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Screens, School District Employees, and Sleep: Is There a Relationship?

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Screens, School District Employees, and Sleep: Is There a Relationship?

By

Mary Kay L. Bruihler

A Thesis Submitted in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

in

Wellness Coaching and Disease Prevention

Minnesota State University

Mankato, Minnesota

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Screens, School District Employees, and Sleep: Is There a Relationship?

Mary Kay L. Bruihler

This thesis has been examined and approved by the following members of the student's committee.

Dr. Mary Kramer, Chair

Dr. Joseph Visker

Dr. Emily Forsyth

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Screens, School District Employees, and Sleep: Is There a Relationship?

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
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ABSTRACT

Statement of the Problem

Working in a school can be stressful and about half of educators in a national survey reported less than the recommended minimum of seven hours of sleep. Smartphones and other screened devices can cause sleep loss and are becoming more prevalent. Is there a relationship between the use of screened devices and sleep among the employees of a school district?

Procedures

Employees (n=36) of a small southern Minnesota school district were given an online survey regarding their sleep habits utilizing the Pittsburgh Sleep Quality Index (PSQI), their screen time use, utilizing the Screen Time Questionnaire (STQ), and their perception of how screened devices affected their bed time, sleep time and ability to sleep due to what they had seen on the screened device just before bedtime.

Findings

Study respondents slept an average of 6.55 hours per night, with 58.3% of participants sleeping <7 hours per night. Almost 80% of participants were categorized as poor sleepers on the PSQI, and one-third used over the counter or prescriptions sleeping medications once per week or more, more frequent than use of sleeping medications by the general population. Television and smartphone use were reported as the most used devices yet were reported to be of a shorter duration than that of the general population. There was no statistically significant correlation between screen time as measured by the SCQ and sleep scores on PSQI. The use of screened devices affected the time when 30.6% of participants went to bed and when 33.4% of participants went to sleep. Almost 14% reported difficulty going to sleep due to their use of screened devices. Smartphones were indicated as the device that affected bedtime (61.1%) and sleep time (63.9%).

Screens, School District Employees, and Sleep: Is There a Relationship?

Chapter 1

Background

Sleep is a concept with multiple dimensions and is defined as "...a recurring, reversible neuro-behavioral state of relative perceptual disengagement from and unresponsiveness to the environment. Sleep is typically accompanied (in humans) by postural recumbence, behavioral quiescence and closed eyes" (Carskodon & Dement, 2005, as cited in Buysse, 2014, p. 10). Many changes occur in the body during sleep, including brain wave activity and various physiological functions. These functions may be more or less active during the various stages of sleep (Harvard Medical School Division of Sleep Medicine, 2007). According to the National Institute of Neurological Disorders and Stroke (2019), sleep quality, quantity, and timing, are as vital to our well-being as eating and drinking water. Sleep is necessary for concentration, memory creation, and learning; the brain and body remain very active during sleep, doing many tasks that we are not aware of, including cleansing toxins from the brain (National Institute of Neurological Disorders and Stroke [NINDS], 2019) and protecting metabolizable energy (Faust et al., 2019). Sleep is important for almost every part of the body and chronic sleep deprivation increases the potential for many disorders including cardiovascular disease, hypertension, weight issues, diabetes, and depression (NINDS, 2019). Disruptions in sleep may be short-lived or chronic and may include decreased quantity of sleep, or fragmentation of sleep, whereby sleep continuity is disturbed (Van Someren et al., 2015). Sleep disorders and insufficient sleep not only affect health,

wellness and life satisfaction, but also pose a significant financial burden on both an individual and societal level (Faust et al., 2019).

Sleep needs vary by individual and by age; the amount of sleep needed tends to decrease as one grows and ages. The recommendation of sleep for adults is 7-9 hours each night, while sleep quantity tends to shorten and the quality is less deep after the age of 60. The recommendation for those over age 60 is between 7-8 hours of sleep (Hirshkowitz et al., 2015).

A recent National Health Interview Survey found that over the past 20 years the number of people who sleep six hours or less per night has increased from 24% to 30% and includes individuals from a variety of occupations. This change is most likely not related to a change in the body's actual need for sleep, but rather outside factors (National Sleep Foundation [NSF], 2019a). Long work hours and 24-hour access to media, as well as other diversions are leading many people to sleeping less than their bodies require (NINDS, 2019). The lack of adequate sleep leads to a decline in performance, while adequate sleep increases alertness, improves attitude, and the ability to perform well. Understanding exactly how much sleep any individual person needs to perform at their best is difficult to determine as there are several variables to be considered, such as the exact task to be completed, when it needs to be done, and how well it needs to be done (NSF, 2019a).

