considered as a possible alternative to hypnotics in previous research and it is considered a non-prescription medicine by Health Canada and the Food and Drug Administration (Canadian Sleep Society, 2003); however, recent research suggests that chronic use of melatonin, especially at high dosages, can disturb the biological clock, and cause daytime fatigue, headache, dizziness, and tolerance (Pandi-Perumal, Zisapel, Srinivasan, & Cardinali, 2005; Kennaway, 2015). The use of PSI appears to impact REM sleep over time leading to negative consequences for memory and learning in PSS as previously mentioned (Pandi-Perumal et al., 2005). The Canadian Sleep Society (2003) suggests PSI should be taken short-term at the lowest dosage possible due to the risk of decreased efficacy and increased dependency over time.

2.2.2 Non-pharmacological sleep interventions

Non-pharmacological sleep interventions have been studied with demonstrated validity in improving sleep patterns in SD individuals as well as being rated as more acceptable than PSIs (Harsora & Kessmann, 2009). Treatments aim to decrease sleep latency, decrease sleep duration, and decrease awakenings during the night (Morin et al., 1999). One NPSI used for SD is Cognitive Behavioural Therapy (CBT), which is a multicomponent intervention aiming to act on cognition and behaviors which may affect sleep (Harsora & Kessmann, 2009). Cognitive Behavioural Therapy includes cognitive psychotherapy, sleep hygiene education, relaxation theory, stimulus control, sleep restriction, and paradoxical intention (Harsora & Kessmann, 2009). Cognitive Behavioural Therapy usually lasts for four to eight weeks with each session ranging anywhere between 60 to 90 minutes long. However, CBT is costly, time consuming and research has shown that it may be, in some cases, ineffective, unaccepted by participants, or have limited potential for long-term benefits (Lynch, Laws, & McKenna, 2010)

Sleep deficiency in PSSs is reported to be significantly worse compared to the general population (Brown, Buoltz, & Soper, 2006). Sleep education programs were developed with the assumption that knowledge would translate into behavior change (Digdon, 2010). However, it has been found that increased sleep knowledge does not necessarily lead to sleep behavior change (Blunden, Chapman, & Rigney, 2012). A meta-analysis of 12 studies (Blunden et al., 2012) found most sleep education programs contain similar contents: sleep physiology, amount of sleep needed, sleep disruption factors, sleep hygiene, consequences of poor sleep and sleep control and relaxation methods. Sleep education programs on average last a month with an

average session lasting 50 minutes. Theoretical approaches researchers applied to sleep education programs in Blunden et al's (2012) review, include social learning and psychoeducational models. Only six of the 12 studies reported receiving positive feedback, rating the program as informative and helpful. The results from these studies showed little change in sleep behavior. Overall, sleep education programs appear to be successful in raising sleep knowledge and increasing motivation for change; however, such programs may not necessarily be successful in implementing consistent improvements in sleep behavior (Blunden et al., 2012).

A study by Digdon (2010) with 499 Canadian PSSs used social cognitive theory to study PSSs belief about sleep and sleep education programs. The study found that low motivation for change could arise from negative attitudes towards recommended sleep practices. Students may have become unaware of experiencing negative effects of SD. In addition, self-efficacy is considered a strong predictor for change. Self-efficacy is defined as an individual's belief about their ability to implement changes, and it was found that students who identified as having poor sleep practices were reported to have poor self-efficacy (Digdon, 2010). On the Sleep Beliefs Scale (Adan, Fabbri, Natale, & Prat, 2006), students with low self-efficacy rated maladaptive sleep practices such as caffeine consumption and practicing stimulating activities in bed, as not having a negative effect on sleep. Digdon (2010) proposed that low self-efficacy scores could be used to predict students' inaction toward sleep education programs recommendations for sleep promoting practices. Digdon (2010) suggested that sleep education programs have short-term effectiveness and students often revert to their irregular schedules. Post-secondary student behaviors are suggested to be motivated by academic, professional, and social goals. These factors prompt students to stay up late to study, work, or socialize, and pursing these goals may be viewed by PSSs as higher priority than maintaining good sleep behavior (Digdon, 2010).

2.2.3 Music as a non-pharmacological sleep intervention

Sound is defined as mechanical energy produced by movement sending a wave through the environment, to be deciphered by physiological signals in the auditory system located in the human ear (Muzet, 2007). Noise is defined as a set of unwanted sounds without control for elements such as volume and duration (Muzet, 2007; Xie, Kang, & Mills, 2009). Noise exposure is a risk to physiological and psychological well-being, because of its influence on fatigue, insomnia, physiological stress and cardiovascular stimulations (Muzet, 2007; Xie et al., 2009).

Noise exposure has been found to prolong sleep latency, increase fragmented sleep, cause early awakenings, shallow sleep, heart rate and negative moods (Öhrström & Björkman, 1988). A study conducted with 24 medical students exposed to a maximum noise level of 60dB during sleep showed increased heart rate and increased movements throughout the night (Öhrström & Björkman, 1988). Similarly, in a study conducted by Griefahn, Marks, and Robens (2006), 32 young adults exposed to quiet (32 decibels (dB)), road (50dB), rail (56dB) and aircraft (62dB) noise conditions, with noise levels varying between 50 and 72dB, showed decreased time spent in REM and SWS sleep. More recently, Buxton et al. (2012), using a three-day polysomnographic study with 12 participants, found that gradual exposure to noise between 40 to 70dB was more likely to cause arousal in the N2 stage of sleep. Additionally, types of noise such as electric sounds and human voices cause an elevation in heart rate and increased probability of arousal in NREM sleep compared to REM sleep. Noise levels between 30 to 40dBs are likely risk factors for arousals, awakenings, body movements, and sleep disturbances (Buxton et al., 2012). Noise levels above 40dB are considered a risk factor for potential health effects, and sleep disturbances, leading to increased sleep latency from a few minutes to 20 minutes (World Health Organization, 2009; Hume, Brink, & Basner, 2012; Muzet, 2007). A noise level of 30dB or below is considered to have no substantial biological effect and to have little to no effect on sleep (World Health Organization, 2009; Hume, Brink, & Basner, 2012; Muzet, 2007).

Music is evident in all cultures and is considered by some to be a low-cost health intervention technique with beneficial effects on physiological, psychological and socioemotional well-being (Kemper & Danhauer, 2005). Music is defined as an intentional auditory stimulus with organized elements such as melody, rhythm, harmony, timbre, form, and style (Kemper & Danhauer, 2005). The use of sedative or relaxing music as an intervention has been found to enhance sleep by activating the parasympathetic nervous system and reducing activities in the neuroendocrine and sympathetic nervous system to reduce the human stress response through muscular relaxation, distraction from thoughts, decrease anxiety, blood pressure, respiration rate, heart rate, and changes in neural activities (Harmat et al., 2008; Kemper & Danhauer, 2005; Lai & Good, 2005; Tan, 2004). Music has also been found to reduce circulating noradrenaline, a neurotransmitter associated with awakening (Huang et al., 2016; Lai & Good, 2005; Grivel et al., 2005). The effect of music listening may be due to its ability to obscure unwanted environmental stimuli such as noise, or in its ability to provide distraction

from unwanted existing stimuli such as stress. It may also act as competing stimuli for unwanted existing stimuli such as pain (Krout, 2007).

Sleep-conducive music (SCM) is characterized as music without accented beats, percussive characteristics, and syncopation, with a slow, steady tempo of 60-80 beats per minute (bpm) (mimicking the human heart rate) and with repetitive rhythms (Chan, Wong, & Thayala, 2011; Gaston, 1951; Knight & Rickard, 2001). Additionally, the characteristics of relaxing or sedative music are a slow stable rhythm, low-frequency tones, classical instrumental effects, soothing and relaxing melodies, and low pitches (Chi & Young, 2011). It is reported that music with high pitches and faster tempos increases tension (Chi & Young, 2011). A study by Morishima, Sugino, Ueya, Kadotani, and Takadama (2016) adjusted music and sound to participants' biological information (such as heartbeat and respiration rate) and found that a sustained sound shortened sleep onset latency compared to sounds that decayed and sounds that faded in and out. A study by Wu, Li, and Yao (2009) with 60 volunteers who evaluated 25 pieces of music, found that participants had higher accuracy identifying the difference between musical elements pitch (76.7%) and tempo (98.3%) whereas other music elements such as volume (53.3%) and timbre (13.3%) had lower identification accuracy. These results suggest that individuals are more sensitive to pitch and tempo compared to volume and timbre.

Western art music emphasizes on formal clarity, balance, and structure (Mornhinweg, 1992). New age music or designer music is identified as music created specifically to affect the listener on a physiological and psychological level by enhancing well-being, positive mood, and reduces stress. It is characterized as a blander and mellower type of music with no central theme, no natural beat, and no recognizable melodies. It does have repeated cycles of gentle undulating sounds to facilitate an environment for relaxation and meditation (Mornhinweg, 1992). In a study with 58 PSSs, listening to classical music resulted in a decrease in heart rate from 73 bpm to 69.5 bpm, listening to new age music showed a decrease in heart rate from 73.45 bpm to 68.8 bpm, and listening to popular music showed an increase in heart rate from 74 bpm to 76bpm (Mornhinweg, 1992). A study by McCraty, Barrios-Choplin, Atkinson, & Tomasino (1998) tested four types of music: classical, grunge rock, new age, and designer music. The results showed that grunge rock music led to an increase in hostility, fatigue, sadness, and tension while reducing relaxation, mental clarity, vigor and compassion compared to the other types of music.

In a systematic review of 17 studies (Chan et al.,2011), listening to music in bed, with closed eyes to minimize distractions, for 30-60 minutes per session was found to be the most beneficial in overall sleep quality. In a meta-analysis of 10 randomized studies looking at the use of music to improve sleep through subjective sleep questionnaires, music was shown to decrease sleep latency, increase sleep duration, reduce sleep disturbances, and reduce daytime dysfunction (Wang et al., 2014). As previously mentioned, a study by Harmat et al. (2007) found, using self-reported analysis, that PSSs who listened to music 45 minutes before sleep for three weeks showed better overall sleep quality from the second week onward. A randomized controlled trial with 50 participants using polysomnography and self-reported analysis, found that music listening for 45 minutes at bedtime for three days improved sleep quality by increasing duration of REM sleep and decreasing duration of N2 stage sleep (Chang, Lai, Chen, Hsieh, & Lee, 2012). Similarly, a study with 24 PSSs using polysomnography and self-reported analysis found that listening to sedative music at 60 bpm for one hour reduced N2 stage sleep. Additionally, the polysomnography analysis showed an increase in SWS in PSSs with sleep onset latency longer than 10 minutes (Chen et al., 2014).

Wu et al. (2009) created REM and SWS music from individual electroencephalogram waveforms and found that REM music includes fast rhythms, lively melodies, and wide variety of note pitches, which suggests an active state of the brain during REM. In contrast, SWS music encompassed low pitches and slower rhythms which suggest a relaxed state the brain during SWS. Additionally, listening to REM music increased reports of happiness, while listening to SWS music increased reports of boredom and sleepiness. Beta waves are associated with alertness, alpha waves are characterised by relaxation and daydreaming, and theta and delta waves signify light and deep sleep respectively (Furman, 1978). Past research has shown that listening to sedative music does lead to a slight increase in alpha rhythm content in electroencephalogram measurement (Wagner, 1975; Furman, 1978). A recent study by Phasukkit, Mahrozeh, Kumngern, and Tsungjotkusolmun (2015), using electroencephalogram and actigraph analyse with 25 participants, found that listening to sedative music while relaxing in bed showed greater sleep efficiency and changes from alpha wave to theta wave activity. Similarly, a study conducted by Verrusio et al. (2015) found that listening to classical music by Wolfgang Amadeus Mozart showed significant increases in alpha wave activity from electroencephalogram analysis.

In additional to influencing neural networks, music listening has also been suggested to have a positive influence on hormone regulation. A study by Khalfa, Bella, Roy, Peretz, and Lupien (2003), conducted with 24 PSSs, found that PSSs who listened to relaxing music after engaging in a stressful task showed a decrease in salivary cortisol levels, whereas, PSSs who did not engage in music listening after the stress task showed a continued increase in salivary cortisol levels. Additionally, patients undergoing surgery listening to music pre- and post-surgery for 30 minutes showed a significant decrease in plasma cortisol levels (Cervellin & Lippi, 2011). In another study, Nilsson (2009) found that participants listening to music pre- and post-surgery for 30 minutes while receiving bed rest showed an increase in subjective relaxation levels and oxytocin levels.

Music appears to have positive effects on sleep by promoting parasympathetic nervous system activity through muscular relaxation, thought distractions, and decrease in heart and respiratory rates (Harmat et al., 2008). Studies have found that the greater the synchronization between heart beat and music beat, the greater the reported relaxation and analgesic effects of music by participants (Harmat et al., 2008). Some studies suggest that sedative or relaxing music between 60 to 80 bpm lowers heart rate and blood pressure, increases deep breathing, and regulates circulating hormone levels such as increased endorphins levels (associated with positive moods), increased phenylethylamine from the limbic system (associated with feelings of mood elevation and love), and decreased cortisol and adrenocorticotropic hormone levels (associated with stress) (Harmat et al., 2008; Solanki, 2016).

2.3 Social marketing theory

Social marketing is the use of traditional commercial marketing principles and techniques to influence voluntary and socially desirable behaviors to promote the health or well-being of the target audience or the public (Andreasen, 2002; Mayasari, 2012; Weinreich, 2011). Unlike traditional marketing, the goal of social marketing is to influence beneficial social behaviors and not to benefit from monetary gain (Mayasari, 2012). Social marketing does not focus on the public but instead uses segmentation and individualization of messages targeting specific audiences to maximize effectiveness (Weinreich, 2011). An important part of the social marketing process involves research on the issue, research on the target audience, an environmental analysis, and pre-testing in order to develop an effective strategy (Weinreich,

2011). However, social marketing and traditional marketing do share similarities including being consumer oriented, and the "Four Ps" of marketing: product, price, place, and promotion (Mayasari, 2012). The product in social marketing is the behavior, service, practice, or physical product the social marketer aims for the target audience to adopt. Price in social marketing is what the target audience members must do in order to obtain the social marketing product. Place includes the distribution channels and how the product will reach target audiences, and finally promotion in social marketing is the messaging system developed to create and sustain demand for the product (Andreasen, 1995; Andreasen, 2002; Weinreich, 2011). In addition to the "Four Ps" of marketing, social marketing also focuses on partnership with the public such as with community groups and secondary audiences who may influence the program and target audiences (Mayasari, 2012; Weinreich, 2011). Social marketing also utilizes theories of behavior change in developing effective messaging. One theory is the Transtheoretical Model of Behavioural Change, which is a biopsychosocial model used to conceptualize the process of behavioral change (Prochaska & Di Clemente, 1982). The Transtheoretical Model of Behavioral Change is comprised of 5 stages of behavior change: pre-contemplation, contemplation, preparation, action, and maintenance (Prochaska & Di Clemente, 1982; Kowalski et al., 2014). In the pre-contemplation stage, individuals do not have intentions for change. The contemplation stage describes individuals who intend to begin change. The preparation stage describes individuals who intend to take action soon or are making plans to do so. The action stage describes individuals who have begun to address the problem. Finally, the maintenance stage describes individuals who persist in the activity for six consecutive months or more (Johnson et al., 2013).

As discussed in section 2.2.2, while awareness campaigns are well received, they do not necessarily lead to change nor move individuals to action stages such as that proposed in the Transtheoretical Model of Behavioral Change. One promising model that focuses on moving beyond knowledge to active behavioural change is social marketing (Andreasen, 2002).

Social marketing focuses on framing the target behavior with other aspects of the behavior of the environment to change a negative message into a positive message (Engelberg et al., 2015). An example of a successful social marketing campaign involves stress management in the workplace. Instead of stress management workshops and education programs, the campaign

used the competitive nature of the employees and turned relaxation into a competition. The use of competition is now a regular element in worksite health promotion programs (Engelberg et al., 2015). Another successful example of a social marketing campaign is the "Truth Campaign." The social marketing campaign focused on reducing adolescence smoking by researching the values of smoking in adolescence, which included rebellion against authority figures such as teachers and parents. Instead of taking the common educational and awareness approach to the consequences of smoking, this social marketing campaign deflected the rebellion away from authority figures in adolescences lives and onto tobacco industries (Weinreich, 2011). The use of mascots is also another effective social marketing strategy. Mascots act as a messenger for campaigns by connecting to the emotional aspect and promoting interpersonal communication (Hayden & Dills, 2015).

Overall, social marketing principles include a focus on changing behavior by working in a unified communication approach, understanding audience values, adapting to changes in audiences, avoiding mass marketing, and focusing on tailored messaging to develop an effective strategy for change (Andreasen, 1995). Based on the existing literature, and the overall goal of improving PSS sleep positive behaviours, we elected to use a social marketing approach to increase PSSs' uptake of a sleep promoting intervention based on music. We selected sleep promoting music because, according to Brown's et al (2017) cross-campus survey of 1,293 University of Alberta students, a 31.0% of students already used music to help promote sleep. That study did not collect data on the type of music students used to promote sleep and they speculated that while the habit might be helpful, the music selected may be less than optimal. Brown et al (2017) suggested that an intervention involving music would be well received and could promote student sleep from a strength-based approach as many students at the University of Alberta already identified with and use music as a sleep intervention. This will be discussed in more detail in later sections. The challenge was to determine a mechanism to influence students' behaviour to take up both sleep-promoting music listening practices and to select sleep conducive music. The use of social marketing theory appeared to present an evidence-based approach, using traditional commercial marking principles and techniques to influence voluntary and socially desirable behaviours (Andreasen, 2002; Mayasari, 2012), to promote prosocial behaviour change.

2.3.1 Offline strategy of advertisement posters

Posters are one of the most common and effective recruitment approaches (Feman, et al., 2008). A study by Fleming, et al., (2015) showed that posters have the capabilities of reaching a large number of participants. Fleming, et al., (2015) compared passive and active recruitment methods (direct contact vs indirect contact) and found that passive recruitment methods such as the use of posters, flyers and newsletters had a 72.7% success rate while active methods such as postal mail and in-person referrals had a recruitment success rate of 50.6%. The high success rate could be due to the participants' repeated exposure to the passive recruitment methods (Fleming, et al., 2015). In addition, outdoor passive advertisements, like the use of posters, report a high recall rate depending on certain factors such as exposure, product, and message (Walliser, 1997; Janiszewki, et al., 2003). Factors such as size and location of advertisement tend to have a strong impact in their attention-grabbing capabilities. The larger the physical size of the advertisement, the more it is remembered (Walliser, 1997; Pieters & Wedel, 2004). Advertising in high-traffic locations, creating repeated exposure, may also lead to increased effectiveness (Feman, et al., 2008; Fleming, et al., 2015).

Graphic communication factors in advertising for effective persuasion include color, font and style of the advertisement. Gorn et al. (1997) reported that while choosing colors is a subjective task, advertisement with high saturation or chroma, and lightness or value, influences feelings of excitement and relaxation and thus, may create a positive attitude towards the advertisement. Research looking at the effects of colors on physiology has shown that certain colors elicit certain biochemical changes. Warm colors have been reported to elicit higher levels of arousal, urgency, and attention, while cool colors generate higher levels of relaxation and pleasure (Chiu et al, 2016; Shi, 2013; Gopikrishna & Kumar, 2015). Additionally, it has been reported that cooler colors elicit a more positive rating in consumers than warmer colors (Chiu et al, 2016; Shi, 2013; Gopikrishna & Kumar, 2015).

The use of typeface can be classified into two broad categories: serif and sans serif fonts. Serif fonts have lines or curves that finish off the ends of the letterforms, while sans serif fonts do not have any finishes (McCarthy & Mothersbaugh, 2002). The use of serif fonts has been reported to deliver superior results as it increases legibility by helping readers distinguish between letters in a word. Additionally, novel fonts have been reported to catch attention and

motivate processing of information, while ornateness of font leads to a decrease in legibility (McCarthy & Mothersbaugh, 2002).

The text size on the advertisement also enhances its readership. Research has found that a minimum of point 10 to 12 font size is easy to read; however, in advertisement, it is recommended that the greater the text size, the greater the readership due to legibility and motivation in processing of information (McCarthy & Mothersbaugh, 2002; Pillai et al., 2012).

2.3.2 Online strategy of electronic mail

Research can be limited by the ability to access populations of interest (Arcia 2014). The widespread use and access to the internet now offers alternative strategies and a cost-effective method to conduct health research (Christensen et al., 2017). Additionally, internet-based recruitment has the advantage of reaching underrepresented populations and populations who are challenging to enroll due to having sensitive health care concerns or mental health concerns (Harris, Loxton, Wigginton, & Lucke, 2015; Christensen et al., 2017).

In a web-based cross-sectional design study in the United States, 1,237 participants were recruited using a mix of online and offline recruitment methods including email notifications, paid electronic advertisements, and paid print advertisements in magazines. The study found that online recruitment methods including electronic advertisements and email notices generated the highest number of participants (85.17%) (Wiist, Sullivan, Wayment & Warren, 2010). Another web-based study in Boston University enrolled 2,421 participants after 99 weeks of recruitment using online and offline recruitment methods (Wise et al., 2015). Offline recruitment methods including flyers, postcards, newspaper and magazine advertisements, recruited 5.77% of participants, while online recruitment methods including electronic advertisements recruited 94.2% of participants. Additionally, the online recruitment methods were also more cost effective (Wise et al., 2015). In a more recent web-based Danish prospective cohort study comparing online and offline recruitment methods for internet-based studies in terms of recruitment and cost efficiency, a total of 8,252 participants were recruited over six years (Christensen et al., 2017). Only 10.4% or 803 participants were recruited using offline recruitment methods including press releases, posters with QR codes placed on notice boards,

and flyers, while online recruitment methods including online advertisements on social media websites, recruited 51.6% or 3985 participants (Christensen et al., 2017).

Studies using offline and online methods to recruit for internet-based studies found offline methods to be less efficient. Christensen et al. (2017) suggests this may be due to the extra effort required by offline methods to go online and find the study homepage to enroll, whereas with online recruitment, enrollment is only a click away.

2.4 Summary of literature review

Literature reviews show that SD is a pervasive and growing problem among PSS populations. Sleep deficiency has a significant physical, psychological and cognitive impact on PSSs and the use of PSIs, Cognitive Behavioral Therapy, and sleep education programs may be costly and ineffective for some in treating the problem for certain individuals over the long-term.

According to the sleep survey conducted at the University of Alberta, the use of music to help facilitate sleep was a popular strategy identified by students and is a form of evidence-based NPSI. This already identified problem and the associated strategy employed by the students at the University of Alberta could form the basis of a strength-based approach. Several studies have been carried out to explore the efficiency of using sedative or relaxing music to help improve sleep and it has been found that listening to music without accented beats, percussive characteristics, and syncopation, and with a slow, steady tempo of 60-80 bpm with repetitive rhythms, and a sound level of 30dB or below have sleep conducive properties.

The challenge is to influence students' behaviour to take up sleep-promoting music listening practices, and the use of social marketing theory appears to present an evidence-based approach to promote prosocial behaviour change, which involves the listening to sleep-conducive music as a low cost and side-effect free form of NPSI to help reduce SD in PSS populations.

CHAPTER 3. METHODS

This chapter discusses the details of the research methods in this study including the study design, sampling, recruitment methods, the inclusion and exclusion criteria, the development of the sleep-conducive music, the procedures of the study, data collection, and data analysis. This study was approved by the University of Alberta Research Ethics Board. All participants have been provided full disclosure of all information necessary for making an informed decision prior to the start of the study and submission of the survey was considered as voluntary consent to participate.

3.1 Study design

This study employed a campus-wide longitudinal prospective design with a pre- and post-test survey with a questionnaire component, where the participants acted as their own control. A survey is useful to measure attitudes, knowledge, and behavior and collect information from a sample of the population of interest (Bowling, 1997). A prospective longitudinal design takes place over the forward passage of time with more than one period of data collection (Bowling, 1997). Longitudinal surveys tend to be either panel or trend (Bowling, 1997). The type of longitudinal survey this study employed was panel survey where the same sample of a defined population was followed up at more than one point in time and changes were recorded at intervals (Bowling, 1997). The panel survey progressed with the baseline data collection, the delivery of the intervention, the follow-up survey one week after the initial intervention uptake, and the second follow-up three weeks after the initial intervention uptake. This study design is useful for studying new interventions and trends in behaviours or attitudes (Bowling, 1997). Additionally, a survey design can gather a large amount of information on a number of people quickly.

An online survey was selected as the most efficient method to collect data in this study as the internet and electronically accessible information have increased both in availability and popularity (Wright, 2005). Additionally, an online survey is a fast and cost-effective tool, accessible at any time, and able to reach a large number of participants compared to traditional survey methods such as interviews (Sue and Ritter, 2012; Wright, 2005). However, online survey studies allow researchers little or no control of when participants complete the survey and could

include bias and a non-representative sample. Therefore, this study attempted to minimize the risk of these factors by collecting demographic information on participants in order to determine if a representative sample was achieved for this study. Additionally, participants entered their own data to control for variance and bias from researchers (Bowling, 1997; Sue and Ritter, 2012).

3.2 Sample

The sampling technique for this study was convenience-sampling technique; a non-probability sampling that is accessible, fast, and suitable for pilot studies (Emerson, 2015). From the literature, this appears to be the first study of this topic and so a sample size calculation was not possible. Thus, we accepted all who volunteered for this study. The sample size was limited to post-secondary students from the University of Alberta.

3.3 Poster design

The use of posters as a study recruitment tool is one of the most common and effective recruitment approaches with the capabilities of reaching a large number of participants (Feman, et al., 2008; Fleming, et al., 2015). According to the Nielson's Global Trust in Advertising report (2015), Asian and Latin American audiences' rate real-life or health-themed messages as more appealing. European and North American audiences' rate humorous messages as more appealing. Younger people, aged 15 to 34, rate high energy or action-filled messages as more appealing. Based on this report, three different themed posters were designed to appeal to a large audience group (Appendix A).

The posters included a brief advertisement of the intervention to be offered, with a slogan and logo designed to fit with the social marketing campaign for SCM. Based on graphic communication principles, the posters utilized novel and traditional serif fonts with minimal ornateness to enhance legibility, attention-grabbing capabilities, and to motivate the processing of information. Poster colors were set to have high levels of chroma and value to elicit feelings of relaxation and draw attention to the posters. Poster colors were cool colors such as blue and green to generate feelings of relaxation and pleasure, and the warm color yellow for its attention-grabbing capabilities. Colors that were excluded include red, orange, purple, pink and black as these colors have been reported to elicit a more negative response. The criteria for poster design

can be found in Appendix B. Posters were designed using the software Adobe Photoshop version 6.0, and online photo editor software FotoJet and PicMonkey.

3.4 Sleep-conducive music design

The three pieces of SCM used in this study were developed by the researcher using the Looplabs platform following evidence-based criteria for SCM, to ensure sleep-conducive properties and to control for bias and errors. All three pieces of music are 30 minutes long, have a steady tempo of 60 bpm throughout, steady dynamics, repeated rhythms, low frequency tones and pitches. The three SCM do not have accented beats, percussive characteristics, and syncopations. The criteria used to create the SCM for this study can be found in Appendix E.

3.5 Recruitment

The social marketing strategy selected based on the literature review was offline advertisement posters displayed in high-traffic buildings at the university. However, we realized as the study unfolded that a second phase involving online recruitment needed to be added due to uncontrollable factors encountered using printed posters. This will be discussed in more detail in later chapters. The two recruitment processes will be described below.

Recruitment for the first phase of this study occurred through offline advertisement in the form of printed posters designed to meet social marketing and graphic communication principles. Posters in the themes humor, energy, and real-life, were displayed in high-traffic areas around the University of Alberta (Appendix A).

As will be discussed in detail below, we elected to test a second social marketing recruitment strategy when the first phase of recruitment resulted in less than the expected number of participants. In the second phase of this study, the recruitment occurred through a campus-wide electronic mail (email) using the University of Alberta online “Mailman” service (http://www.mailman.srv.ualberta.ca/). The “Mailman” service is a mailing list which allows mass emails to be sent to email lists at the University of Alberta. Online invitations were sent to the student population. As mentioned in section (1.4.2) online recruitment methods, such as email, have also been found to be highly efficient (Christensen et al., 2017). The email invitation

was designed to meet social marketing principles, which included a brief advertisement of the intervention and an invitation to participate (Appendix C).

3.6 Inclusion and exclusion criteria

The inclusion criteria for this study included any post-secondary students attending the University of Alberta at the time of the study with self-reported sleep deficiency. All interested students were welcome to participate in the intervention. The exclusion criteria included those with hearing impairments and an inability to communicate in the English language.

As participants acted as their own controls, and the primary aim of the study was to test the social marketing approach as opposed to measurable change in sleep quality, those diagnosed with sleep disorders, health conditions, or those using sleep medication were not excluded from the study.

3.7 Social marketing protocol

1) As mentioned previously, although the original plan was to test only the social marketing strategy of posters, the study was extended to also test electronic invitations. Therefore, the study employed two phases. In phase one, participants were recruited using printed posters for four weeks. Posters had a Universal Resource Locator (URL) and a Quick Response (QR) code image linking participants to the online survey containing the study and the consent information (Appendix D).

After four weeks of poster recruitment, a washout period of two weeks where no recruitment for the study took place. After this period, phase two of the study took place, where email invitations were sent out with the URL to the online survey and consent form using the University of Alberta's "Mailman" service. Email recruitment was sent out once a week for a total of four weeks.

The online survey was hosted on Google Forums. The survey gathered basic demographic information, self-reported sleep quality based on two standardized self-reported sleep questionnaires (the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989) and the Epworth Sleepiness Scale (ESS) (Johns, 1991), participants' sleep knowledge using the Sleep Beliefs Scale (SBS) (Adan et al., 2006), questions about the participants' attitudes on the social

marketing campaign posters, current music practices to induce sleep, and beliefs about the music and its impact on their sleep. Submission of the survey was considered as consent to participate (Appendix G).

2) After completion of the survey, students were then directed to the campaign website designed using the Wix platform (https://www.wix.com/) to download one of three SCM. Participants were instructed to listen to the SCM at a low volume, in bed with the lights out, and ready to go to sleep doing no additional activity for 30 minutes. The music was uploaded to MediaFire (https://www.mediafire.com/), a file hosting software, as the music download platform. The SCM intervention lasted for three weeks.

3) One week after the uptake of the intervention, a follow-up data collection, responding to the poster or, in stage two, electronic invitation to access the website and complete the survey, was completed through email communication (Appendix F). Emails were sent out to participants with a follow-up survey to evaluate the uptake and adherence of the intervention from the website, the participants' sleep quality using the PSQI and the ESS, and participants' sleep beliefs using the SBS.

4) The second follow-up data collection was completed three weeks after the uptake of the intervention. Emails were sent out to participants with the follow-up survey to evaluate for uptake and adherence of the intervention from the website, and participants' sleep quality using the PSQI and ESS, and participants' sleep beliefs using the SBS.

3.8 Data collection

Literature search revealed no existing standardized survey tool to evaluate this form of social-marketing campaign and the uptake and adherence of an NPSI based on music; thus, a survey was constructed to collect data about the participants' attitude and acceptance of the intervention. The baseline survey included five sections: 1) demographic information gathering information on age, study program, gender, and email contact for later follow-up, 2) participants' attitudes about the social marketing campaign posters, 3) participants' attitudes about music and its impact on their sleep, 4) current music to induce sleep practices, 5) self-reported sleep quality utilizing two standardized sleep questionnaires, the PSQI (Buysse et al., 1989) and the ESS (Johns, 1991), and 6) participants' sleep knowledge using the SBS (Adan et al., 2006). At first

and second follow-up of the study, questions about the uptake, adherence, and evaluation of the usefulness of the SCM were included.

3.8.1 Evaluation of the social marketing campaign

Participants' evaluation of the social marketing campaign posters was measured based on survey questions and number of students recruited. The number of participants recruited using email was compared to the number of participants recruited using printed posters to determine which of the two recruitment methods, online or offline recruitment was more effective. In phase one of the study, survey questions gathered participants' attitudes on which of the three posters first prompted them to visit the website, and the reason for visiting the URL or the QR code. In phase two, survey questions also asked participants if any offline posters from phase one of the study, were noticed before receiving the email invitation. The survey included multiple choice questions and free-text responses (Appendix G).

3.8.2 Uptake of the SCM by students

The uptake of the intervention was measured with StatCounter (https://statcounter.com/) to determine the unique visits to the website that hosts the SCM. Uptake of the intervention was also measured using the MediaFire file hosting software, which tracked the number of downloads of each music file.

3.8.3 Adherence to the SCM intervention and evaluation of the SCM by students

Survey questions included multiple choice and free-text response designed to measure adherence to the SCM intervention by students. The survey gathered information on frequency of use throughout the week, length of use, barriers that may have prevented usage, attitude of the SCM, and subjective sleep quality (Appendix G).

3.8.4 The Pittsburgh Sleep Quality Index

The PSQI (Appendix H) is a widely used, standardized, self-reported sleep measurement to evaluate sleep quality (Buysse, et al., 2008). The PSQI is a self-reported questionnaire comprised of 19 questions that evaluates subjective sleep quality with a global score ranging from zero to 21, with a score of "zero" indicating "no difficulties" and a score of "21" indicating "severe

difficulties in sleep". The PSQI has been found to have a sensitivity of 89.6% and a specificity of 86.5%. It covers a wide range of indicators relevant to sleep quality and shows strong reliability and moderate validity in both clinical and non-clinical cases (Buysse, et al., 2008).

The PSQI was included in this study as a self-report assessment tool to measure the sleep quality of participants pre- and post-intervention. The questionnaire was collected at baseline, one week after baseline, and three weeks after baseline. Although change in sleep was not an aim of the study, we were curious to see if there was a potential secondary outcome suggesting there was improved sleep related to the SCM use.

3.8.5 The Epworth Sleep Scale

The ESS (Appendix I) is a self-rated questionnaire that measures daytime sleepiness comprised of eight questions (Johns, 1991). Each of the eight questions has a score ranging from zero to three on participants' sleepiness in daily living, with "zero" indicating "would never doze or sleep" and a score of "three" indicating "high chance of dozing or sleeping" (Johns, 1991). The ESS final score represents the sum of the eight items with a score ranging from zero to 24, with a score of 10 or greater indicating significant sleepiness (Johns, 1991). The ESS has shown high test-retest reliability correlation ($r=0.82$), and a high level of internal consistency using Cronbach's statistic alpha (Johns, 1991).

The ESS was included in this study as a self-report assessment tool to measure the sleep quality of participants pre- and post-intervention. While change in sleep was not an aim of the study, we were curious to see if there was a potential secondary outcome of improved sleep related to the SCM use. The ESS was collected at baseline, one week after baseline, and three weeks after baseline.

3.8.6 The Sleep Beliefs Scale

The SBS (Appendix J) is a revised version of the Sleep Hygiene Awareness tool developed to assess sleep attitudes and beliefs (Adan et al., 2006). The scale is comprised of 20 questions with good internal consistency (Adan et al., 2006).

The SBS was included in this study to see if sleep beliefs shift over the course of the study. As the SCM intervention is not intended to alter sleep beliefs, we would not expect to see any

changes in SBS scores between baseline and follow-ups. A shift in beliefs may be indicative of a cofounding influence, which would be considered in data analysis. The SBS was collected at baseline, and three weeks after baseline.

3.9 Data analysis

The quantitative data in this study was analyzed using the IBM Statistical Package for the Social Sciences (SPSS) statistics software with alpha set at 0.05. Analysis included descriptive statistics, and paired samples t-test for comparing between groups. Non-parametric testing included the Friedman test for comparing within groups. Non-parametric testing makes fewer assumptions, thus, offering a more robust model that is wider in scope and more applicable than traditional parametric testing.

As the study also collected free-text responses, qualitative content analysis was used to analyse descriptive data collected in the study (Bowling, 1997). We summarized the open-ended text responses into categories according to the main ideas and ranked these categories by the frequency with which responses appeared in each category (Bowling, 1997).

3.10 Summary of methods

This study employed a campus-wide longitudinal prospective design with a pre- and post-test survey with a questionnaire component, where the participants acted as their own control. The success of the social marketing strategies was the primary outcome of interest. Post-secondary students at the University of Alberta were recruited initially through the use of offline advertisement in the form of printed posters; however, due to poor response to the printed posters, an online email listserve invitation recruitment method was added. After the initial baseline data collection, participants were directed to the music hosting website to access the SCM intervention. Follow-up data was collected at the 1st and 3rd week after the baseline data collection. An online survey was developed to collect information on participants' attitudes and evaluation of the social marketing campaign and SCM. Additionally, as a secondary outcome, standardized sleep questionnaires were included at baseline and follow-ups to evaluate self-reported sleep quality.

CHAPTER 4. RESULTS

This chapter presents the results of the study. All Tables and Figures are provided in Appendix K. This section looks at the participants' demographics, findings regarding the social marketing campaign, and self-reported sleep measurement tools.

4.1 Participants' involvement in the social marketing campaign

The recruitment for participants using the offline recruitment of posters occurred from October 29th, 2017 to November 19th, 2017. The recruitment for participants using the online recruitment of email occurred from December 6th, 2017 to December 27th, 2017. Figure 1 shows the highest recruitment rate was in the online advertisement group (n=185) compared to the poster advertisement group (n=29). However, 2.7% (n=5/185) of the online advertisement group participants reported noticing the offline posters before receiving the online email invitations (Table 1). The reported reason by participants for responding to the online invitation compared to the poster invitation included, "*...posters require stopping to take a picture of [the] info/address (hard if busy) or [to] take a slip of paper that is easily lost,"* and *"... [it is] less effort to click a link [than] actually remembering one from a poster and then going to it."*

As the study progressed from the baseline, to the first follow-up, then to the second follow-up, the number of participants that dropped out increased. By the first follow-up, 62.1% (n=18/29) of participants remained in the study in the poster advertisement group, and 48.1% (n=89/185) of participants remained in the study in the online advertisement group. By the end of the study, the poster advertisement group had a completion rate of 51.7% (n=15/29), and the online advertisement group had a completion rate of 40.5% (n=75/185). The data collected from subjective sleep measures of participants who did not complete the study were excluded from analysis.

4.1.1 Recruitment using social marketing theory

Figure 2 shows the number of individuals who accessed the website hosting the download links for the SCM during the recruitment period of the study. "Page loads" is defined by StatCounter as the total number of times a page or a section of a page was loaded or reloaded in a browser. "Unique visits" is defined as the total number of distinct individuals visiting the website

based on internet cookie, and "return visits" is defined as the total number of returning individuals to the website based on internet cookie. During the poster advertisement period, the first week of advertisement generated the highest number of unique visits to the website (n=35). During the second week of the poster advertisement period, the number of unique visits decreased (n=9), then increased (n=19) during the third week and decreased (n=3) during the final fourth week. During the online advertisement period, the first week generated n=78 unique visits to the website. This number then increased to n=97 in the second week, decreased to n=60 during the third week, and decreased to n=48 in the final fourth week.

The number of downloads is shown in Table 1. The number of downloads was tracked using "page loads," with the online advertisement group having a total download count of n=682 throughout the duration of the study, and the poster advertisement group having a total download count of n=184 throughout the duration of the study.

4.2 Demographic characteristics

The demographic information of participants in the study is shown in Table 2. The sample of participants in the poster advertisement group is 82.8% (n=24/29) undergraduate, with the remaining participants in graduate studies. In the online advertisement group, 65.9% (n=122/185) is in undergraduate studies with the remaining participants in graduate studies. Information collected on gender reported that 72.4% (n=21/29) and 71.9% (n=133/185) of participants in the poster and online advertisement group respectively, identified as female, 20.7% (n=6/29) and 25.4% (n=47/185) identified as male in the poster and online groups, and 6.9% (n=2/29) and 2.7% (n=5/185) in the poster and online groups identified as non-binary, which consists of cisgender female, gender fluid, non-binary, genderqueer, grey femme, demi-sexual, and transgender. Participants under 25 years of age were reported by 75.9% (n=22/29) and 53.0% (n=122/185) of participants in the poster and online groups respectively, and 17.2% (n=5/29) and 30.8% (n=48/185) reported to be between 25 to 30 years old in the poster and online groups respectively, and 6.9% (n=2/29) and 16.2% (n=30/185) reported to be more than 30 years old in the poster and online groups respectively.

4.3 Attitudes toward the offline social marketing strategy

Offline advertisement posters were placed in eight different high traffic areas around campus. New posters were put up every week for the entire duration of the poster advertisement period, in the same location within each individual building. Table 3 shows the evaluation of the social marketing approach using posters. The poster that was most noticed on campus (44.8%, n=13/29), perceived to be the most attention-grabbing (41.4%, n=12/29), and the one that prompted participants to visit the website (44.8%, n=13/29) was the humour themed poster. Other posters, in decreasing frequency, were the energy themed poster, and the real-life themed poster.

4.4 Reasons for visiting the social marketing website

Table 4 show participants' reasons for visiting the URL or QR code on the poster. Participants who reported being curious were 75.9% (n=22/29) and 71.9% (n=133/185) in the poster and online groups. Participants who reported needing help with sleep were 51.7% (n=15/29) and 58.9% (n=109/185) in the poster and online groups. Lastly, participants who reported being recommended by a friend were 6.9% (n=2/15) and 4.9% (n=9/185) in the poster and online groups respectively.

4.5 Pre-SCM intervention results

Data were obtained from participants regarding whether music listening to aid with sleep was used before the uptake of the SCM intervention. In the poster advertisement group, 62.1% (n=18/29) reported occasionally listening to music and 37.9% (n=11/29) reported never listening to music for sleep. In the online advertisement group, 44.3% (n=82/185) reported occasionally listening to music and 55.7% (n=103/185) reported never listening to music for sleep (Table 5). A crosstabulation was performed, which looked at the relationship between program of study and age of participants with frequency of music listening, and length of music listening, and no significant results were found.