Sleep can be disrupted and diminished by a multitude of medical conditions, such as cancer, neurologic disorders, pain syndromes, cardiac conditions, and gastrointestinal disorders (Kamath et al., 2015). Medically diagnosed sleep disorders, including such

problems as chronic insomnia, obstructive sleep apnea, periodic limb movement disorder, and narcolepsy can negatively impact the ability to get appropriate sleep (Depner et al., 2014). The National Sleep Foundation (2019c) website includes nocturia, snoring, pregnancy, having a baby in the home, hormone disorders or menopause, caffeine or alcohol use in the evening, gastroesophageal reflux disease, atypical work schedules, and screen time as possible sleep disrupters (NSF, 2019c). Socioeconomic factors, such as economic, safety, and future insecurities were identified as reasons for poor sleep, as was a generally hectic lifestyle and discomfort of the immediate sleep area (Sonnega et al., 2019).

According to the National Sleep Foundation (NSF), less than one half of Americans feel either extremely or very well-rested after sleeping. While over half of Americans report varying their usual bedtime and waking time by over a half an hour at least one time per week, those who do not vary their bed or waking times report feeling well rested 1.5 times more often than those who are less consistent in their sleep habits and report significantly fewer effects physically and in their productivity (NSF, 2019b).

In 2011, the NSF surveyed Americans related to their use of communications technology around and during sleep time. At that time, 72% of 13-18-year-olds and 67% of 19-29-year-olds took their cell phones with them to their bedrooms at bedtime. Of those two groups, 56% and 42% respectively sent and received text messages in the hour before sleep. It was noted that 22% of Americans left their phone ringers on during the night as well, potentially disrupting their sleep by being awakened with calls or text messages after sleep onset. Laptops were used in the hour before bed by 61% of

Americans, with the percentages much higher with those in the 13-29-year-old range. Laptop activities during this time included internet use, social networking, using word processors or spreadsheets, entertainment, or communicating with others. According to the NSF (2011)'s poll, people who used either of these devices in the hour before bed were more frequently waking feeling less refreshed from their sleep, reported more daytime sleepiness, and had an increased likeliness of driving while drowsy than those who did not use these devices (NSF, 2011).

While the NSF's 2011 communications survey was completed nine years ago, even the youngest participants in that survey are now adults and there exists now an even greater number of smart phones and other media devices that are small and lightweight enough to be easily used in bed. According to Pew Research Center (2019), 99% Americans age 18-29 and 30-49 own a cell phone, with 96% and 92% of those respectively being smart phones. The number decreases in the 50-64-year-old range with 95% owning a cell phone and 79% owning a smart phone. Besides mobile phones, various other information devices are owned by many Americans, with nearly 75% of adults in the U.S. owning a desktop or lap top computer and about half owning tablets and about half owning e-reader devices.

Fossum et al. (2014) states that behaviors around sleep time can potentially affect sleep by overriding natural sleep-wake cycles. This study found that the use of laptops while in bed to watch television, movies or other extended programming was positively related to insomnia, while bedtime use of mobile phones can delay the onset of sleep.

Statement of the Problem

Sleep is important to many aspects of health, including physical health, mood, and cognitive functioning, yet about one-third of the American population does not reach the suggested daily seven hours of sleep (Centers for Disease Control and Prevention [CDC], 2018). There are many causes for the sleep disruptions that lead to this lack of adequate sleep, including several different physical, emotional, genetic, and social factors. Exposure to excess light at night or lack of daytime light can have a negative effect on the circadian rhythm (Medic et al., 2017). Christensen et al. (2016) noted that smart phones and other screens are often used in the bedroom and kept close by during sleeping hours and can be associated with disturbed sleep symptoms, such as poor sleep or insomnia. In a study that automatically recorded smartphone screen time via a downloaded app, it was found that smartphone screen time negatively affected sleep, especially if used around bedtime (Christensen et al., 2016).

Sleep loss was shown to negatively impact emotional processing and to have a negative effect on emotional empathy. Generally, delayed sleep phases, caused by later initiation of sleep, were found to be related to the decreases in empathy (Kahn et al., 2013, as cited in Guadagni et al., 2017). Sleep quality was negatively impacted by a habitual use of social networking sites, with a resulting increase in the number of small cognitive errors made at work or in daily activities (Xanidis & Brignell, 2016).