4.5.1 Pre-SCM sleep music routine

Only 13 out of 29 participants in the poster advertisement group, and 61 out of 185 participants in the online advertisement group responded to the free-text response "what is your

sleep music listening routine?" The remaining participants responded that the question did not apply to them. Free-text responses to participants' sleep music listening routines, found in table 5, were coded into three categories: 'listen at bedtime,' listen to music when there are difficulties with sleep onset and 'listen then turn the music off manually.' Participants who responded to listening to music at bedtime were 69.2% (n=9/13) and 67.2% (n=41/61) in the poster and online advertisement groups, respectively. Some responses from these participants included, "*…[I] put the music on and leave it on a timer so it turns off,"* "*…before sleeping with eyes closed, preparing for sleep,"* and *"…[I] start playing music over my phone speakers and have it out beside my bed before I go to sleep, just let it play through until the end of the album."* The use of music to help with sleep when participants had difficulties with sleep onset was observed in 15.4% (n=2/13) and 19.7% (n=12/61) of poster and online advertisement group participants. Participants responded "*…If I am having a hard time falling asleep, usually about an hour or so in, I'll play something on my phone," "…when I've had a very stressful day," "…I usually only listen to music when I am desperate to fall asleep, kind of a last resort after I can't fall asleep or stay asleep,"* and "*…Sometimes if I am having trouble falling asleep, I will put on some music to stop my brain from thinking of other things."* Lastly, the routine of listening to music for sleep, then turning the music off manually had a response of 15.4% (n=2/13) and 13.1% (n=8/61) in the poster and online advertisement groups respectively, with participants responding *"…[I] put in headphones, take them off and pause the song when I'm drifting off"* and "*…[I] play it [until] I fall asleep, then wake up at some point to turn it off and go back to sleep."*

4.5.2 Sleep music genre

Table 6 shows the genre of music participants listened to for their sleep before the SCM intervention. In the poster advertisement group, 18 out of 29 responded, and in the online advertisement group, 80 out of 185 responded to the question. Free-text responses of genre were coded into 11 categories. The ranking of different music genres did appear to change between groups. The most frequent genre of sleep promoting music used by both phases' participants was 'classical music,' (38.9%, n=7/18 and 23.8%, n=19/80 in the in the poster and online advertisement groups respectively). Other genres frequently used by participants included 'nature sounds' (16.7% and 15.0% in the poster and online advertisement groups respectively), and 'new age music' (11.1% and 13.8% in the poster and online advertisement groups

respectively). Other genres much less frequently identified include ‘soundtracks,’ ‘electronic music,’ ‘pop, rock, rap and hip-pop music,’ ‘any calming music,’ ‘jazz, blues, R&B, and soul music,’ ‘podcasts,’ ‘country music,’ and ‘white noise.’

4.6 Adherence to the SCM protocol

Adherence in this study is defined as following the study protocol of listening to the SCM at a quiet volume, every night for 30 minutes, and in bed, lights out, trying to fall asleep for the duration of the study period. Table 7 and Table 8 presents the information regarding participants’ adherence to the SCM. Participants were informed on the website that the SCM was to be listened to at a low volume, for 30 minutes or longer, and to be listened to consistently, in bed, lights out, and ready for sleep. Participants responded to multiple choice questions on what volume the SCM was played at, how many nights of SCM, the length of SCM played, and their activities during the SCM intervention. Additionally, a crosstabulation was performed for both advertisement groups, which looked at program of study, and age of participants with frequency of music listening, and length of music listening, and days of SCM usage, and no significant results were found. Details of these findings are presented below.

4.6.1 Volume of the SCM

Participants in both groups responded to multiple choice questions on what volume they listened to the SCM. Multiple choice response gave participants a comparation of decibel levels to everyday noises. According to a decibel comparison chart, “as loud as *light breathing* to *a quiet room”* was reported to be between 10 to 30 decibels, “as loud as a *moderate snoring* to a *normal conversation*” was reported to be between 40 to 50 decibels, and “as loud as a *busy street* to a *vacuum cleaner”* was reported to be between 60 to 70 decibels (Purdue Science, 2000). In the first follow-up, 72.2% (n=13/18) and 76.4% (n=68/89) in the poster and online advertisement groups respectively, perceived to have listened to the SCM between a sound level of 10 to 30 decibels. Participants who perceived to have listened to the SCM at a sound level of 40 to 50 decibels were 27.8% (n=5/18) and 23.6% (n=21/89) in the poster and online advertisement groups, and no participants reported listening to the SCM at a perceived volume of 60 to 70 decibel in the first follow-up. In the second follow-up, an increase in frequency in the 10 to 30 decibels was observed (86.7%, n=13/15 and 81.3%, n=61/75 in the poster and online

advertisement groups respectively). A decrease in participants who reported listening to the SCM at a perceived volume of 40 to 50 decibels was observed, with only 13.3% (n=2/15) and 17.3% (n=13/75) in the poster and online advertisement groups respectively. Only one participant (1.3%), in the online advertisement group, reported listening to the SCM at a perceived volume of 60 to 70 decibels.

4.6.2 The frequency of SCM intervention

The frequency of SCM use can be found in Table 7. In the first follow-up, more participants reported using the SCM for five to seven nights in both groups. In the poster and online advertisement groups for the first follow-up, 55.6% (n=10/18) and 64.0% (n=57/89) used the SCM for five to seven nights respectively. This frequency decreased to 46.7% (n=7/15) and 58.7% (n=44/75) for the poster and online advertisement groups in the second follow-up, respectively. An increase in the frequency of participants who used the SCM for one to four nights was seen from the first follow-up to the second follow-up. Participants in the first follow-up reported listening to the SCM for one to four nights were 44.4% (n=8/18) and 36.0% (n=32/89) in the poster and online advertisement groups, respectively. This increased to 53.3% (n=8/15) and 41.3% (n=31/75) in the poster and online advertisement groups, respectively.

The length of the SCM played by participants can also be found in Table 7. The length of listening to the SCM generally remained similar across groups. In the first follow-up, 66.7% (n=12/18) and 58.4% (n=53/89) of participants in the poster and online advertisement groups respectively, reported listening to the SCM for 15 to 30 minutes. In the second follow-up, 60.0% (n=9/15) in the poster advertisement group and 58.7% (n=44/75) in the online advertisement group, used the SCM for 15 to 30 minutes respectively. The frequency of participants who listened to the SCM for less than 15 minutes in the first follow-up were 27.8% (n=5/18) and 14.6% (n=13/89) in the poster and online advertisement groups respectively. In the second follow-up, 26.7% (n=4/15) in the poster advertisement group and o 25.3% (n=19/75) in the online advertisement group listened to the SCM for less than 15 minutes respectively. Lastly, 5.6% (n=1/18) and 27.0% (n=24/89) listened to the SCM for more than 30 minutes in the poster and online advertisement groups respectively in the first follow-up. In the second follow-up, 13.3% (n=2/15) in the poster advertisement group and 16.0% (n=12/75) in the online advertisement group used the SCM for more than 30 minutes respectively.

4.6.3 Activity during the SCM protocol

Table 8 lists the activities that participants engaged in while carrying out the SCM protocol. Activities participants engaged in during the SCM protocol included 'lights out, in bed, trying to fall asleep,' 'lights out, in bed and using electronic devices,' 'in bed and doing non-electronic related activates' such as reading a book, and talking to a partner, and 'carrying out the SCM and doing something other than trying to sleep.' The majority of participants in both groups and during both follow-ups had their lights out, were in bed and trying to sleep when the SCM was played. In the poster advertisement group, 83.3% (n=15/18) of participants in the first follow-up were in bed, with lights out, trying to fall asleep to the SCM. This decreased to 80.0% (n=12/15) in the second follow-up. Participants who listened to the SCM in bed, while using an electronic device increased from 11.1% (n=2/18) in the first follow-up to 13.3% (n=2/15) in the second follow-up. No participants listened to the SCM in bed while doing a non-electronic related activity, however, this increased to 6.7% (n=1/15) in the second follow-up. Finally, only 5.6% (n=1/18) of participants listened to the SCM out of bed and engaged in another activity during the first follow-up, and this decreased to zero in the second follow-up of the study.

In the online advertisement group, 78.7% (n=70/89) of participants in the first follow-up listened to the SCM in bed, trying to sleep. This decreased to 77.3% (n=58/75) in the second follow-up of the study. Participants who listened to the SCM in bed, while using an electronic device decreased slight from 13.5% (n=12/89) in the first follow-up to 13.3% (n=10/75) in the second follow-up. Participants who listened to the SCM in bed while doing a non-electronic activity decreased from 4.5% (n=4/89) in the first follow-up to 2.7% (n=2/75). Finally, participants who listened to the SCM out of bed and engaged in another activity increased from 3.4% (n=3/89) in the first follow-up to 6.7% (n=5/75) in the second follow-up.

In summary, the majority of participants in both groups used the SCM at a perceived volume of 10 to 30 decibels for five to seven nights, and for 15 to 30 minutes long. The majority of participants also reported listening to the SCM lights out, in bed, trying to fall asleep. As previously mentioned, the SCM was recommended to be listened to at a maximum decibel level of 30, for 30 minutes long, and to be listened to in bed doing no additional activities.

4.6.4 Perceived barriers to following the SCM protocol

Participants were asked what prevented them from carrying out the SCM protocols. As participants' activities before bed were similar, we combined the two groups when examining the barriers. Table 9 lists what participants stated prevented them from carrying out the SCM. In the first follow-up, 23.4% (n=25/107) of participants responded that 'nothing prevented them from carrying out the SCM protocol.' Ranking the remaining five possible responses in descending order of frequency are participants 'falling asleep,' followed by 'forgetfulness,' 'other reasons,' 'perceived ineffectiveness' of the SCM, and 'time restraint,' which, for the purpose of this study, is defined as a perceived insufficiency in time to carry out the protocol by participants. The choice 'other reasons,' which for this study, is defined as what prevented participants from carrying out the SCM protocol, included responses such as technical difficulties or change in the sleep environment. In the second follow-up, the frequency of participants who had 'nothing preventing them from carrying out the SCM protocol' decreased to 16.7% (n=15/90). The highest ranked response was 'falling asleep' (23.3%, n=21/90). Other responses in descending order of frequency were 'time restraint,' 'forgetfulness,' 'other reasons,' and 'perceived ineffectiveness.'

One participant who selected 'fell asleep' as a perceived barrier to carrying out the SCM said *"... [I was] tired enough I fell asleep right away".* Responses for participants who responded to having a 'time restraint' included *"...[I] slept extremely late due to exams and studying,"* "*...[I] had other plans and didn't have 30 minutes set aside to listen,"* and *"... [It is] difficult to plan a full 30 minutes of listening before sleep."* Responses for participants that selected 'forgetfulness' included *"...[I] left my device on which the music was stored at work"* and *"... [It is] hard to remember to listen to the music before sleep."* Responses to participants who chose 'perceived ineffectiveness' included *"...I found that I was still awake after the 30 minutes, so [I] stopped turning it on before bed," "...[I] did not require music to fall asleep,"* "*...the music is very repetitive….my brain was more focused on the repeat than trying to fall asleep…it was extremely distracting and did not help me fall asleep at all,"* and *"...I was stressed about midterms and staying up quite late to study, so I found that my sleep was worse this week."* Lastly, examples of responses from participants who chose 'other' reasons, included "*...[my] headphones got uncomfortable,"* and *"... [I was] sleeping at my partner's house."*

4.7 Participants' attitudes toward the SCM intervention

Table 10 shows the evaluation of the SCM by participants. Participants were given a scale from 0 to 5, with 0 being 'the SCM was not helpful at all,' and 5 being 'the SCM was extremely helpful.' At the first follow-up 44.4% (n=8/18) (poster group) and 58.4% (n=52/89) (online group) rated the SCM to be between 3 and 5. In the second follow-up, participants who rated the SCM between 3 and 5 increased to 80.0% (n=12/15) (poster group) and 68.0% (n=51/75) (online group). Examples of participants' who rated the SCM higher on the 0 to 5 scale included, *"...I could focus on something other than my thoughts," "...sometimes it can be difficult to hear, but the undulating volume and rhythmic beat helped induce a trance-like state of relaxation," "...I seem to fall asleep faster and wake up less during the night,"* "*…I think it is really helpful to force yourself to lay in the dark without doing anything else. It helps you clear your mind of everything else while just listening to the music," and "…once I got used to the music, it became something I associated with going to sleep."* Participants who rated the SCM lower on the 0 to 5 scale said "*...I fall asleep when I'm tired, [it] doesn't matter if I'm listening to the music or not," "...the repetition of the same notes over and over actually annoys me rather than calms me,"* and "*...Initially I found the music helpful, but I found it irritating after awhile,"* and "*...I've been very distracted this week…and it's midterm season so my mind is busy."*

4.8 Participants' adherence to the study

In the online advertisement group, at the second follow-up, participants were asked what kept them participating in the study. Participants responded using free-text responses, and responses were coded into six categories, which included 'wanted to improve sleep,' 'curious about the study,' 'perceived effectiveness' of the SCM, 'commitment' to complete the study, 'enjoyed the SCM,' and 'other' reasons such as the incentive offered in the study and the study follow-up reminders. Participants desire to improve their sleep received the highest frequency of responses (37.3%, n=28/75). Examples of participant responses included *"...I kept participating to see if it would improve [my sleep]"* and *"... [I wanted] to find a sleep pattern."* Other less frequent responses I was 'curious about the study' (18.7%, n=14/75), 'perceived effectiveness of the SCM' (14.7%, n=11/75), 'commitment to complete the study' (10.7%, n=8/75), 'enjoyed the SCM' (10.7%, n=8/75), and 'other' (8.0%, n=6/75). A sample response of participants who were curious about the study said "*... [I was] interested in [the] effects [of] music on sleeping."*

Participants who perceived the SCM to be effective responded "*...I noticed that I would stay asleep longer when I actually listened to the music as I was going to bed compared to when I didn't,"* and "*...it was helping my sleep patterns."* Participants who mentioned their adherence to the study was due to commitment said "*... [I was] interested in results and contributing to the study,"* and *"...my commitment to robust studies with complete data."* Participants who enjoyed the SCM responded "*...[I] enjoyed it"* and *"...just the music!"* Lastly, responses to 'other' reasons include "*...I hoped to get the $50 gift card,"* and '*...[the] reminders."*

4.9 Results of the Pittsburgh Sleep Quality Index (PSQI)

As mentioned in the methodology, the PSQI is a self-reported sleep quality questionnaire with a total score from 0- 21, which is known as the "global score." A global score that is equal to, or less than five is considered to be a sign of good sleep quality. In contrast, a score of more than five is associated with poor sleep quality. The results of the global score of the PSQI for both groups at baseline, the first follow-up, and the second follow-up, is shown in Table 12, and changes in the PSQI global score can be seen in Figure 3.

The mean global score at baseline for the poster and online advertisement groups was 7.93 and 8.80, respectively. These scores indicate that the sleep quality in both groups was poor. At the first follow-up, the mean global score for the poster and online advertisement groups decreased to 7.33 and 7.95, respectively. At the second follow-up, the mean global score increased to 7.53 in the poster advertisement group and decreased to 6.81 in the online advertisement group. Although the results showed poor sleep quality in both groups, in the online advertisement group, there was significant improvement from the baseline to the follow-ups by the Friedman test (df=2, n=75, X^2=20.1, $p<.000$). However, no statistical significance was observed in the poster advertisement group by the Friedman test (df=2, n=15, X^2=2.00, $p=.368$).

4.9.1 Participants' sleep schedule

The results of participants' sleep schedules from the PSQI are presented in Table 13. In the PSQI, questions 1 and 4a asked participants 'when have you usually gone to bed?' and 'how many hours of actual sleep did you get at night.' As participants' sleep schedules were similar, we combined the two groups when examining the data. The percentage of participants who

reported sleeping for 6.1 to 8 hours per night at baseline was 69.2% (n=148/214); at follow-up one it was 67.3% (n=72/107); and at follow-up two it was 72.2% (n=65/90). The percentage of participants who reported sleeping 4 to 6 hours per night was 19.2% (n=41/214) at baseline, 15.0% (n=16/107) at the first follow-up, and 15.6% (n=14/90) at follow-up two. Participants who reported sleeping for more than 8 hours per night at baseline was 7.9% (n=17/214), at follow-up one was 10.3% (n=11/107), and at follow-up two was 10.0% (n=9/90). Lastly, participants who reported sleeping less than 4 hours per night was 3.7% (n=8/214) at baseline, 7.5% (n=8/107) at the first follow-up, and 2.2% (n=2/90) at the second follow-up.

Participants were also asked to report their approximate bedtime. At baseline, 55.6% (n=119/214) reported sleeping before midnight. This decreased to 53.3% (n=57/107) at the first follow-up and remained the same at 53.3% (n=48/90) in the second follow-up. Participants who reported going to sleep between midnight and three in the morning were 41.6% (n=89/214) at baseline, 43.0% (n=46/107) at the first follow-up, and 44.4% (n=40/90) at the second follow-up. Lastly, participants who reported sleeping after three in the morning were 2.8% (n=6/214) at baseline, 3.7% (n=4/107) at the first follow-up, and 2.2% (n=2/90) at the second follow-up.

4.10 Results of the Epworth Sleepiness Scale (ESS)

The ESS is a self-reported questionnaire that measures daytime sleepiness. The questionnaire consists of eight items with a score ranging from 0 to 3, and a total score of 0 to 24, with higher scores indicating greater excess daytime sleepiness. An ESS score of 0-5 is interpreted as ‘lower normal daytime sleepiness,’ a score of 6 to 10 is interpreted as ‘higher normal daytime sleepiness,’ a score of 11 to 12 is ‘mild excessive daytime sleepiness,’ a score of 13 to 15 is ‘moderate excessive daytime sleepiness,’ and a score of 16 to 24 is interpreted as ‘severe excessive daytime sleepiness.’ Participants took the ESS at the baseline, the first follow-up, and the second follow-up.

The results in Table 14 showed that the mean ESS total score for the offline group decreased from 8.13 at baseline to 7.40 at the first follow-up, then increased to 7.93 at the second follow-up respectively. In the online group, the ESS total score decreased from 8.72 at baseline, to 7.64 at the first follow-up, and then to 7.29 at the second follow-up respectively. Statistical analysis using the Friedman test showed significant improvement in the online group from the

baseline to the two follow-ups (df=2, n=75, X^2=11.2, p=.004); however, no significance was observed in the offline group (df=2, n=15, X^2=0.792, p=.673).

4.11 Results of the Sleep Beliefs Scale (SBS)

The SBS is a tool developed to assess sleep attitudes and beliefs and is comprised of 20 items, with responses being either 'positive effect,' 'neither effect,' or 'negative effect.' The SBS was completed by participants at the baseline and the second follow-up. The SBS total score is from 0 to 20 and is based on the correct answer to the item in the SBS. A correct answer to a question is one point and an incorrect answer is zero points. The results of the SBS total score are shown in Table 15.

As the study did not provide participants with information related to sleep beliefs, we did not expect to see change. Rather, the SBS was considered to be a proxy indicator of potential co-interventions. Statistical analysis using the paired samples test showed that there was no significant difference between the baseline and the second follow-up SBS total score in both the offline (df=14, n=15, p=.900) and the online group (df=74, n=75, p=.255).

The incorrect responses on the SBS is shown in Table 16. The items on the SBS with an incorrect rate of more than 40% in both groups across the baseline and the second follow-up included:

- 'Getting up when it is difficult to fall asleep'
- 'Recovering lost sleep by sleeping for a long time'
- 'Doing intense physical exercise before going to bed'
- 'Drinking alcohol in the evening'
- 'Trying to fall asleep without having a sleep sensation'

Other items on the SBS with an incorrect rate in approximate decreasing order of frequency, observed in both groups across the baseline and the second follow-up included:

- 'Using sleep medication regularly'
- 'Going to bed 2h earlier than the habitual hour'
- 'Smoking before falling asleep'

- ‘Going to bed 2h later than the habitual hour’
- ‘Going to bed with an empty stomach’
- ‘Going to bed immediately after eating’
- ‘Studying or working intensely until late night’
- ‘Thinking about one’s engagements for the next day before falling asleep’
- ‘Taking a long nap during the day’
- ‘Using the bed for eating, calling on the phone, studying, or other non-sleeping activities’
- ‘Going to bed and waking up always at the same hour’
- ‘Drinking coffee or other substances with caffeine after dinner’
- ‘Diverting one’s attention and relaxing before bedtime’
- ‘Sleeping in a quiet and dark room’
- ‘Being worried about the impossibility of getting enough sleep’

4.12 Summary of results

Twenty-nine PSSs were recruited using the poster advertisement strategy, and 185 PSSs were recruited using the online advertisement strategy. Results from the poster advertisement suggests that a humour themed advertisement was well received at the University of Alberta campus. However, recruitment from the posters was very low and the online advertisement strategy reached a wider audience. Similar to Brown et al (2017) we found that a number of participants occasionally use music as a sleep onset intervention. After the uptake of the SCM intervention, results show that overall adherence to the SCM protocol was feasible and the SCM intervention appeared to be an acceptable sleep intervention among PSSs based on subjective ratings on a scale of ‘zero’ to ‘five.’ The PSQI and ESS in the poster advertisement group showed no significant difference. However, the PSQI and ESS scores in the online advertisement group showed statistical significance. All the findings are presented in Appendix K in Tables and Figures. Future discussion of the results will be provided in the following chapter.

CHAPTER 5. DISCUSSION

The primary objective of this study was to evaluate the outcome of a social marketing strategy to recruit PSSs to a website that provides SCM. Secondary objectives were to evaluate the rate of uptake for the SCM, students' adherence to the SCM, students' evaluation of the SCM, and to compare self-reported sleep quality in students and sleep beliefs before and after SCM use.

The specific research questions were:

1) Are posters designed with evidence-based principles an effective method to recruit PSSs to a website that provides the SCM?

2) Are email invitations a more effective method to recruit PSSs to the website that provides the SCM compared to the offline method of printed posters?

3) Will PSSs uptake and adhere to the SCM intervention for the duration of the study?

4) Does PSSs' self-reported sleep characteristics and practice change before and after the SCM intervention?

5) What are PSSs' attitudes toward the SCM?

This chapter will discuss each of the research questions in relation to the findings. Additionally, this chapter will also discuss the limitations of the study and recommendations for future studies.

5.1 Are posters designed with evidence-based principles an effective method to recruit PSSs to a website that provides the SCM?

The original recruitment strategy for this study looked at using posters (see section 2.3). However, despite evidence-based studies showing posters are an effective method of recruiting participants (Fleming et al., 2015), there were many uncontrollable factors with using posters as an intervention delivery tool, thus, a decision was made during the study to include the online recruitment strategy of using emails. Uncontrollable factors with using printed posters included meeting the posting rules in each individual building, posting time limitations, the covering of

posters by other advertisements, limited space available for posters on boards, and removal of posters without the researcher's knowledge. An example of these uncontrollable factors can be found in Figures 4 and 5. These will be discussed in the following paragraphs.

Three different poster designs were put up in eight high traffic buildings across the University of Alberta campus. A total of 150 posters were printed and 76 posters were posted across these eight buildings. The remaining posters were used to replace posters that were removed without the researchers' knowledge. Posters were reposted each week to ensure visibility and posters were put up on the same posting boards throughout the entire advertisement period to allow for repeated exposure.

Certain buildings on campus have rules regarding the putting up of posters. These rules included specific poster contents, limited number of posters allowed in the building and on each posting board, and a limited amount of time posters were allowed to be up. Additionally, certain buildings with more noticeable posting boards only allowed posters by members of their specific department. These known, but unmodifiable factors limited the number of posters put up in each building. This then limited the amount of student exposure to the and our capability to reach a large number of participants. Certain buildings on campus also did not allow posters to cover up other posters. This reduced the amount of space available on posting boards and often, posters were in competition for the optimal attention-grabbing area of the boards. Often, we would find our posters relocated from their original space on the board to the bottom or to a corner of the board, where it noticeably drew less attention. It is not unreasonable to conclude this relocation would have influenced the effectiveness of the exposure.

In buildings that had little to no rules regarding posters, posting boards often filled up quickly, with posters overlapping one another or removed. Often, we would find our posters buried under new posters or removed completely. Similarly, even in buildings with posting guidelines, posters were also found to be removed before the approved due date. Thus, we could not be sure how long students were exposed to the posters before they were either covered or removed. This again may have impacted the effectiveness of the posters for social marketing. Important to note is that, when participants were asked where they noticed the posters, buildings with regulated rules or had regular cleaning of their posting boards had the highest response, whereas buildings with a high number of posting boards but no regulated rules or regular

cleaning, had fewer reported views. This suggests that the clean presentation of posters may affect the effectiveness of posters. However, the sample size obtained from the poster advertisement method was insufficient to draw strong conclusions.

In summary, while the use of posters has been reported in general settings, to be one of the most common and effective method of recruitment by evidence-based research (Feman et al., 2008; Fleming et al., 2015), this study was not able to recruit a significant number of participants using printed posters. Despite following evidence-based research on creating posters with effective graphic communications, the process of translating theory to practice proved to be challenging. Several uncontrollable external factors were found throughout the recruitment period, which may have affected the success of printed posters as a recruitment tool. These findings highlight the challenges in delivering a health campaign message on a campus-wide level.

5.2 Are email invitations a more effective method to recruit PSSs to the website that provides the SCM compared to the offline method of printed posters?

The second phase of this study looked at the use of online advertisement for recruitment. Based on participants' responses in section 4.1, the increased number of responses to the online advertising method compared to the poster advertising method may have been due to the convenience of the direct link in the online advertisement to the survey. Studies using offline and online recruitment methods for web-based data collection often found the offline method to be less efficient (Christensen et al., 2017). It is speculated that this could be due to the extra effort required for offline advertisement methods, where after seeing the advertisement, participants then would have to go online and enroll in the study (Christensen et al., 2017; Wiist et al., 2010). In contrast, with an online advertisement, participants would only have to click on the link and start participation (Christensen et al., 2017). In addition, with printed posters, individuals may feel less secure and may feel self-conscious looking at an advertisement for a health intervention in a public place. One participant responded that the use of a university sanctioned online platform gave them a sense of safety and trust in participating in the study. Thus, the feeling of security, and even possibly the anonymity of enrolling through an online platform, may have given an advantage to populations who have challenges with enrollment in studies due to

sensitivities in health care or mental health care concerns, or in individuals with reduced mobility (Harris et al., 2015; Kayrouz, Dear, Karin, & Titov, 2016).

While the online advertisement received more participants compared to the poster advertisements (Table 1), uptake of the intervention through the online method was not significant compared to the University of Alberta's student population of over 35,000 undergraduates and graduate students. The "Mailman" platform was speculated to be able to reach a wide audience as the platform specifically sends out a mass email once a week to the entire student population. However, the number of participants enrolled in the study compared to the student population showed that the online advertising method may not be as effective as initially speculated. This could be because the "Mailman" platform may not be as well known among the student population or as popular a platform compared to other University online platforms, such as the University's social media accounts including Facebook, Twitter, or Instagram.

In summary, the use of an online platform in the form of email invitations, appeared to be more effective than the use of printed poster, possibly because an online platform could offer more convenience and accessibility for participants to enroll in the study. However, this study aimed to deliver the intervention on a campus-wide level. The number of students enrolled in the study suggests that the use of the online platform of email invitations was an effective delivery mechanism to achieve high uptake.

5.2.1 Interpreting the findings of the poster and online advertisements

It has been proposed that success rates of advertisements may be due to repeated exposure of the advertisement (Janiszewki et al., 2013; Fleming et al., 2015). Previous studies looked at the effectiveness of recruitment uses multiple platforms and messages; however, there were no indication that social marketing principles were used. As previously stated in section 2.4.2, Wiist et al. (2010) recruited 1,237 participants after a six-month recruitment period using multiple advertisement platforms including email invitations, electronic banners, printed banners, and paid advertisements. Similarly, Wise et al. (2015) recruited 2,421 participants after 99 weeks of recruitment, and Christensen et al. (2017) recruited 8,252 participants over after six years of recruitment. Both studies used multiple advertisement platforms, with a mixture of online and

offline recruitment methods. Another study at a Northeastern University, looked at recruitment of PSSs to a study with minimal compensation, and with comprehensive and creative advertising (Rodger & Franko, 2015). The study had two phases. The first phase involved printed poster advertisements placed in public areas around campus for four-month (Rodgers & Franko, 2015). In the second phase of the study, the researchers modified the posters and placed them in public spaces around campus. In addition, the researchers also used a college social media platform to advertise the study and the researchers had several professors at the university present the study and hand out the study flyers to their class. The researchers also distributed flyers around campus in person wearing a bright colored shirt which advertised the study. The second phase received an increase in the number of participants (Rodgers & Franko, 2015). These studies suggest that the use of multiple advertisement delivery outlets may be more effective at recruitment.

The total recruitment period for this study was eight weeks across the two advertisement platforms. The poster advertisement lasted four weeks, and the email advertisement lasted four weeks. The limited advertisement exposure period, along with the use of only two delivery platforms may have affected the effectiveness of the advertisements despite the use of social marketing principles. While it is possible that a longer advertisement period, to increase repeated exposure to the advertisements, may have been a barrier to the number of participants enrolled in the study, the highest uptake was seen at the beginning of both advertisement periods (Table 1). The decreased frequency of visits to the website and uptake of the SCM by participants as the advertisement weeks progressed could be due to being over-exposed to the advertisements, which may have led to the target audience losing interest or becoming bored with the same advertisements presented to them repeatedly. Additionally, the email advertisements had the same message throughout the recruitment period, and the poster advertisements had three different designs and messages to appeal to a wider audience. Thus, the repeated exposure of the same advertisements and messages may have diminished its effects over time. Future studies should look at the target audiences need for novelty.

These results suggest that, while repeated exposure is effective in recruitment of participants as presented in previous studies, using the same messages and advertisements may lead to over-exposure and audience members becoming bored. Thus, having modified versions of the graphic communication factors and advertisement messages to renew novelty, and

multiple delivery platforms to increase exposure of the advertisement, may impact the spread of the message.

5.2.2 Interpreting the use of social marketing principles as an intervention delivery vehicle

As this study was based on social marketing principles, we researched our target audience members, the issue and concerns it had on PSSs, and the delivery channels available. This research led us to develop the SCM intervention we predicted would be well received, and it led us to develop different messaging systems. While more distribution channels should be explored in the future for delivery of the SCM, the messages chosen for the advertisement may not have been effective or motivating enough for greater uptake of the intervention. Previous, successful, social marketing campaigns such as the "Truth" campaign focused on preventing teenage smoking, researched adolescences and discovered their core values and what drives them to smoke, such as rebellion against authority figures, independence, and inclusion in social groupings. The campaign took these values and redirected them, such as rebellion against tobacco companies instead of authority figures in their life and bringing adolescences together for a larger movement (Weinreich, 2011). Another campaign called "Save the Crabs Then Eat 'Em" looked at reducing nutrient pollution in bays by reducing residential fertilization in the spring. The campaign took the passion their target audiences had for an iconic seafood, rather than the audiences limited concern for the bay, and reframed the issue of a polluted bay as a culinary concern rather than an environmental one (Weinreich, 2011). The two campaigns studied the target population, while our study assumed that PSSs are motivated by academic performance and health based on evidence-based studies. Our study focused on developing messages based on strength-based evidence and student values such as grades, physical and mental health, and social performances and the negative impact sleep deficiency has on these values. However, while these values may be viewed as highly important to PSSs, we were not able to recruit a significant number of PSSs to the study as previously discussed. Thus, we assume that the commitment required of a student toward the pursuit of their academic, social, and professional goals may overrule other values such as health concerns (Digdon, 2010).

Additionally, this study offered students a chance to win one of three 50-dollar gift cards of their choice. While we predicted that the SCM will be well received by PSSs, external motivators such as a financial incentive, may play a greater role in students' decision to

participate. Because students may not view their sleep as a priority, students' motivation to uptake an intervention may be low, unless a greater motivator was offered of which students' may view as attractive, such as a high financial or prize incentive. As mentioned in the previous paragraphs, Rodger & Franko's (2015) study faced challenges in recruiting participants on a university campus with minimal incentives. The second phase of their study enrolled more participants, which may be due to the increased delivery channels and one professor agreeing to provide extra credit for participation (Rodger & Franko, 2015). While incentives may be important for the recruitment of participants for studies, from a social marketing view point, the goal proposed is to create change through intrinsic motivation rather than focusing on extrinsic motivations for change. A study looking at engagement and learning with 125 PSSs found that by using a popular social media platform (Twitter) for academic and co-curricular discussions, students showed greater engagement and higher GPAs compared to students who were not taught using social media platforms (Junco, Heiberger & Loken, 2010). Ryan et al (1997) looked at intrinsic motives for adherence to exercise and reported that adherence was associated with motives for enjoyment, competence, and social interactions. These studies suggest that by exploring intrinsic motivators and strategies for engagement, future studies could look at creating more effective strategies to deliver an intervention that primarily targets the intrinsic motivations of students.

This study aimed to adopt recruitment strategies based on social marketing principles to deliver a sleep intervention on a campus-wide level to the PSS population. Despite the use of social marketing principles to create advertisements, and the evidence-based research, the delivery of a wide-spread sleep intervention proved to the difficult. We speculate that due to the dynamic nature of marketing research, it can be difficult to keep abreast with what is trending and what may be obsolete, such as the use of traditional printed posters versus electronic advertisements. Other factors that may have affected the wide-spread delivery of the intervention could be due to the use of only two platforms, posters and emails. Thus, the use of more delivery channels, including larger printed advertisements such as banners, or additional online platforms such as popular social media websites, in addition to creating more variety in advertisements and more effective messaging, may increase the delivery of the intervention to a wider audience.

5.3 Will PSSs uptake and adhere to the SCM intervention for the duration of the study?

One of the aims of this study was to identify PSSs' uptake of the SCM. In Brown's et al. (2017) cross-campus survey, it was identified that music listening was supported by 55.9% of 1,294 responses, and 31.1% of 724 responses identified using music as a strategy for sleep, thus, Brown et al. (2017) suggested that an intervention involving music would be well received and relevant as many students at the University of Alberta already identified with and use music as a sleep intervention. The findings in Brown's et al. (2017) study proposed the use of music as a NPSI for SD from a strength-based approach. A strength-based paradigm does not require a behavioural change, but emphasizes individuals' knowledge, competencies, capabilities, and resources, and aims to build on an existing practice that is not necessarily effective in its current form (Powell, Batche, Ferro, Fox, & Dunlap, 1997). Thus, this study used a strength-based paradigm by building on the students' already existing practices and provided the evidence-based intervention of SCM.

This study was able to recruit a total of 214 students to uptake the SCM intervention, and 56.5% (n=121/214) of students reported using music as a sleep intervention. Although the number of students recruited in our study who use music as an intervention is lower compared to the 225 out of 724 students who reported using music as a sleep intervention in Brown's et al. (2017) study, a significant portion of students recruited to this study also used music as a sleep aid. This suggests that because we used a strength-based approach, which targeted students who already used music as a sleep intervention or are interested in the idea, students may have perceived the SCM to be attractive. However, the total number of students recruited (n=214) was much lower compared to the 724 out of 1,294 students who reported to endorse music listening in Brown's et al. (2017) study. Reasons for this could be that a significant portion of the students simply did not have issues with sleep, students did not perceive they had issues with sleep, or students had no intentions for change. Another reason for the insufficient uptake is students may perceive that they do not have the time to commit to an additional activity. With the hectic schedules of students being one of the main factors which contribute to sleep deficiency in the PSS population, students may have viewed the addition of another activity to their already overwhelming schedules as unappealing. As previously mentioned, Digdon (2010) proposed that PSSs behaviours may be motivated by factors such as academic, professional, and social goals,

and these external motivators may be viewed as higher priority to PSSs than maintaining good sleep behaviour. In Brown's et al. (2017) cross-campus survey, 36.7% of students commented that class schedules and academic commitments played a large role in their sleep. These results suggest that students may perceive they do not have the time to take up another commitment or activity outside of their academic, professional, and social commitments already in-place. The effort required to make a change to their sleep, even if the intervention presented is strength-based, may not be perceived by PSSs as a strong enough motivator to make a behavioural change.

In summary, by using a strength-based approach, the uptake of the SCM by students who already reported using music as a sleep aid is promising. However, the uptake of the SCM from the general student population on campus was insufficient to draw conclusions and the question requires further study.

5.3.1 Interpreting PSSs' adherence to the SCM

Looking at the overall adherence to the study, the poster advertisement group had a completion rate of 51.7%, and the online advertisement group had a completion rate of 40.5%. While the poster advertisement group appeared to have a higher overall adherence rate, the sample size is insufficient to draw strong conclusions. The email reminders sent out to students may have influenced students' adherence to the study. Additionally, students were also reminded of the prize incentive available to them upon the completion of the study, which may have factored into the adherence rate.

Based on the results presented in section 4.6, the majority of students adhered to the SCM protocol. The top three reported reasons for adherence to the study were wanting to improve sleep, interested in sleep and the SCM, and the SCM was perceived to be effective. Reasons reported by participants for not adhering to the SCM included forgetfulness, not having the time set out to listen to the SCM because of other activities such as studying or social events, and students perceived the SCM to be ineffective towards their sleep. Students who did not complete the full 30-minute cycle reported either falling asleep without the SCM or falling asleep before the SCM ended. Additionally, the frequency of students who followed the SCM protocol to listen to the SCM in bed, while trying to fall asleep, decreased slightly as the study progressed.

The lack of adherence seen in the results could be because students viewed their academic and social commitments as higher priority and perceived they did not have 30 minutes to set aside to listen to the music. As discussed in section 4.6.4, one of the main barriers that prevented students from carrying out the SCM protocol was they perceived that they did not have the time. Even though students were informed that the SCM was to be listened to when they were in bed (no additional time was needed to be set out to carry out the intervention), simply the perception of an additional activity that takes 30 minutes long may still have been perceived by students as time consuming. Another possibility for the lack of adherence are habits, which are defined as actions that become automatically triggered by situational cues (Lally, Van Jaarsveld, Potts, & Wardle, 2010). It has been suggested that the stronger prior habits are, the more likely an individual may lapse to the prior behaviour (Kwasnicka, Dombrowski, White, & Sniehotta, 2016). Post-secondary students may have formed undesirable sleep habits when carrying out their academic, social and professional activities, such as irregular sleep schedules and carrying out "all-nighter" activities, thus, the development of a new behaviour may be overlapped by prior habits. It has been suggested that the removal of unhealthy triggers from the environment may support maintenance of a behaviour (Prochaska & Di Clemente, 1983).

Another frequently reported reason for not adhering to the SCM is perceived ineffectiveness of the SCM. Reasons reported by students included they did not require music to help them sleep, the addition of the SCM affected their sleep negatively, the SCM did not do anything for their sleep, and the SCM was not to their liking. This suggests that for certain individuals, personal preference may override the purported physiological effects of SCM. This will be discussed in more detail below. Additionally, students reported preferring to sleep in silence or they would have fallen asleep with or without the music. This suggests that the lack of adherence to the SCM could also be because some students enrolled in the study had no issues with their sleep. Another reason for the perceived ineffectiveness could be due to nonadherence to the SCM protocol (Table 13). Based on evidence-based studies, SCM is most effective when listened to in bed, lights out trying to fall asleep, listened to continuously at a low volume for 30 minutes or more per session (Appendix E). Students who did not adhere to the SCM protocol may not have been able to experience the physiological effects of the SCM.

As previously mentioned in section 4.1, over 40% of students adhered to the study (Table 1) and the majority of students adhered to the SCM protocol throughout the study (Table 7). The decrease in adherence could be due to students not being able to utilize the SCM to its optimal benefits. Additionally, with many students staying up late and sleeping short hours, the irregularity in sleep schedules could have impacted the adherence range of the SCM by students. One interesting report by a student stated that, as a musician, they were more focused on analysing the music rather than listening to it. This suggests that having a formal music background may impact the effects of the SCM. Future studies may look at the impact of how musical training affects a sleep intervention based on music. In summary, the uptake and adherence of the SCM shows promising results. This study was able to support participants in achieving temporary maintenance of the SCM but may have been too short a duration to influence lasting behavioural change.

5.4 Does PSSs' self-reported sleep characteristics and practice change before and after the SCM intervention?

A secondary aim of this study was to look at students' sleep quality through self-reported sleep and daytime fatigue questionnaires. By choosing self-report sleep measures, individuals can highlight biological, psychological, and environmental factors which may influence their perceived sleep quality (Engel, 1977). Engel (1977) proposed the biopsychosocial model to illustrate the interactive factors which may influence individuals' perception of symptoms and experience.

Students in the study, at baseline, reported high PQSI and ESS scores indicating poor sleep quality and high excess daytime sleepiness. These high scores could be due to the students' sleep schedule as seen in Table 13. For example, over 40% of students went to bed after midnight and over 15% of students slept four to six hours per night. As previously mentioned, sleep deficiency is a prevalent issue for the PSS population and it is suggested to be the most common cause of poor sleep quality and excess daytime sleepiness (Pagel, 2009). While the PSQI and ESS scores in the poster advertisement group did show slight decrease from the baseline data, a small sample size meant that the results were not statistically significant. However, in the larger online advertisement group, the results of the PSQI and ESS showed statistically significant change between baseline and follow-up.

The significant improvement in the PSQI score after the uptake of the SCM for the online advertisement group may have been due to participants' biased perception of their sleep quality. However, the perception improved sleep may be a strong indicator of sleep quality, as sleep quality is often psychological and subjective in nature due to the interactive factors involved. Additionally, students may have been biased toward the SCM intervention. Students' may have been optimistic and expected positive changes with their sleep with the use of the SCM, which may have supported their positive attitudes toward the SCM as a NPSI.