Short sleep duration has been shown to vary by job type, with those who have long hours or job-related stress having an increased prevalence of short sleep. Sleep time was often found to be exchanged for paid work time (Cirelli, 2019). Teaching is among the most stressful jobs in the U.S. and the stress is “causing teacher burnout, lack of

engagement, job dissatisfaction, poor performance, and some of the highest turnover rates ever” (Greenberg et al., 2016). A 2017 survey of teachers reported that 61% found their work to be stressful often or always (American Federation of Teachers, AFL-CIO [AFT] & The Badass Teachers Association [BATs], 2017) The cost to school districts of teacher turnover is approximately \$7 billion per year, and one study in New York City attributed lower achievement scores in the core subjects of math and language arts to the teacher turnover issue. Psychological stress on teachers affects the teacher’s mental health, but carries over to their physical health, with 51 percent reporting poor sleep quality and 46% noted to have excess daytime sleepiness (Greenberg et al., 2016). Sleep duration is also a concern with educators, as reported in The National 2017 Educator Quality of Work Life Survey. In that survey, 48% of educators (teachers, paraprofessionals, other professional staff, and support staff) indicated that they slept less than seven hours per night, with Minnesota educators sleeping an average of 6.7 hours each night (AFT & BATs, 2017).

Teachers are salaried employees and expected to be prepared for their daily classroom duties, which means that they may need to work outside of normal school hours to complete their preparations, especially when they are new to the profession (M. Johnson, personal communication, April 27, 2020). The current body of research does not provide information relating to relationships between sleep quality and quantity in local public-school faculty and staff and their use of screens.

Rationale of the Study

With a third of the United States population not sleeping the recommended length of time on a regular basis, many people are at risk for developing chronic medical

conditions which will have a great impact on their lives. Medical conditions such as type 2 diabetes, heart disease, overweight/obesity, and depression are all affected by sleep. Safety is also a concern, with a higher risk for injury related to accidents (CDC, 2018). Screens including those on smart phones are becoming more prevalent, and the American Psychological Association noted in a 2017 study that ten years after smartphones were developed and social media, text messaging, and email became available on handheld devices, 86% of adults in the United States admit that they regularly check their smartphone accounts. This elevated use of technology has led to increased stress amongst those who engage more frequently with their devices. On a scale of 1-10, those who use their phones to check work email, even when not working, rate their stress as a 6 out of 10, those who are constantly checking, but not work mail rate their stress level as 5.3 out of 10, compared to those who are not frequent checkers, and rate their stress as 4.3 out of 10 (American Psychological Association, 2017).

The use of stimulating interactive technology, such as cell phones, gaming consoles, and laptops has been found to be related to difficulty going to sleep and not finding sleep to be refreshing; conversely passive activities, such as reading or watching television was found to assist with sleep (Gradisar et al., 2013). The use of technology in bedrooms occurs often, frequently in the hour before sleep and is mostly used by those below the age of 30, suggesting that the use of technology is potentially a factor in current sleep disturbances (Gradisar et al., 2013). Exelmans and Van den Bulck (2016) conducted a study of 844 Belgian adults, aged 18-94 years (average age 46.0 years) showing that mobile phones were regularly found at the bedside for adults with about

60% of respondents keeping their phones near them when they were in bed. Using the mobile phone after lights were out had a negative relationship with the quality of sleep and difficulty sleeping, with resulting daytime fatigue symptoms. Most frequently phone use was related to sleep latency (delayed onset of sleep), sleep efficiency (good quality sleep), and sleep disturbances. The authors suggest that there could be an underlying biological cause related to the light emitted from the screens (Exelmans & Van den Bulck, 2016).

Kyriacou describes teacher stress generally falling into one of three main areas including mental, physical, and behavioral characteristics, with sleep problems being considered behavioral. Stress and burnout have negative ramifications for teachers which can adversely affect the teacher's performance as an instructor, their personal learning, and behavior. These factors, including sleep difficulties, can affect student outcomes and have a negative impact on the general climate of the school, with resulting challenges in meeting the school's educational program goals and targets. These problems can also negatively affect budgets because of increased absenteeism and high teacher turnover (Kyriacou, 2011, as cited in Naghieh et al., 2015).

Purpose of the Study

The purpose of this study is to assess the relationship between screen use and the sleep quality and quantity of the faculty and staff of a selected public-school district in southern Minnesota.