In addition to sleep quality, daytime sleepiness scores also improved significantly in the online advertisement group. Sleep quality has been suggested to be associated with ease of waking, tiredness, clear-headedness, how rested, restored and refreshed an individual feel, and mood and physical feelings (Harvey et al., 2008). Thus, daytime sleepiness may be considered a critical factor in defining subjective sleep quality, where feelings of tiredness predicted poorer sleep quality, and alertness predicted better sleep quality (Harvey et al., 2008). The improvement in the ESS scores may have been the result of students' perception of having achieved better sleep. Thus, improved daytime alertness could be due to the SCM intervention enforcing a sleep routine in students. Other reasons could be that students were biased in their perception of their daytime sleepiness and were optimistic about the SCM intervention as discussed in the previous paragraph.

In summary, while the smaller poster advertisement group did not achieve statistically significant results, the online advertisement group showed students' self-reported sleep quality and daytime sleepiness improved over the course of the study. These improvements may suggest that the students achieved better sleep than before. However, we cannot determine whether the improvements are related to the SCM and further study is indicated.

5.4.1 Interpretation of the Sleep Beliefs Scale results

The purpose of the SBS used in this study was to control for bias of sleep beliefs change. A change in the SBS scores may indicate the presence of confounding factors introduced during the study, which may relate to students' sleep. Because this study did not include any information related to sleep beliefs, no significant difference of the SBS score was expected during the course of the study. This was the case and the results indicate that no co-interventions

or confounding factors to change participants' knowledge and understanding of sleep occurred. However, the SBS results showed PSSs' had high rates of incorrect sleep beliefs, which is concerning. The items with the highest incorrect rate were "drinking alcohol in the evening," "doing intense physical exercise before going to bed," "trying to fall asleep without a sleep sensation," "getting up when it is difficult to fall asleep," and "recovering lost sleep by sleeping for a long time." Participants endorsed these as having a "positive" or "no effect" on sleep when, indeed, the opposite is true.

This study did not collect information on alcohol consumption, physical exercise before bed. However, from free-text responses, students often reported sleep onset to be an issue and few mentioned recovering sleep on weekends. These factors were not controlled for during the study, which may have weakened the effects of the SCM and students' perception and adherence to the SCM.

5.6 What are PSSs' attitudes toward SCM?

In both the poster advertisement group and the online advertisement group, the rating and perceived effectiveness of the SCM was largely positive, and as the study progressed, the students' positive rating of the SCM increased. Reasons for this change may be due to physiological changes triggered by the continued use of the SCM, and perhaps the SCM helped create a solid sleep routine. As reported by some students', knowing they had to listen to the SCM for 30 minutes for this study, they felt it was mandatory to transition to bed and go to sleep, and some reported that the SCM helped them associate with going to sleep. A high number of students also reported that the SCM helped distract them from rumination and worry. It may be that the SCM had the ability to obscure or compete with unwanted environmental stimuli such as stress (Krout, 2007). Another possible reason could be that most students who remained in the study were biased towards SCM and those who were not favourable dropped out and felt it was ineffective for them. A number of students reported that the SCM was ineffective; that they did not need music to help them sleep; or that they did not prefer the SCM. This suggests that personal preference may also play a role in the effectiveness of the SCM, and although this study offered participants' three choices of SCM composed based on evidence-based research, these options were not aligned with participants' self-preferred choice for sleep music.

Many of the genres of music listened to by students, before the uptake of the SCM in this study, are reported to not have sleep conducive properties based on evidence-based studies (Table 6). As previously mentioned, the genre "new age music," was developed to help individuals decrease stresses by creating an environment for relaxation and meditation (Mornhinweg, 1992). Music conducive to sleep matches the same criteria of new age music. Both have no central theme, no natural beat, and no recognizable melody or harmony progressions (Mornhinweg, 1992). However, from the results, the majority of students identified other genres of music that has been reported to not have sleep conducive properties such as popular music, rock, hip-pop, and music from movie and gaming soundtracks (Table 6). Previous studies have reported that the genre of music listened to impacts physiological level (McCraty et al., 1998; Iwanga & Moroki 1999; Iwanaga et al., 1996). Pelletier's (2004) meta-analysis study reported that music and music-assisted relaxation techniques significantly decreased arousal. They concluded that the music the research team selected produced better results than music selected based on individual preferences, as the music chosen by individuals may be distracting and may cause excitement (Pelletier, 2004). Students in this study reported listening to music they were familiar or comfortable with as part of their sleep routines, regardless of whether the genre of music selected was conducive for sleep or not. Additionally, some participants in this study reported having their own "sleep music playlist" with music they use when they are having difficulties with sleep. While the results in this study are subjective and may be subject to bias, one possible explanation for the effects of non-conducive music genres on sleep chosen by students may be due to familiarity or habit, rather than a physiological effect.

Hoffer (1981) suggested that while soothing music may have therapeutic effects, personal preferences may play a large role because people tend to like what they know, and dislike what is unfamiliar. Seigle (1974) suggested that music occupies peoples' minds with something familiar and preferred, and this acts as a distraction, which help refocuses attention. A study with 10 PSS participants looked at the effects of music listening compared to listening to tones (Lazic & Ogilvie, 2007). The study used standard polysomnographic measures and electroencephalogram, and self-reported ratings of sleep quality (Lazic & Ogilvie, 2007). The study found that, while objective sleep measures revealed no statistically significant differences, students' who listened to tones fell asleep three minutes faster than students' who listened to music. However, participants rated the music condition to be significantly more relaxing, comforting, pleasant,

and soothing, compared to listening to tones (Lazic & Ogilvie, 2007). Burns et al. (2002), studied the effects of different genres of music with 60 PSSs. Genres included classical music, hard-rock music, self-selected music, or silence. The study found no statistically significant difference in the physiological arousal in all groups and suggested that the increased perceived relaxation reported by participants may be due to personal thoughts and beliefs. These studies' results suggest that while music genre may have a physiological effect on sleep, the practice of listening to something familiar and preferred may also play a role in the effect music has on sleep. Thus, individual preferences should not be excluded when choosing music for sleep.

Although individual preferences of music may have a positive effect on sleep quality, music chosen or composed by researchers based on evidence-based studies can further help individuals recognize musical elements that may contribute to sleep and optimize music's sleep conducive effects. Although we did not measure whether individual music preferences impacted students' sleep quality, future studies should examine this more closely.

5.7 Limitations

The limitations of this study will be discussed in this section. First, a potential limitation of this study was the time frame. After the first phase of the study, we employed a wash-out period of two weeks before the start of the second phase of the study. While a longer wash-out period may have been preferred, the wash-out period of two weeks was chosen to best coincide with the academic calendar. Second, while one of the SCM criteria was to listen to the music at a volume of 30 dB or less, we were unable to control the volume due to the unpredictable nature of the students' sleeping environment, the music listening devices used, the use of speakers, headphones or earbuds, other background noises in the sleep environment, and the distance of the music player from the listeners. Third, this study did not consider the uncontrolled cofounding factors which may have impacted the results. These factors included significant unanticipated modification and removal of posters, the exam schedules and holidays which coincided with the study, and participants' potential caffeine, alcohol and blue light exposure before bedtime. Several students reported that their sleep schedules fluctuated because of travel and they had limited access to the SCM during this time. These cofounding factors may always be occurring in this study as the study was done in a naturalistic environment and may have had an impact on students' attitudes and adherence of the SCM, thus, they may have negatively

impacted the results. Additionally, the free-text response question about motivation to continue participation was only added to the second phase of the study, it was not included in the first phase of the study.

In addition to design limitation, the researcher had limited experience with survey design and with qualitative data analysis. It is possible that different survey question design and content analysis perspective may have led to some alternative findings and conclusions.

5.8 Recommendations for future studies

This study aimed to answer whether the use of posters and email invitations are effective social marketing techniques for SCM, PSSs uptake and adherence to the SCM, PSSs self-reported sleep characteristics, and PSSs attitudes toward the SCM.

Firstly, we found that, despite evidence-based studies reporting the effectiveness of using social marketing theory as an intervention delivery tool through the use of posters and online invitations, unexpected and uncontrollable factors when delivering the campaign message on a campus-wide level precluded answering the question. Due to the dynamic nature of marketing research, future studies looking at the use of social marketing to deliver a NPSI should attempt to expand recruitment strategies and explore more delivery channels and effective messaging to reach target audiences. As this study only utilized two platforms, it may have limited the campus-wide delivery of the intervention. Additionally, the effect of novel versus repeated exposure of advertisements should be tested. This study created the advertisements and messaging based on evidence-based studies. However, we did not carry out in-person research of the target population on campus. Thus, the use of focus groups of the target population to gain a better understanding of PSSs may be a consideration for future studies. Additionally, the survey in this study was developed by the researcher and was not pilot tested. Future studies looking at the use of social marketing theory can consider gathering more accurate information related to social marketing and undergo pilot or psychometric testing.

Secondary objectives of this study aimed to answer PSSs adherence and attitudes found that PSSs adherence and attitudes toward the SCM was largely positive and an acceptable form of NPSI. However, students who rated the SCM as ineffective due to personal preference for the music warrants future study. While this study provided three pieces of similar music following

the SCM criteria to give an option to students, we did not study whether personal preference had an impact on students' attitudes to the SCM. Future studies specifically targeting populations that regularly use music as a sleep aid could look using a prospective case series study design to determine whether providing a choice impacts students' decision to uptake and adhere to the intervention. Lastly, as this study did not collect information on students' music background, future studies could consider exploring the relationship between a formal musical training background and students' attitudes regarding the effectiveness of the SCM.

CHAPTER 6. CONCLUSION

Sleep deficiency is a pervasive issue among PSSs and has serious negative consequences on physical and psychological well-being. This study aimed to test delivery mechanism for a strength-based NPSI on a campus-wide level using social marketing principles as a frame work to promote the uptake of SCM in PSSs with self-reported sleep problems.

The first research question this study addressed was whether posters designed with evidence-based principles are an effective social marketing strategy to recruit PSSs to a website that provided the SCM. Despite evidence-based studies reporting the effectiveness and popularity of using posters as a recruitment tool, and meeting evidence-based criteria for poster design and messaging, this study faced uncontrollable external factors, which may have affected the effectiveness of the posters. The second research question, added subsequent to poor outcomes from the poster recruitment, was whether email invitations are more effective at recruiting PSSs to the website that provides the SCM. Though the online advertisement method was successful at recruiting more participants compared to the poster advertisements, challenges were faced with delivering the campaign message on a campus-wide level. However, while the two delivery platforms may have been insufficient in delivering the SCM to the whole student population, it appeared to be more successful in delivering the message to a more specific population – students who already use music as a sleep aid. Though sleep deficiency is a prevalent issue among PSSs, this study was not able to recruit the general student population. The results from this study indicates that the use of social marketing principles and using a strength-based approach is promising, however, the effectiveness of a mass health campaign warrants further research.

Secondary objectives of this study were to determine PSSs' uptake and adherence to the SCM, PSSs' self-reported sleep characteristics, and PSSs' attitudes toward the SCM. While uptake of the SCM was not a significant percentage of the whole student population, the students who did participate showed good adherence to the SCM. Additionally, students' attitudes toward the SCM were largely positive. Thus, positive attitudes toward the SCM and adherence indicates that the SCM may be an acceptable NPSI approach to improve sleep among a portion of the PSS population. Lastly, self-reported sleep measures evaluated potential change in sleep quality after the uptake of the SCM. The results indicated that the SCM potentially improved participants'

self-reported sleep quality and daytime sleepiness. While many factors play a role in subjective sleep quality, the significant improvements in the findings of the self-reported sleep questionnaires were notable and worth future investigation.

To the knowledge of the researchers, this is the first study that used social marketing principles to deliver a non-pharmacological sleep intervention of sleep conducive music to the post-secondary student population. Although the study aligned with the existing evidence-base, challenges were faced when translating theory to practice. This study aimed to answer whether the use of social marketing to deliver a campus-wide sleep campaign was successful and found several uncontrollable factors. To help build stronger evidence for the use of social marketing theory as an intervention delivery vehicle and the acceptability of a sleep intervention based on music by PSSs, future studies need to explore more delivery channels and to develop more effective messages and strategies to overcome the challenges observed in this study.

References

Adan, A., Fabbri, M., Natale, V., & Prat, G. (2006). Sleep beliefs scale (SBS) and circadian typology. *Journal of Sleep Research, 15*(2), 125-132.

Agarwal, A., Eryuzlu, L., & Chawla, K. (2015). Sleep deprivation: student perceptions and its relationship to cardiovascular disease. *UTMJ, 92*(2), 34-38.

Anderson, C., & Platten, C.R. (2011). Sleep deprivation lowers inhibition and enhances impulsivity to negative stimuli. *Behavioural Brain Research, 217,* 463-466.

Andreasen, A. R. (1995). *Marketing social change: changing behavior to promote health, social development, and the environment* (1st ed.). Washington, DC: Jossey-Bass publishers

Andreasen, A. R. (2002). Marketing social marketing in the social change marketplace. *Journal of Public Policy & Marketing, 21*(1), 3-13.

Arcia, A. (2014). Facebook advertisements for inexpensive participant recruitment among women in early pregnancy. *Health Education and Behavior, 41*(3), 237-241.

Blunden, S. L., Chapman, J., & Rigney, G. A. (2012). Are sleep education programs successful? The case for improved and consistent research efforts. *Sleep Medicine Reviews, 16,* 355-370.

Bowling, A. (1997). *Research Methods in Health: Investigating Health and Health Services.*

Brown, C. A., Qin, P., & Esmail, S. (2017). Sleep? Maybe later…A cross-campus survey of university students and sleep practices. *Educ. Sci., 7*(3), 66, doi:10.3390/educsci7030066

Buboltz, W.C., Brown, F., & Soper, B. (2001). Sleep habits and patterns of college students: a preliminary study. *Journal of American College Health, 50*(3), 131-135.

Burns, J., Labbe, E., Arke, B., et al (2002). The effects of different types of music on perceived and physiological measures of stress. *Journal of Muisc Therapy, 39 2 101-116*

Buxton, O. M., Ellenbogen, J. M., Wang, W., Carballeira, A., O'Conner, S., Cooper, D., Gordhandas, A. J., McKinney, S. M., & Solet, J. M. (2012). Sleep disruption due to hospital noises. *Annals of Internal Medicine, 157*(3), 170-180.

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index – a new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193-213.

Buysse, D.J., Hall, M.L., Strollo, P.J., Kamarck, T.W., Owens, J., Lee, L., Reis, S.E., & Matthews, K.A. (2008). Relationships between the Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), and clinical/polysomnographic measures in a community sample. *Journal of Clinical Sleep Medicine, 4*(6), 563-571.

Canadian Sleep Society. (2003). Insomnia. Retrieved from: https://css-scs.ca/files/resources/brochures/insomnia.pdf

Chan, M. F., Wong, Z. Y., & Thayala, N. V. (2011). The effectiveness of music listening in reducing depressive symptoms in adults: a systematic review. *Complementary Therapies in Medicine, 19,* 332-348.

Chang, E., Lai, H., Chen, P., Hsieh, Y., & Lee, L. (2012). The effects of music on the sleep quality of adults with chronic insomnia using evidence from polysomnographic and self-reported analysis: a randomized control trial. *International Journal of Nursing Studies, 49,* 921-930.

Chen, C-K., Pei, Y-C-., Chen, N-H., Huang, L-T., Chou, S-W., Wu, K. P., Ko, P-C., Wong, A. M. K., & Wu, C-K. (2014). Sedative music facilitates deep sleep in young adults. *The Journal of Alternative and Complementary Medicine, 20*(4), 312-317.

Coren, S. (1994). The prevalence of self-reported sleep disturbances in young adults. *International Journal of Neuroscience, 79*(1), 67-73.

Curcio, G., Ferrara, M., & de Gennaro, L. (2006). Sleep loss, learning capacity and academic performance. *Sleep Medicine Reviews, 10,* 323-337.

Chi, G. C. H. L., & Young, A. (2011). Selection of music for inducing relaxation and alleviating pain. *Hollistic nursing practice, 25*(3), 127-135.

Chiu, Y-P., Lo, S-K., & Hsieh, A-Y. (2016). How color similarity can make banner advertising effective: insights from Gestalt theory. *Behaviour and Information Technology,* DOI: 10.1080/0144929X.2016.1267264

Christensen, T., Riis, A. H., Hatch, E. E., Wise, L. A., Nielsen M. G., Rothman, K. J., Sorensen, H. T., & Mikkelsen, E. M. (2017). Costs and efficiency of online and offline recruitment methods: a web-based cohort study. *Journal of Medical Internet Research, 19*(3), 1-12.

Cook, C. (2012). Email interviewing: generating data with a vulnerable population. *Journal of Advanced Nursing, 68*(6), 1330-1339.

Digdon, N. L. (2010). Circadian preference and college students' beliefs about sleep education. *Chronobiology International, 27*(2), 297-317.

Emerson, R. W. (2015). Convenience sampling, random sampling, and snowball sampling: how does sampling affect the validity of research? *Journal of Visual Impairment & Blindness, 109*(2), 164-168.

Engel, G. L. (1977). The need for a new medical model: A challenge for biomedicine. *Science, 196* (4289), 129-136.

Feman, S.P.C., Nguyen, L.T., Quilty, M.T., Kerr, C.E., Nam, B.H., Conboy, L.A.,… Davis, R.B. (2008). Effectiveness of recruitment in clinical trials: an analysis of methods used in a trial for irritable bowel syndrome patients. *Contemporary Clinical Trials, 29,* 241-251.

Fleming, J., Kamal, A., Harrison, E., Hamborg, T., Stewart-Brown, S., Thorogood, M., Griffiths, F., & Robertson, W. (2015). Evaluation of recruitment methods for a trial targeting childhood obesity: families for health randomised controlled trial. *Trials, 16,* 535-544.

Gaston, E. T. (1951). Dynamic music factors in mood change. *Music Educators Journal, 37,* 42-44.

Gomes, A. A., Tavares, J., & de Azevedo, M. H. P. (2011). Sleep and academic performance in undergraduates: a multi-measure, multi-predictor approach. *Chronobiology International, 28*(9), 786-801.

Gopikrishna, R., & Kumar, M. (2015). A conceptual study on psychology of color in marketing and branding. *IJER, 12*(2), 501-505.

Gorn, G. J., Chattopadhyay, A., Yi, Tracey, & Dahl, D. W. (1997). Effects of color as an executional cue in advertisement: they're in the shade. *INFORMS, 43*(10), 1387-1400.

Griefahn, B., Marks, A., & Robens, S. (2006). Noise emitted from road, rail and air traffic and their effects on sleep. *Journal of Sound and Vibration, 295,* 129-140.

Harmat, L., Takacs, J., & Bodizs, R. (2008). Music improves sleep quality in students. *Journal of Advanced Nursing, 62*(3), 327-335.

Harris, M. L., Loxton, D., Wigginton, B., & Lucke, J. (2015). Recruiting online: lessons from a longitudinal survey of contraception and pregnancy intentions of young Australian women. *American Journal of Epidemiology, 181*(10), 737-746.

Harsora, P., & Kessmann, J. (2009). Nonpharmacological management of chronic insomnia. *American Family Physician, 79*(2), 125-130.

Harvey, A. G., Stinson, K., Whitaker, K. L., Moskovitz, D., & Virk, H. (2008). The subjective meaning of sleep quality: A comparison of individuals with and without insomnia. *SLEEP, 31*(3), 383-393

Hershner, S. D., & Chervin, R. D. (2014). Causes and consequences of sleepiness among college students. *Nature and Science of Sleep, 6,* 73-84.

Hicks, R. A., Fernandez, C., & Pellegrini, R. J. (2001). Striking changes in the sleep satisfaction of university students over the last two decades. *Perceptual and Motor Skills, 93,* 660.

Hicks, R. A., Fernandez, C., & Pellegrini, R. J. (2001). The changing sleep habits of university students: an update. *Perceptual and Motor Skills, 93,* 648.

Hume, K. I., Brink, M., & Basner, M. (2012). Effects of environmental noise on sleep. *Noise & Health, 14*(61), 297-302.

Iwanaga, M., & Moroki, Y. 1999. Subjective and physiological responses to music stimuli controlled over activity and preference. *Journal of Music Therapy, 36 1 26-28*

Iwanaga, M., Ikeda, M., Iwaki, T. 1996. The effects of repetitive exposure to music on subjective and physiological responses. *Journal of Music Therapy, 33 3 219-230*

Janiszewski, C., Noel, H., & Sawyer, A. G. (2003). A meta-analysis of the spacing effect in verbal learning: implications for research on advertising repetition and consumer memory. *Journal of Consumer Research. 30*(1)*,* 138-149.

John, M. W. (1991). A new method for measuring daytime sleepiness: the Epworth sleepiness scale. *Sleep, 14*(6), 540-545.

Juni, S., & Gross, J. S. (2008). Emotional and persuasive perception of fonts. *Perceptual and Motor Skills, 106,* 33-42.

Kadam, Y. R., Patil, S. R., Waghachavare, V., & Gore, A. D. (2016). Influence of various lifestyle and psychosocial factors on sleep disturbances among the college students: a cross-sectional study from an urban area of India. *Journal of Krishna Institute of Medical Sciences University, 5*(3), 51-60.

Kemper, K. J., & Danhauer, S. C. (2005). Music as Therapy. *Complementary and Alternative Medicine, 98*(3), 282-288.

Kennaway, D. J. (2015). Potential safety issues in the use of the hormone melatonin in paediatrics. *Journal of Paediatrics and Child Health, 51*(6), 584-589.

Khalfa S, Bella, S. D., Roy M., Peretz, I., & Lupien, S. J. (2003). Effects of relaxing music on salivary cortisol level after psychological stress. *Ann N Y Acad Sci, 999,* 374-376

Killgore, W. D. S., Kahn-Greene, E. T., Lipizzi, E. L., Newman, R. A., Kamimori, G. H., & Balkin, T. J. (2008). Sleep deprivation reduces perceived emotional intelligence and constructive thinking skills. *Sleep Medicine, 9,* 517-526.

Knight, W. E. J., & Rickard, N. S. (2001). Relaxing music prevents stress-induced increases in subjective anxiety, systolic blood pressure, and heart rate in healthy males and females. *Journal of Music Therapy, 38*(4), 254-272

Kripke, D. F. (2000). Chronic hypnotic use: deadly risks, doubtful benefit. *Sleep Medicine Reviews, 4*(1), 5-20.

Krout, R. E. (2007). Music listening to facilitate relaxation and promote wellness: integrated aspects of our neurophysiological responses to music. *The Arts of Psychotherapy, 34,*134-141.

Lai, H-L., & Good, M. (2005). Music improves sleep quality in older adults. *Journal of Advanced Nursing, 49*(3), 234-244.

Lazic, S. E., & Ogilvie, R. D. (2007). Lack of efficacy of music to improve sleep: A polysomnographic and quantitative EEG analysis. *International Journal of Psychophysiology, 63*, 232-239.

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. *Journal of Adolescent Health, 46*, 124-132.

Lynch, D., Laws, K. R., & McKenna, P. J. (2010). Cognitive behavioral therapy for major psychiatric disorder: does it really work? A meta-analytical review of well-controlled trials. *Psychological Medicine, 40*(1), 9-24.

Maczaj, M. (1993). Pharmacological treatment of insomnia. *Drugs, 45*(1), 44-55.

Mayasari, I. (2012). The perspectives to understanding social marketing as an approach in influencing consumer behavior for good. *Gadjah Mada International Journal of Business, 14*(2), 163-182.

McCarthy, M. S., & Mothersbaugh, D. L. (2002). Effects of typographic factors in advertising-based persuasion: a general model and initial empirical tests. *Psychology and Marketing, 19*(7-8), 663-691.

McCraty, R., Barrios-Choplin, B., Atkinson, M., & Tomasino, D. (1998). The effects of different types of music on mood, tension and mental clarity. *Altern Ther Health Med*, *4*, 75-84.

Milojevich, H. M., & Lukowski, A. F. (2016). Sleep and mental health in undergraduate students with generally healthy sleep habits. *PLoS ONE, 11*(6), 1-14.

Morin, C. M., Hauri, P. J., Espie, C. A., Spielman, A. J., Buysse, D. J., & Bootzin, R. R. (1999). Nonpharmacologic treatment of chronic insomnia. *SLEEP, 22*(8), 1134-1156.

Morishima, M., Sugino, Y., Ueya, Y., Kadotani, H., & Takadama, K. (2016). Effects on sleep by "cradle sound" adjusted to heartbeat and respiration. *AAAI Spring Symposium Series,* retrieved from: http://www.aaai.org/ocs/index.php/SSS/SSS16/paper/view/12736

Mornhinweg, G. C. (1992). Effects of music preference and selection on stress reduction. *Journal of Holistic Nursing, 10*(2), 101-109

Muzet, A. (2007). Environmental noise, sleep and health. *Sleep Medicine Reviews, 11,* 135-142.

National Sleep Foundation. (2011). 2011 sleep in America poll: communications technology in the bedroom. Retrieved from: https://sleepfoundation.org/sites/default/files/sleepinamericapoll/SIAP_2011_Summary_of_Findings.pdf

National Sleep Foundation. (2016). Melatonin and sleep. Retrieved from: https://sleepfoundation.org/sleep-topics/melatonin-and-sleep

Nielsen. (2015, September). Global trust in advertising report. Retrieved from https://www.nielsen.com/content/dam/nielsenglobal/apac/docs/reports/2015/nielsen-global-trust-in-advertising-report-september-2015.pdf

Nilsson, U. (2009). Soothing music can increase oxytocin levels during bed rest after open-heart surgery: a randomised control trial. *Journal of Clinical Nursing, 18,* 2153-2161.

Öhrström, E., & Björkman, M. (1988). Effects of noise-disturbed sleep – a laboratory study on habituation and subjective noise sensitivity. *Journal of Sound and Vibration, 122*(2), 277-290.

Pagal, J. F. (2009). Excessive daytime sleepiness. *American Family Physician, 79*(5), 390-396.

Pandi-Perumal, S. R., Zisapel, N., Srinivasan, V., & Cardinali, D. P. (2005). Melatonin and sleep in aging population. *Experimental Gerontology, 40,* 911-925.

Pelletier, C. L. (2004). The effect of music on decreasing arousal due to stress: a meta-analysis. *Journal of Music Therapy, 41 3 192-214*

Pieters, R., & Wedel, M. (2004). Attention capture and transfer in advertising: brand, pictorial, and text-size effects. *Journal of Marketing, 68*(2), 36-50.

Pillai, K. G., Katsikeas, C. S., & Presi, C. (2012). Print advertising: type size effects. *Journal of business research, 65,* 865-868.

Powell, D. S., Batche, C. J., Ferro, J., Fox, L., & Dunlap, G. (1997). A strength-based approach in support of multi-risk families: principles and issues. *Topics in Early Childhood Special Education, 17(1)*, 1-26.

Purdue Science. (2000). Noise sources and their effects. Retrieved from: https://www.chem.purdue.edu/chemsafety/Training/PPETrain/dblevels.htm

Rauschecker, J. P. (2001). Cortical plasticity and music. *Annals of the New York Academy of Science, 930,* 330-336.

Raymann, R. J. E. M., Swaab, D. F., & van Someren, E. J. W. (2008). Skin deep: enhanced sleep depth by cutaneous temperature manipulation. *Brain, 131,* 500-513.

Rodgers, R. F., & Franko, D. L. (2015). Eating disorder prevention on college campuses: recruitment challenges. *Revue européenne de psychologie appliquée, 65,* 125-131.

Shi, T. (2013). The use of color in marketing: colors and their physiological and psychological implications. *Berkeley Scientific Journal, 17*(1), 1-6.

Shi, W., Shang, P., Ma, Y., Sun, S., & Yeh, C-H. (2017). A comparison study on stages of sleep: quantifying multiscale complexity using higher moments on coarse-graining. *Communication in Nonlinear Science and Numerical Simulation, 44,* 292-303.

Stratton, V. N., & Zalanowski, A. H. (1984). The relationship between music, degree of liking, and self-reported relaxation. *Journal of Music Therapy, 21 4* 184-192.

Sue, V.M., & Ritter, L.A. (2007). *Conducting Online Surveys*. Los Angelas: Sage Publications.

Tan, L. P. (2004). The effects of background music on quality of sleep in elementary school children. *Journal of Music Therapy, 41*(2), 128-150.

Thacher, P. V. (2008). University students and "the all nighter": correlates and patterns of students' engagement in a single night of total sleep deprivation. *Behavioural Sleep Medicine, 6*(16), 16-31.

Trockel, M. T., Barnes, M. D., & Egget, D. L. (2000). Health-related variables and academic performance among first-year college students: implications for sleep and other behaviors. *Journal of American College Health, 49*(3), 125-131.

Tsai, L-L., & Li, S-P. (2004). Sleep patterns in college students' gender and grade differences. *Journal of Psychosomatic Research, 56,* 231-237.

Tsoi, W. F. (1991). Insomnia: drug treatment. *Annals of the Academy of Medicine Singapore, 20*(2), 269-272.

University of Alberta. (2016). Workbook: U of A Student. Retrieved from https://idw-bi.ualberta.ca/t/Production/views/UofAStudent/UofAStudentFallHeadcount?%3Aembed=y&%3AshowShareOptions=true&%3Adisplay_count=no&%3AshowVizHome=no

van Cauter, E., Spiegel, K., Tasali, E., & Leproult, R. (2008). Metabolic consequences of sleep and sleep loss. *Sleep Medicine, 9*(1), S23-S28.

van Gelder, M. M. H. J., Bretveld, R. W., & Roeleveld, N. (2010). Web-based questionnaires: the future in epidemiology? *American Journal of Epidemiology, 172*(11), 1292-1298.

Verrusio, W., Ettorre, E., Vicenzini, E., Vanacore, N., Cacciafesta, M., & Mecarelli, O. (2015). The Mozart effect: a quantitative EEG study. *Consciousness and Cognition, 35,* 150-155.

Wagner, J., & Wagner, M. L. (2000). Non-benzodiazephones for the treatment of insomnia. *Sleep Medicine Reviews, 4*(6), 551-581.

Walker, M. P., & Stickgold, R. (2004). Sleep-dependent learning and memory consolidation. *Neuron, 44*, 121-133.

Walliser, B. (1997). A comparison of the effectiveness of perimeter and outdoor advertising. *Asia-Australia Marketing Journal, 5*(1), 21-31.

Wang, C-F., Sun, Y-L., & Zang, H-X. (2014). Music therapy improves sleep quality in acute and chronic sleep disorders: a meta-analysis of 10 randomized studies. *International Journal of Nursing Studies, 51,* 51-62.

Weinreich, N.K. (2011). *Hands-on social marketing: a step-by-step guide to designing change for good* (2nd ed.). Thousand Oaks, CA: SAGE publications.

Wise, L. A., Rothman, K. J., Mikkelsen, E. M., Stanford, J. B., Wesselink, A. K., McKinnon, C., Gruschow, S. M., Horgan, C. E., Wiley, A. S., Hahn, K. A., SØrensen, H. T., & Hatch, E. E. (2015). Design and conduct of an internet-based preconception cohort study in North America: pregnancy study online. *Paediatric and Perinatal Epidemiology, 29,* 360-371.

Wiist, W. H., Sullivan, B. M., Wayment, H. A., & Warren M. (2010). A web-based survey of the relationship between Buddhist religious practices, health, and psychological characteristics: research methods and preliminary results. *Journal of Religious Health, 49*, 18-31.

Wolfe, D. E., O'Connell, A. S., Waldon, E. G. (2002) Music for relaxation: a comparison of musicians and nonmusicians on ratings of seleced musical recordings. *Journal of Music Therapy, 39 1 40-55.*

Wong, M. L., Lau, E. Y. Y. L., Wan, J. H. Y. W., Cheung, S. F., Hui, C. H., & Ying, D. S. (2013). The interplay between sleep and mood in predicting academic functioning, physical health and psychological health: a longitudinal study. *Journal of Psychosomatic Research, 74,* 271-277.

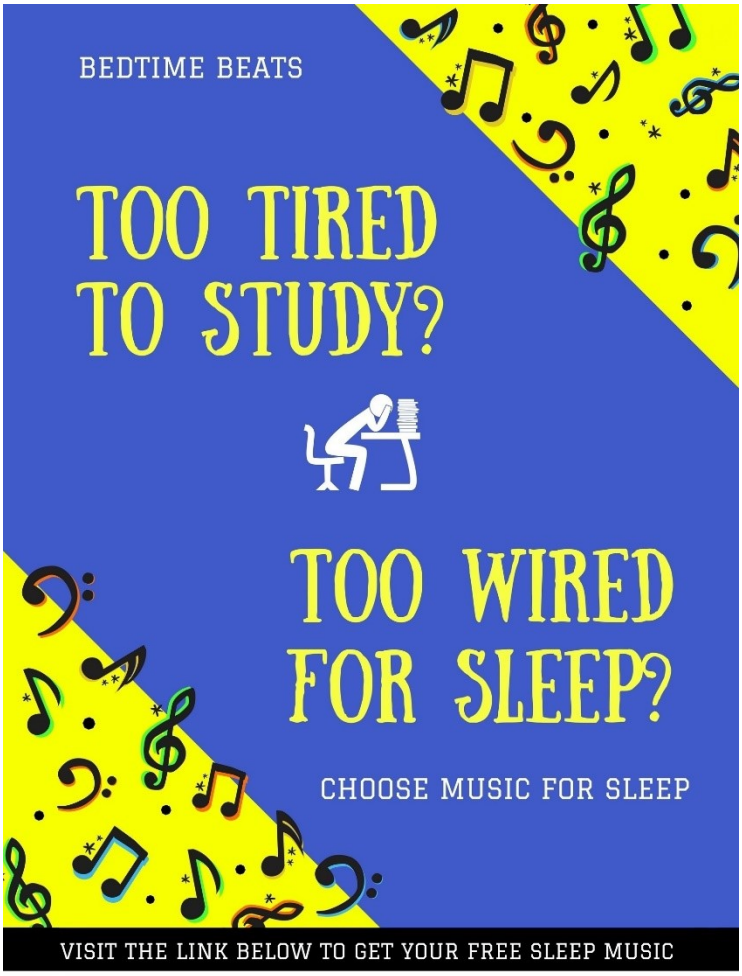
World Health Organization. (2009). WHO night noise guidelines for Europe. Retrieved from: http://www.euro.who.int/en/health-topics/environment-and-health/noise/policy/who-night-noise-guidelines-for-europe

Wright, K.B. (2005). Researching internet-based populations: advantages and disadvantages of online survey research, online questionnaire authoring software packages, and web survey services. *Journal of Computer-Mediated Communication, 10*(3), 00. doi: 10.1111/j.1083-6101.2005.tb00259.x

Xie, H., Kang, J., & Mills, G. H. (2009). Clinical review: the impact of noise on patients' sleep and the effectiveness of noise reduction strategies in intensive care units. *Critical Care, 13*(2), 208-216.

Appendix A – Offline recruitment posters

Energetic themed



WE WOULD LIKE TO INVITE YOU TO PARTICIPATE IN THIS SLEEP RESEARCH STUDY!

VISIT THE URL OR SCAN THE QR CODE FOR MORE INFORMATION!

THIS STUDY HAS BEEN APPROVED BY THE HEALTH RESEARCH ETHICS BOARD OF THE UNIVERSITY OF ALBERTA

HAVE QUESTIONS? CONTACT US!

YULUAN WANG (YULUAN@UALBERTA.CA)
MSC STUDENT, FACULTY OF REHABILITATION MEDICINE

CARY BROWN (CARY.BROWN@UALBERTA.CA)
DEPARTMENT OF OCCUPATIONAL THERAPY
FACULTY OF REHABILITATION MEDICINE

UNIVERSITY OF ALBERTA
FACULTY OF REHABILITATION MEDICINE

http://bit.ly/2vlpkGb

Humoristic themed

BEDTIME BEATS

HAVE ZOMBIEITIS?
WE HAVE A CURE!

TRY MUSIC FOR SLEEP!

VISIT THE LINK BELOW TO GET YOUR FREE SLEEP MUSIC!

Photograph retrieved from: https://i.pinimg.com/originals/9a/56/b0/9a56b01aae20211fe5f3b817dfe7f9f2e.jpg

We would like to invite you to participate in this sleep research study!

Visit the URL or scan the QR code for more information!

This study has been approved by the Health Research Ethics Board of the University of Alberta

Have questions? Contact us!

Yuluan Wang (yuluan@ualberta.ca)
MSc student, Faculty of Rehabilitation Medicine

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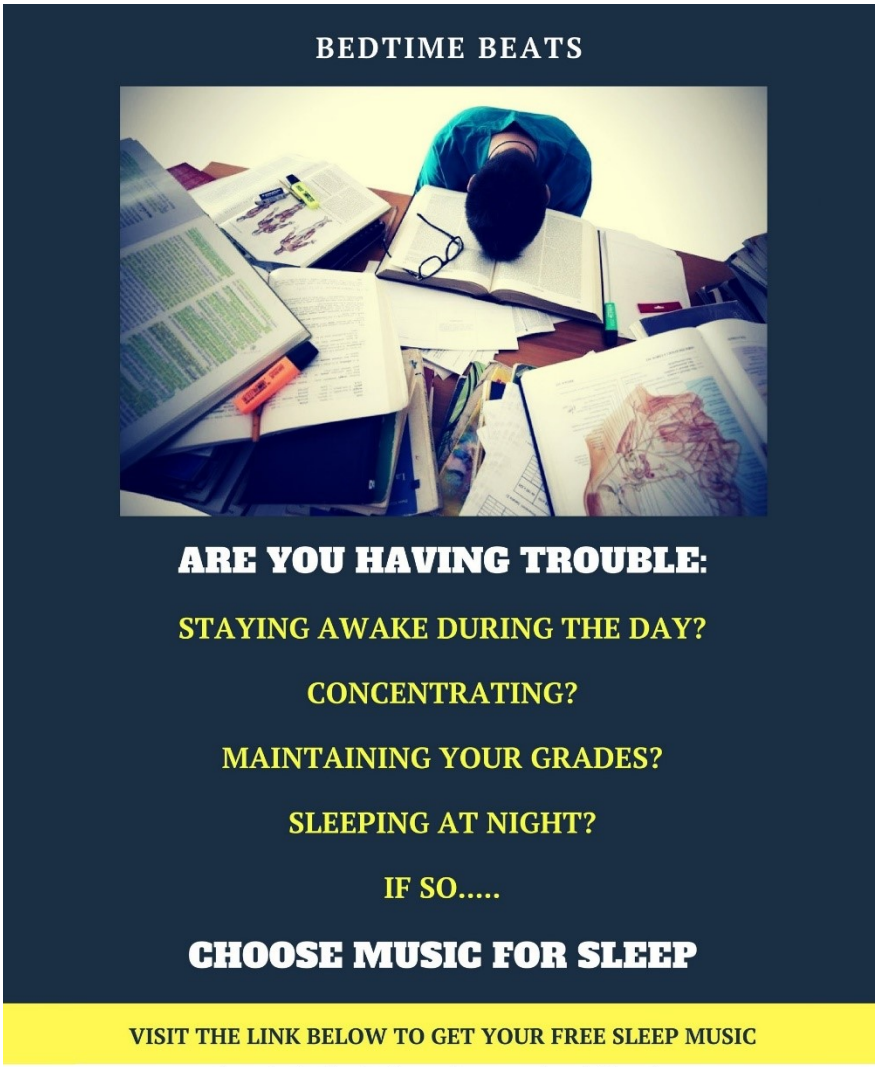
Department of Occupational Therapy
Faculty of Rehabilitation Medicine

UNIVERSITY OF ALBERTA
FACULTY OF REHABILITATION MEDICINE

http://bit.ly/2vlpkGb

Realistic themed



Photograph retrieved from: http://www.pondermonster.com/homeschool-burnout/

We would like to invite you to participate in this sleep research study!

Visit the URL or scan the QR code for more information.

This study has been approved by the Health Research Ethics Board of the University of Alberta

Have questions? Contact us!

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FACULTY OF REHABILITATION MEDICINE

http://bit.ly/2vlpkGb

Appendix B Poster design criteria

Table 1. Characteristics of posters for recruitment

Graphic communication classification	Effectiveness	Criteria for poster design
Passive outdoor advertisement (Fleming et al 2015).	• Reach a large population (Fleming et al 2015). • 72.7% success rate (Fleming et al 2015). • Repeated exposure increases recall (Fleming et al 2015; Feman et al., 2008). • 58% trust rate (Nielsen, 2015).	Posters are used as a passive outdoor advertisement.
Product (Feman et al., 2008).	• Low cost product increase recall (Feman et al., 2008). • Branded product increases recall (Feman et al., 2008).	Free sleep conducive music offered by the Faculty of Rehabilitation Medicine
Size (Walliser, 1997).	• Increase in poster size leads to increase in influence and recruitment (Walliser 1997)	
Different themes and messages (Nielsen, 2015).	• Reach wide variety of audiences (Weinreich, 2011). • Individualize messages instead of an all-inclusive message that might now resonate with everyone (Weinreich, 2011). • Asian and Latin American audiences rated real-life or health-themed messages as more resonating (Nielsen, 2015). • Europeans and North American audiences rated humours contents are more appealing (Nielsen, 2015). • Younger generations, aged 15 to 34, rated high energy or action-filled messages as more appealing (Nielsen, 2015). • Uniqueness of messages or themes leads to increased recall; such as artwork vs photographs, and black	The use of 3 different themes to reach a wider audience: Humoristic themed Energetic themed Realistic themed

	and white images vs colored (Walliser, 1997).	
Text size	• 10-12 point font sizes are easy to read; however, in advertisement, the greater the text size, the greater the readership due to increased legibility (McCarthy et al., 2002; Pillai et al., 2012).	
Text style	• Two broad categories of fonts: serif and sans serif (McCarthy et al., 2002; Pillai et al., 2012). • Serif fonts enhances legibility, and is associated with eliciting emotional responses (McCarthy et al., 2002; Juni & Fross, 2008). • Novel fonts catches attention and motivates processing of information (McCarthy et al., 2002). • Bold words imply importance (McCarthy et al., 2002). • Scripted or italicized fonts imply sophistication (McCarthy et al., 2002). • Ornateness leads to decreased legibility unless used briefly in advertisement as a decorative element (McCarthy et al., 2002). • Increased height of letters leads to increased legibility; however, too high and legibility will be interrupted (McCarthy et al., 2002).	Posters uses novel and classic serif fonts, bolded to draw attention and imply importance with minimal ornateness.
Color	• High levels of chroma and value in color elicits feelings of excitement and relaxation (Gorn et al., 1997) • Similarity of color between advertisement and webpage of product increases positive attitudes for advertisement and increases time and fixation on webpage (Chiu et al., 2016). • Warm and cool colors induces biochemical change (Shi, 2013)	Poster colors are cool colors and yellow to generate relaxation, pleasure, and to grab attention. Posters are set using Photoshop to have high levels of chroma and value.

	• Warm colors elicit higher levels of arousal, urgency and attention (Chiu et al., 2016; Shi, 2013). • Cool colors generate higher levels of relaxation and pleasure (Chiu et al., 2016; Shi, 2013). • Red: anger, danger, warmth, passion, and increases heart rate and blood pressure (Gopikrishna & Kumar, 2015). • Orange: fun, bright, friendly, and playful • Yellow: positive, sunny, optimistic, energetic and rated as the most eye-catching color (Gopikrishna & Kumar, 2015). • Green: an emotionally positive color, signifies growth, rebirth, and nature, stability and endurance (Gopikrishna & Kumar, 2015). • Blue: cool, clean, clear, trustworthy, and dependable feel (Gopikrishna & Kumar, 2015). • Purple: nostalgic and sentimental feel in lighter chroma and value. In lower chroma and value, purple has sophisticated, and royalty feel (Gopikrishna & Kumar, 2015). • Pink: higher chroma and value is associated with femininity, lower chroma and value associated with sentimental tone (Gopikrishna & Kumar, 2015). • Black: bold, powerful, classic, confident, and sophisticated (Gopikrishna & Kumar, 2015). • Research shows cooler colors elicit a more positive rating than warmer colors (Chiu et al., 2016; Shi 2013). • However, colors should be chosen to match the personality of the advertised product (Shi, 2013; Gopikrishna & Kumar, 2015).	Posters advertising the product and linking audiences to the corresponding webpage will share similarity in color and quality of design

Appendix C – Online recruitment email invitation

Bedtime Beats

Are you having trouble with your sleep? Choose music for sleep!

Students at the University of Alberta Faculty of Rehabilitation Science have created music specifically for sleep. We would like to invite you to participate in this sleep research study. Visit the link below to get started and to get your **free sleep music and add music listening to your bedtime routine**!

Have questions? Contact us:

Yuluan Wang (yuluan@ualberta.ca)

MSc student, Faculty of Rehabilitation Medicine

Cary Brown (cary.brown@ualberta.ca)

Department of Occupational Therapy

Faculty of Rehabilitation Medicine

This study has been approved by the Health Research Ethics Board of the University of Alberta.

Appendix D Consent information

The use of social marketing theory as a frame work to promote uptake of sleep-conducive music by post-secondary students

Are you having trouble with sleep? If so, we invite you to participate in this research study to look at whether music listening and using social marketing can help improve sleep. Please read the following information carefully before proceeding.

What is this study?

The aim of this study is to test whether using social marketing is an effective method to introduce a sleep strategy based on music to post-secondary students.

What is social marketing?

Social marketing is the use of traditional commercial marketing principles and techniques to influence voluntary and socially desirable behaviors to promote the health or well-being of the public.

Why are we using social marketing?

Social marketing will be used to examine options for engaging post-secondary students' attention and prompting them to access a new online resource. The social marketing strategies we will be using will be printed posters and email invitations.

Why are we using music to help with sleep?

Sleep deficiency is a problem in post-secondary students worldwide and has serious negative consequences on overall health. While there are several sleep strategies available, music listening has been found to be popular among students to help with sleep.

What type of music will be used to help with sleep?

The music used in this study is called sleep-conducive music. It is music designed and found by research to have beneficial effects on well-being and sleep.

What are we asking you to do?

1) First, please complete the following survey that will gather information on your sleep, and opinions on this study. This will take approximately 15-20 minutes to complete.

2) After completing the survey, you will be directed to the study website. There will be 3 sleep-conducive music available for you to download. Please only choose one piece to listen to for this study.

3) Please listen to the music for 30 minutes, in bed, with the lights out and ready for sleep. Please set your music devices to turn off after 30 minutes.

4) After 1 week of having the music, you will get an email with a survey so you can tell us how your sleep has been.

5) After 2 more weeks of having the music, a final survey will be sent out through email checking in on how your sleep has been.

6) At the end of the study, you will automatically be entered into a draw for a chance to win 1 of 3 prizes valued at a maximum of $50 CAD each, with an 1 in 150 chance of winning.

What are the benefits of participating in this study?

Sleep-conducive music may improve sleep quality and the results from this study may benefit future sleep research. Additionally, you will receive 3 pieces of free sleep-conducive music designed by researchers at the University of Alberta and a chance to win 1 of 3 prizes.

Are there any risks involved?

There are no foreseen risks for participating in this study. If discomfort does occur, you can stop at anytime.

Confidentiality?

Participation will only be known to you and the researchers. Confidentiality will be kept to the best of the researchers and the institutions ability; however, confidentiality cannot be guaranteed on the University of Alberta Google app "Google Forms" (https://privacy.google.com/?hl=en#). All information collected will be reported in a way that does not identify you personally. The information gathered will be stored on the laboratory computer located in the Faculty of Rehabilitation Medicine in the offices of Dr. Cary Brown for a minimum of 5 years, and then destroyed.

Can I withdrawal?

You do not have to take part in the study at all and you are free to drop-out at any time by letting the researcher know. However, your survey responses cannot be withdrawn once submitted.

Contact information:

For more information or questions related to the study, please contact Yuluan Wang (yuluan@ualberta.ca)

For more information on this study or your rights as a research participant, please contact Dr. Cary Brown (cary.brown@ualberta.ca) or Dr. John Misiazek, Associate Dean Research (john.misiazek@ualberta.ca)

By completing and submitting this survey, you confirm that you have read and understood the above and agree to take part in this research. Your participation is voluntary and you are free to leave the study at any time by simply closing the web browser.

Appendix E Sleep-conducive music criteria

Table 1. Characteristics and physiological properties of music to promote sleep

Sleep conducing music description	Physiological effects	Criteria for sleep conducing music
Sound level (<30 decibels) (World Health Organization, 2009).	• 30 decibels or less has little to no effect on sleep (World Health Organization, 2009).	A maximum sound level of 30 decibels
No accented beats, percussive characteristics, and syncopations (Gaston, 1951).	• Decreases tension (Chi & Young, 2011). • Decreases arousal (Chi & Young, 2011).	Music with no accented beats, percussive instruments, and syncopations.
Tempo of 60-80bpm (Gaston, 1951).	• Mimics the human heart rate (Chan et al., 2011) • Regulates parasympathetic nervous system activities such as heart and respiration rate (Harmat et al., 2008). • Greater synchronization between music beat and heart beat leads to greater relaxation and analgesic effects (Harmat et al., 2008). • Decreases tension (Chi & Young, 2011).	Tempo of 60bpm throughout
Steady, repetitive rhythms and tempos with sustained sounds (Knight & Richard, 2001); Morishima et al., 2016).	• Decreases sleep onset latency (Knight & Richard, 2001); Morishima et al., 2016). • Decreases tension (Chi & Young, 2011).	Music with a steady tempo of 60 bpm throughout, sustained sound, unfluctuating dynamics, and repetitive rhythms
Low-frequency tones and pitches (Chi & Young, 2011).	• Decreases tension (Chi & Young, 2011).	Music with low frequency tones and pitches
A listening duration of 30-60 minutes long (Chan et al., 2011)	• Increases REM sleep duration and SWS duration (Chang et al., 2012; Chen et al., 2014).	Music looped to last 30 minutes for 30 minutes of listening

	• Decreases N2 stage sleep duration and sleep onset latency (Chang et al., 2012; Chen et al., 2014). • Increases alpha brain wave activity (Verrusio et al., 2015). • Increases cerebral synaptic plasticity (Rauschecker, 2001). • Reduces circulating noradrenaline (Harmat et al., 2008). • Decreases cortisol and adrenocorticotropic hormones (Khalfa et al., 2003). • Increases endorphins, oxytocin, and phenylenthylamine (Harmat et al., 2008; Nilsson, 2009). • Increases positive moods (Harmat et al., 2008). • Decreases distractive thoughts (Harmat et al., 2008).	

Appendix F Follow-up email reminder

First follow-up one week after baseline:

Hello all,

Thank you for taking the time to participate in this study. Attached to the email is the link to a survey to see how you are doing so far with the music and your sleep. It should take no more than 20 minutes to complete. A final follow-up will be sent out in 2 weeks' time. Please continue to listen to the music every night, at a low volume for a minimum of 30 minutes.

By completing this study, you will be entered into a draw for a $50 gift card.

Thank you for your time and participation!

Final follow-up two weeks after baseline:

Hello all,

This will be the final step of this study. Attached to the email is the link to the final survey to see how you are doing with the music and your sleep. It should take no more than 20 minutes to complete. By completing this final survey, you will be entered into a draw for a $50 gift card.

Thank you for your time and participation!

Appendix G Study survey and questionnaire

Baseline survey (for poster recruitment)

1) Demographics:

Gender	Female Male Non-binary
Year of birth	
Program	Undergraduate Graduate PhD
Faculty/Department	

2) Which of these posters did you notice around campus?

A. (Thumbnail of poster 1)
B. (Thumbnail of poster 2)
C. (Thumbnail of poster 3)
D. Word of mouth

3) Which of three posters first caught your attention?

A. (Thumbnail of poster 1)
B. (Thumbnail of poster 2)
C. (Thumbnail of poster 3)
D. Word of mouth

4. Which of these three posters prompted you to visit the website?

A. (Thumbnail of poster 1)
B. (Thumbnail of poster 2)
C. (Thumbnail of poster 3)
D. Word of mouth

5. Where on campus did you take notice of them?

A. CCIS
B. Education
C. FAB
D. SUB
E. CAB
F. ECHA
G. Other:_____

6. Why did you visit the URL/OR code on the poster?

A. Need help with sleep
B. Curious
C. Friend suggested it
D. Other:_____

7. How frequently do you listen to music to help you sleep?

A. Never
B. Once or twice a week
C. Three or more times a week
D. Every night

8. What type of music do you listen to to help you sleep? _____

9. What is your music listening routine? _____

10. How long do you listen to the music for?

A. Less than 15 minutes
B. 15 to 30 minutes
C. More than 30 minutes

11. When do you listen to music? _____

12. SBS (Appendix J)
13. PSQI (Appendix H)
14. ESS (Appendix I)

Baseline survey (for email recruitment)

1) Demographics:

Gender	Female Male Non-binary
Year of birth	
Program	Undergraduate Graduate PhD
Faculty/Department	

2) Did you see any posters about this study before receiving the email invitation?

A. Yes
B. No

3) If YES, please tell us why you decided not to respond to the poster, but to the email.

4) Why did you visit the URL/OR code on the poster?

A. Need help with sleep
B. Curious
C. Friend suggested it
D. Other:_____

5) How frequently do you listen to music to help you sleep?

E. Never
F. Once or twice a week
G. Three or more times a week
H. Every night

6) What type of music do you listen to to help you sleep? _____

7) What is your music listening routine? _____

8) How long do you listen to the music for?

A. Less than 15 minutes
B. 15 to 30 minutes
C. More than 30 minutes

9) When do you listen to music? _____

10) SBS (Appendix J)

11) PSQI (Appendix H)

12) ESS (Appendix I)

Follow-up survey

13) Approximately how loud was the volume of the music set to?
    a. As loud as “light breathing”
    b. As loud as “whispering
    c. As loud as a “quiet room”
    d. As loud as “moderate snoring”
    e. As loud as a “normal conversation”
    f. As loud as a “busy street”

g. As loud as a “vacuum cleaner”

14) During the past week, how many nights did you listen to the downloaded music once you were in bed for the night? (check all that apply):
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

15) On average, during the past week, how many minutes did you listen to the music?
A. Less than 15 minutes
B. 15 to 30 minutes
C. More than 30 minutes

16) What prevented you from listening every night for 30 minutes? _____

17) What else were you doing while listening to the music?
A. Lights out, trying to fall asleep in bed
B. Working on my laptop/computer
C. On the phone
D. Using other electronic devices (eg games, tablets)
E. reading on electronic device
F. reading paper book with light on
G. other
H. Others: _____

18) Compared to when you did not have the music, on a scale of 0-5 how much do you feel the music has helped your sleep? _____

19) Why do you think this is? _____

20) SBS (Appendix J) (**Final follow up only)**
21) PSQI (Appendix H)
22) ESS (Appendix I)

Appendix H Pittsburgh Sleep Quality Index

Name_____ Date_____

Sleep Quality Assessment (PSQI)

What is PSQI, and what is it measuring?

The Pittsburgh Sleep Quality Index (PSQI) is an effective instrument used to measure the quality and patterns of sleep in adults. It differentiates "poor" from "good" sleep quality by measuring seven areas (components): subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month.

INSTRUCTIONS:

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

During the past month,

1. When have you usually gone to bed? _____
2. How long (in minutes) has it taken you to fall asleep each night? _____
3. What time have you usually gotten up in the morning? _____
4. A. How many hours of actual sleep did you get at night? _____
   B. How many hours were you in bed? _____

5. During the past month, how often have you had trouble sleeping because you	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)
A. Cannot get to sleep within 30 minutes				
B. Wake up in the middle of the night or early morning				
C. Have to get up to use the bathroom				
D. Cannot breathe comfortably				
E. Cough or snore loudly				
F. Feel too cold				
G. Feel too hot				
H. Have bad dreams				
I. Have pain				
J. Other reason (s), please describe, including how often you have had trouble sleeping because of this reason (s):				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
9. During the past month, how would you rate your sleep quality overall?	Very good (0)	Fairly good (1)	Fairly bad (2)	Very bad (3)

Scoring

Component 1	#9 Score	C1 _____
Component 2	#2 Score (<15min (0), 16-30min (1), 31-60 min (2), >60min (3)) + #5a Score (if sum is equal 0=0; 1-2=1; 3-4=2; 5-6=3)	C2 _____
Component 3	#4 Score (>7(0), 6-7 (1), 5-6 (2), <5 (3)	C3 _____
Component 4	(total # of hours asleep) / (total # of hours in bed) x 100 >85%=0, 75%-84%=!, 65%-74%=2, <65%=3	C4 _____
Component 5	# sum of scores 5b to 5j (0=0; 1-9=1; 10-18=2; 19-27=3)	C5 _____
Component 6	#6 Score	C6 _____
Component 7	#7 Score + #8 score (0=0; 1-2=1; 3-4=2; 5-6=3)	C7 _____

Add the seven component scores together _____ ***Global PSQI*** _____

A total score of "5" or greater is indicative of poor sleep quality.
If you scored "5" or more it is suggested that you discuss your sleep habits with a healthcare provider

Retrieved from https://www.gonzaga.edu/student-life/Health-Center/psqi_sleep_questionnaire_1_pg.pdf

Appendix I Epworth Sleepiness Scale

Epworth Sleepiness Scale

Name: _____ Today's date: _____

Your age (Yrs): _____ Your sex (Male = M, Female = F): _____

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired?

This refers to your usual way of life in recent times.

Even if you haven't done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the **most appropriate number** for each situation:

0 = would **never** doze
1 = **slight chance** of dozing
2 = **moderate chance** of dozing
3 = **high chance** of dozing

It is important that you answer each question as best you can.

Situation	**Chance of Dozing (0-3)**
Sitting and reading	
Watching TV	
Sitting, inactive in a public place (e.g. a theatre or a meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
In a car, while stopped for a few minutes in the traffic	

THANK YOU FOR YOUR COOPERATION

Retrieved from: http://www.sleepapnea.org/assets/files/pdf/ESS%20PDF%201990-97.pdf

Appendix J Sleep Beliefs Scale

	Positive effect	*Neither effect*	*Negative effect*
1. Drinking alcohol in the evening	☐	☐	☐
2. Drinking coffee or other substances with caffeine after dinner	☐	☐	☐
3. Doing intense physical exercise before going to bed	☐	☐	☐
4. Taking a long nap during the day	☐	☐	☐
5. Going to bed and waking up always at the same hour	☐	☐	☐
6. Thinking about one's engagements for the next day before falling asleep	☐	☐	☐
7. Using sleep medication regularly	☐	☐	☐
8. Smoking before falling asleep	☐	☐	☐
9. Diverting one's attention and relaxing before bedtime	☐	☐	☐
10. Going to bed 2 h later than the habitual hour	☐	☐	☐
11. Going to bed with an empty stomach	☐	☐	☐
12. Using the bed for eating, calling on the phone, studying and other non-sleeping activities	☐	☐	☐
13. Trying to fall asleep without having a sleep sensation	☐	☐	☐
14. Studying or working intensely until late night	☐	☐	☐
15. Getting up when it is difficult to fall asleep	☐	☐	☐
16. Going to bed 2 h earlier than the habitual hour	☐	☐	☐
17. Going to bed immediately after eating	☐	☐	☐
18. Being worried about the impossibility of getting enough sleep	☐	☐	☐
19. Sleeping in a quiet and dark room	☐	☐	☐
20. Recovering lost sleep by sleeping for a long time	☐	☐	☐

Appendix K Summary of tables and figures

Table 1 Results of the social marketing campaign (# of participants (%))

	Poster group	Online group
Baseline	29	185*
1st follow-up	18 (62.1%)	89 (48.1%)
2nd follow-up	15 (51.7%)	75 (40.5%)

*2.7% (n = 5/185) of participants noticed the offline posters before receiving the online email invitation.

Music download*	184	682

Website visitation	Week 1	Week 2	Week 3	Week 4	Week 1	Week 2	Week 3	Week 4
Page loads*	51	12	27	5	93	104	65	56
Unique visits**	35	9	19	3	78	97	60	48
Return visits***	12	4	6	1	7	11	7	6

*total number of page views generated each time the website was loaded or reloaded
**total number of distinct individuals visiting the website
***total number of returning individuals to the website (based on HTTP cookie)

Table 2 Demographic information

Gender	**Female**	**Male**	**Non-binary**
Online group (n=185)	71.9% (n=133)	25.4% (n=47)	2.7% (n=5)
Poster group (n=29)	72.4% (n=21)	20.7% (n=6)	6.9% (n=2)

Program	**Undergraduate**	**Graduate**	**Ph.D**
Online group (n=185)	65.9% (n=122)	25.9% (n=48)	8.1% (n=15)
Poster group (n=29)	82.8% (n=24)	17.2% (n=5)	0

Age	**<25**	**25-30**	**>30**
Online group (n=185)	53.0% (n=98)	30.8% (n=57)	16.2% (n=30)
Poster group (n=29)	75.9% (n=22)	17.2% (n=5)	6.9% (n=2)

Faculty	**Science**	**Arts**	**Health Sciences**	**Education**	**Engineering**	**Business**	**Law**
Online group (n=185)	43.2% (n=80)	15.1% (n=28)	13.0% (n=24)	11.9% (n=22)	11.4% (n=21)	4.3% (n=8)	1.1% (n=2)
Poster group (n=29)	58.6% (n=17)	24.1% (n=7)	0	10.3% (n=3)	0	6.9% (n=2)	0

Table 3 Results of recruitment posters (n=29)

	Most noticed poster seen on campus	**Most attention-grabbing poster seen on campus**	**Poster prompting visitation**
Humour themed	44.8% (n=13)	41.4% (n=12)	44.8% (n=13)
Energy themed	37.9% (n=11)	31.0% (n=9)	34.5% (n=10)
Real-life themed	13.8% (n=4)	24.1% (n=7)	13.8% (n=4)
Word of mouth	3.4% (n=1)	3.4% (n=1)	6.9% (n=2)

Table 4 Participants' reason for visiting the campaign website

	Poster group (n=29)*	**Online group (n=185)****
Curious	75.9% (n=22)	71.9% (n=133)
Needed help with sleep	51.7% (n=15)	58.9% (n=109)
Friend suggested it	6.9% (n=2)	4.9% (n=9)
Other	0	4.9% (n=9)
	*34.5% (n=10) chose two or more responses	**40.6% (n=75) chose two or more responses

Table 5 Pre-SCM intervention music listening results

	Poster group (n=29)		Online group (n=185)
	Music listening frequency		**Music listening frequency**
Occasionally (1-2 nights/week)	41.4% (n=12)	**Occasionally (1-2 nights/week)**	33.0% (n=61)
Never listen to music	37.9% (n=11)	**Never listen to music**	55.7% (n=103
Frequently (>3 nights/week)	20.7% (n=6)	**Frequently (>3 nights/week)**	11.4% (n=11)
	Music listening Routine (n=13)		**Music listening Routine (n=61)**
Listen at bedtime	69.2% (n=9)	**Listen at bedtime**	67.2% (n=41)
Difficulties with sleep onset	15.4% (n=2)	**Difficulties with sleep onset**	19.7% (n=12)
Listen then turn off manually	15.4% (n=2)	**Listen then turn off manually**	13.1% (n=8)

Table 6 Pre-SCM intervention music genre results

	Poster group (n=18)		Online group (n=80)
Classical	38.9% (n=7)	**Classical**	23.8% (n=19)
Nature sounds	16.7% (n=3)	**Nature sounds**	15.0% (n=12)
New age	11.1% (n=2)	**New age**	13.8% (n=11)
Soundtracks	11.1% (n=2)	**Soundtracks**	3.8% (n=3)
Any calming music	11.1% (n=2)	**Any calming music**	7.5% (n=6)
Podcasts	5.6% (n=1)	**Podcasts**	3.8% (n=3)
Jazz/Blues/R&B/Soul	5.6% (n=1)	**Jazz/Blues/R&B/Soul**	6.3% (n=5)
Pop/Rock/Rap/Hip-hop	0	**Pop/Rock/Rap/Hip-hop**	8.8% (n=7)
Country	0	**Country**	2.5% (n=2)
Electronic	0	**Electronic**	12.5% (n=10)
White noise	0	**White noise**	2.5% (n=2)

Table 7 Sleep-conducive music (SCM) use reported by participants

	Poster group		Online group	
	Volume of SCM		Volume of SCM	
	1st Follow-up (n=18)	2nd Follow-up (n=15)	1st Follow-up (n=89)	2nd Follow-up (n=75)
10-30 decibels	72.2% (n=13)	86.7% (n=13)	76.4% (n=68)	81.3% (n=61)
40-50 decibels	27.8% (n=5)	13.3% (n=2)	23.6% (n=21)	17.3% (n=13)
60-70 decibels	0	0	0	1.3% (n=1)
	Frequency of SCM		Frequency of SCM	
	1st Follow-up (n=18)	2nd Follow-up (n=15)	1st Follow-up (n=89)	2nd Follow-up (n=75)
1-4 nights	44.4% (n=8)	53.3% (n=8)	36.0% (n=32)	41.3% (n=31)
5-7 nights	55.6% (n=10)	46.7% (n=7)	64.0% (n=57)	58.7% (n=44)
	Length of time listening		Length of time listening	
	1st Follow-up (n=18)	2nd Follow-up (n=15)	1st Follow-up (n=89)	2nd Follow-up (n=75)
<15 minutes	27.8% (n=5)	26.7% (n=4)	14.6% (n=13)	25.3% (n=19)
15-30 minutes	66.7% (n=12)	60.0% (n=9)	58.4% (n=52)	58.7% (n=44)
>30 minutes	5.6% (n=1)	13.3% (n=2)	27.0% (n=24)	16.0% (n=12)

Table 8 Results of participants' activities during the SCM protocol

	Poster advertisement group		Online advertisement group	
	1st Follow-up (n=18)	**2nd Follow-up (n=15)**	**1st Follow-up (n=89)**	**2nd Follow-up (n=75)**
Lights out in bed, trying to fall asleep	83.3% (n=15)	80.0% (n=12)	78.7% (n=70)	77.3% (n=58)
Lights out, in bed and using electronic devices	11.1% (n=2)	13.3% (n=2)	13.5% (n=12)	13.3% (n=10)
Lights out, in bed and doing non-electronic related activities	0	6.7% (n=1)	4.5% (n=4)	2.7% (n=2)
SCM and doing something other than trying to sleep	5.6% (n=1)	0	3.4% (n=3)	6.7% (n=5)

Table 9 Participant reported barriers to carrying out the SCM protocol

	1st Follow-up (n=107)		2nd Follow-up (n=90)
Nothing prevented SCM	23.4% (n=25)	**Nothing prevented SCM**	16.7% (n=15)
Fell asleep before starting	23.4% (n=25)	**Fell asleep before starting**	23.3% (n=21)
Forgetfulness	18.7% (n=20)	**Forgetfulness**	20.0% (n=18)
Other	15.0% (n=16)	**Other**	10.0% (n=9)
Perceived ineffectiveness	11.2% (n=12)	**Perceived ineffectiveness**	10.0% (n=9)
Time limitation	8.4% (n=9)	**Time limitation**	20.0% (n=18)

Table 10 Rating of the SCM intervention by participants

	Poster group		Online group	
	1st Follow-up (n=18)	**2nd Follow-up (n=15)**	**1st Follow-up (n=89)**	**2nd Follow-up (n=75)**
0 – 2*	55.6% (n=10)	20.0% (n=3)	41.6% (n=37)	32.0% (n=24)
3 – 5**	44.4% (n=8)	80.0% (n=12)	58.4% (n=52)	68.0% (n=51)

* 0 = the SCM was not helpful at all
** 5 = the SCM was extremely helpful

Table 11 Participants' reported motivation for participation in the study

	"Why did you remain in the study" (n=75)
Want to improve sleep	37.3% (n=28)
Curious about the study	18.7% (n=14)
Perceived effectiveness	14.7% (n=11)
Commitment	10.7% (n=8)
Enjoyed the SCM	10.7% (n=8)
Other	8.0% (n=6)

Table 12 Global score of the Pittsburgh Sleep Quality Index (PSQI)*

	Poster group (n=15)**	**Online group*** (n=75)**
Baseline	7.93 ± 2.25	8.80 ± 3.51
1st Follow-up	7.33 ± 2.26	7.95 ± 3.81
2nd Follow-up	7.53 ± 2.33	6.81± 3.18

* The PSQI score ranges from 0 to 21; higher scores indicate worst sleep quality

** Friedman test; compared with the baseline, the 1st follow-up and the 2nd follow up in the offline group; *p=.368*

*** Friedman test; compared with the baseline, the 1st follow-up and the 2nd follow up in the online group; *p<.000*

Table 13 Sleep schedule results from PSQI

	Baseline (n=214)	1st Follow-up (n=107)	2nd Follow-up (n=90)
Perceived sleep schedule			
<0:00 a.m.	55.6% (n=119)	53.3% (n=57)	53.3% (n=48)
0:00-3:00 a.m.	41.6% (n=89)	43.0% (n=46)	44.4% (n=40)
>3:00 a.m.	2.8% (n=6)	3.7% (n=4)	2.2% (n=2)
Perceived hours of sleep			
<4h	3.7% (n=8)	7.5% (n=8)	2.2% (n=2)
4-6h	19.2% (n=41)	15.0% (n=16)	15.6% (n=14)
6-8h	69.2% (n=148)	67.3% (n=72)	72.2% (n=65)
>8h	7.9% (n=17)	10.3% (n=11)	10.0% (n=9)

Table 14 Results of the Epworth Sleepiness Scale (ESS)*

	Poster group**	**Online group*****
Baseline	8.13 ± 4.05	8.72 ± 4.54
1st Follow-up	7.40 ± 4.26	7.64 ± 4.77
2nd Follow-up	7.93 ± 5.50	7.29 ± 4.98

* The ESS score ranges from 0 to 24; higher scores indicate greater excess daytime sleepiness

** Friedman test; compared with the baseline, the 1st follow-up and the 2nd follow up in the offline group; *p=.673*

*** Friedman test; compared with the baseline, the 1st follow-up and the 2nd follow up in the online group; *p=.004*

Table 15 Results of the Sleep Beliefs Scale (SBS)*

	Poster group**	**Online group*****
Baseline	14.07 ± 3.59	13.55 ± 2.98
2nd Follow-up	14.13 ± 3.40	13.93 ± 3.55

* The SBS has a total score of 20; higher scores indicate better sleep beliefs

** Paired samples test; compared with the baseline, the 1st follow-up and the 2nd follow up in the offline group; *p=.900*

*** Paired samples test; compared with the baseline, the 1st follow-up and the 2nd follow up in the online group; *p=.255*

Table 16 Incorrect responses on the SBS

	Poster group		Online group	
	Baseline (n=29)	**2nd Follow-up (n=15)**	**Baseline (n=185)**	**2nd follow-up (n=75)**
Getting up when it is difficult to fall asleep*	82.8% (n=24)	66.7% (n=10)	61.6% (n=114)	58.7% (n=44)
Recovering lost sleep by sleeping for a long time*	65.5% (n=19)	46.7% (n=7)	58.9% (n=109)	57.3% (n=43)
Doing intense physical exercise before going to bed*	55.2% (n=16)	53.3% (n=8)	49.7% (n=92)	53.3% (n=40)
Drinking alcohol in the evening*	48.3% (n=14)	53.3% (n=8)	51.9% (n=96)	41.3% (n=31)
Trying to fall asleep without having a sleep sensation*	51.7% (n=15)	53.3% (n=8)	43.2% (n=80)	42.7% (n=32)
Using sleep medication regularly	44.8% (n=13)	40.0% (n=6)	48.6% (n=90)	37.3% (n=28)
Going to bed 2 h earlier than the habitual hour	48.3% (n=14)	26.7% (n=4)	40.0% (n=74)	41.3% (n=31)
Smoking before falling asleep	31.0% (n=9)	33.3% (n=5)	44.9% (n=83)	41.3% (n=31)
Going to bed 2h later than the habitual hour	41.4% (n=12)	33.3% (n=5)	33.5% (n=62)	37.3% (n=28)
Going to bed with an empty stomach	27.6% (n=8)	26.7% (n=4)	35.1% (n=65)	36.0% (n=27)
Going to bed immediately after eating	20.7% (n=6)	26.7% (n=4)	32.4% (n=60)	37.3% (n=28)
Studying or working intensely until late night	34.5% (n=10)	20.0% (n=3)	31.4% (n=58)	21.3% (n=16)
Thinking about one's engagements for the next day before falling asleep	27.6% (n=8)	26.7% (n=4)	20.0% (n=37)	16.0% (n=12)

Taking a long nap during the day	20.7% (n=6)	13.3% (n=2)	18.9% (n=35)	18.7% (n=14)
Using the bed for eating, calling on the phone, studying, or other non-sleeping activities	13.8% (n=4)	20.0% (n=3)	19.5% (n=36)	20.0% (n=15)
Going to bed and waking up always at the same hour	13.8% (n=4)	26.7% (n=4)	15.7% (n=29)	13.3% (n=10)
Drinking coffee or other substances with caffeine after dinner	10.3% (n=3)	20.0% (n=3)	9.7% (n=18)	9.3% (n=7)
Diverting one's attention and relaxing before bedtime	6.9% (n=2)	6.7% (n=1)	10.3% (n=19)	12.0% (n=9)
Sleeping in a quiet and dark room	3.4% (n=1)	0	5.4% (n=10)	5.3% (n=4)
Being worried about the impossibility of getting enough sleep	0	0	6.5% (n=12)	6.7% (n=5)

* Items with a >40% incorrect rate in both groups

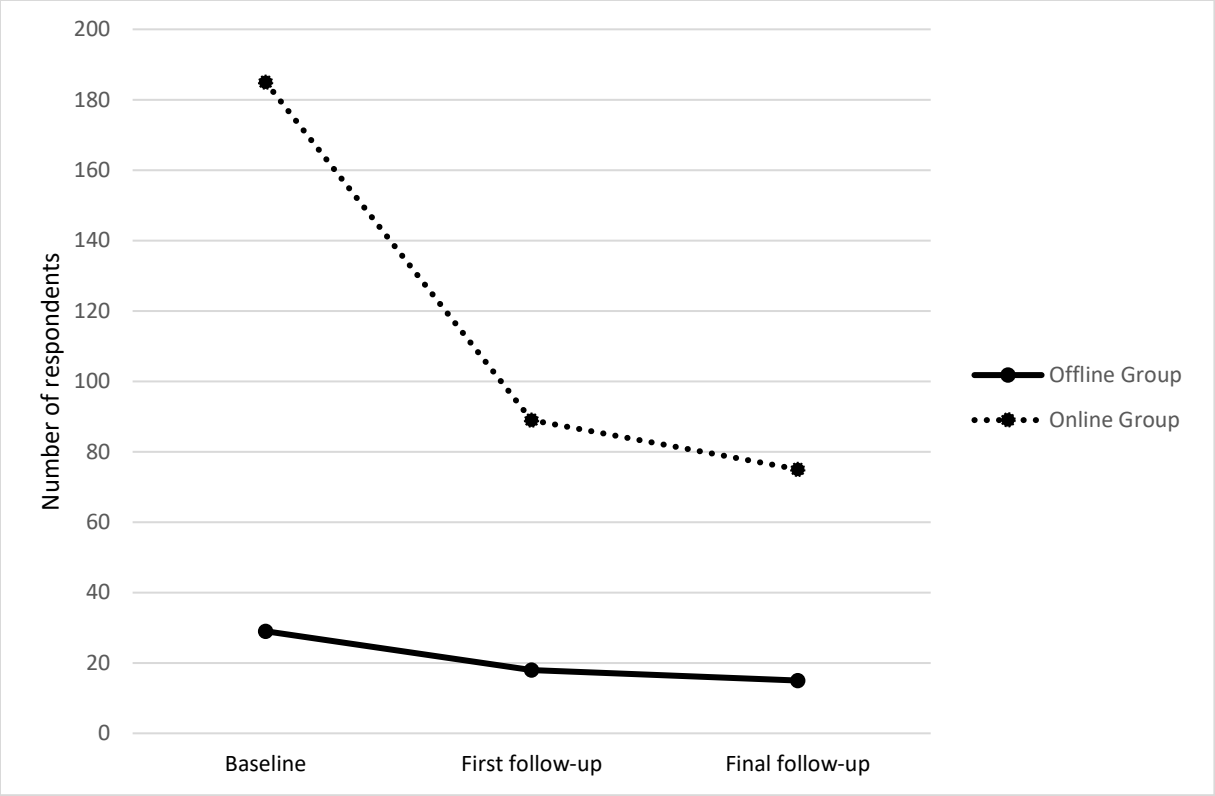

Figure 1 The number of individuals who responded to the SCM advertisements

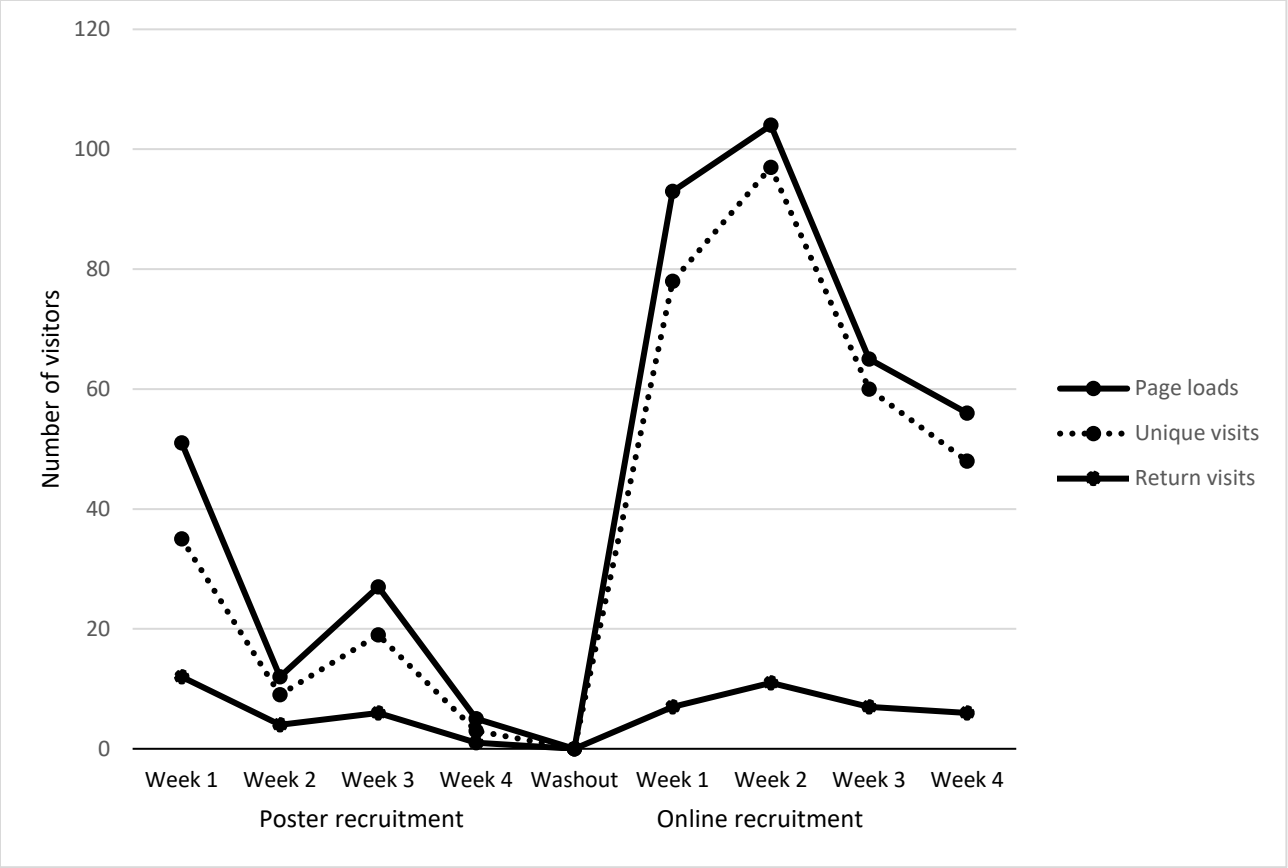

Figure 2 The number of individuals who visited the website

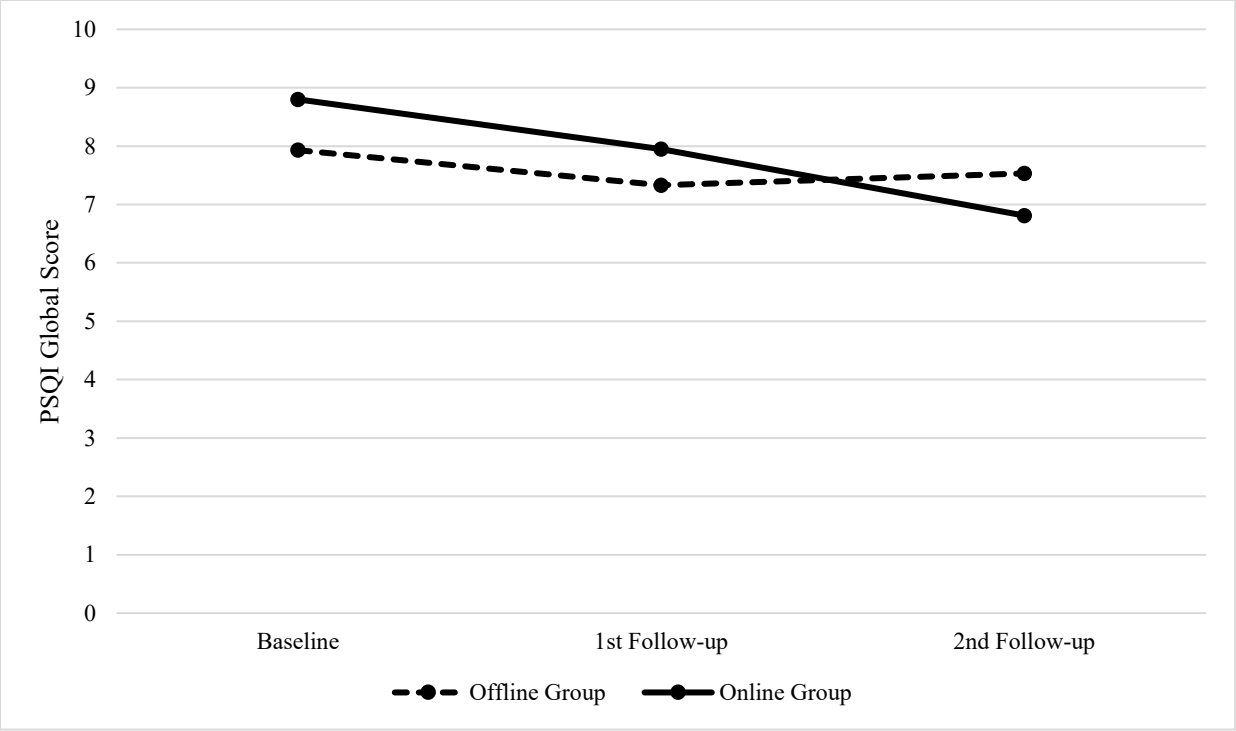

Figure 3 Changes in the PSQI global score

Figure 4 Poster advertisement at the start of the recruitment week

Figure 5 Poster advertisement at the end of the recruitment week