Research Questions

1. What is the extent of screen time among the faculty and staff of the selected school district?
2. What are the levels of sleep quality and quantity among the faculty and staff of the selected school district?
3. What is the relationship between screen time and sleep quality and quantity among the faculty and staff of the selected school district?

Delimitations

Delimitations included the selection of the faculty and staff of a small public-school district that was in a location easily accessed by the researcher. The sampling period was three weeks and was a one-time, online, cross-sectional survey. The sample included all the faculty and staff employed by the school district, either in a part- or full-time capacity. Research subjects included faculty (teachers) who have attained at least a bachelor's degree and staff who may have specialized education or may have no education beyond high school graduation.

Assumptions

Assumptions included that the participants would read each question thoroughly and answer the survey questions appropriately, with honesty, and have an accurate recollection of the information requested in the survey.

Definitions

- The phrases **school district employees** or **faculty/staff** each include full- and part-time employees of the selected school district who have a school district issued email address (M. Johnson, personal communication, January 14, 2020).
- **Electronic screen devices** or **screens** are any media devices which may or may not be connected to the internet, including televisions, television-connected devices, mobile/cellular phones with screens, computers, e-readers, tablets, and gaming devices (Vizcaino et al., 2019).
- **Screen time** is time spent actively engaging with an electronic device with a screen-based display as the primary activity. This does not include activities where the use of the screen-based display is a secondary activity, such as having a television on while cleaning or cooking (Vizcaino et al., 2019).
- **Sleep quality** is a measure of how well a person sleeps, and is defined by the NSF as falling asleep within 30 minutes or less, sleeping soundly throughout the night with a maximum of one awakening, and returning to sleep within 20 minutes of awakening in the night (NSF, 2019c).
- **Sleep latency (SL)** is the time between when a person attempts to sleep until the time that they actually fall asleep (Shrivastava et al., 2014) and is also referred to as **sleep onset latency (SOL)** (Exelmans et al., 2018).
- **Shuteye latency (SEL)** is time spent in bed performing activities while not trying to sleep at that time (Exelmans et al., 2018).
- **Sleep efficiency** is the percentage of time is bed when a person is actually sleeping and is based on the total time in bed divided by the total time spent

asleep and multiplied by 100. This percentage does not differentiate between a long sleep latency, time in bed after waking or multiple short periods of wakefulness during the night (Shrivastava et al., 2014).

- **Insomnia** is a common sleep complaint that includes symptoms such as not falling asleep easily, staying asleep throughout the night or waking sooner than desired without being able to return to sleep. These sleep problems are accompanied by problems during the day attributed to lack of sleep. (American Academy of Sleep Medicine [AASM], n.d.).
- **Circadian rhythms** are a part of an internal system that regulates bodily functions and behaviors in a cyclical pattern that repeats itself approximately every 24 hours. Circadian rhythms influence regular patterns of eating and sleeping as well as body temperature and the production of hormones (Muth, 2016).
- **Sleep-wake homeostasis** is an internal sleep drive that maintains the balance between sleep and wakefulness. The drive grows stronger the longer you are awake and causes longer and deeper sleep after a period of being deprived of sleep (NINDS, 2019).
- **Chronotype** describes a person's natural tendency towards earlier or later sleep timing and is related to how the sleep-wake cycles interrelate with the circadian cycle. Chronotype is sometimes described as **morningness** or **eveningness** and can be considered a person's "circadian preference" (Jones et al., 2019).

Chapter 2

Review of Literature

The purpose of this study is to determine if there is a relationship between screen use and the sleep quality and quantity of the faculty and staff of a selected public-school district. This chapter reviews literature regarding the phenomenon of sleep, including the cycles of sleep, how sleep is regulated in the body, sleep patterns, and suggested sleep duration. Recent changes in sleep habits as related to electronic screen devices will be reviewed, as will literature regarding public school faculty and staff stress and sleep habits as well as sleep related to electronic devices with screens.

Sleep

Sleep is a complicated process that is regulated and directed by multiple systems in the body. According to Czeisler (2015), sleep is crucial for the brain, as well as the body, facilitating the clearance of harmful metabolic waste generated by neural activity during waking hours and by supporting brain development, memory creation, learning, and understanding. Sleep also supports the metabolic and endocrine systems. While much is yet unknown about all of sleep's functions, it is evident that its disruption has far-reaching physiological effects on the body, from the subcellular level to complex systems such as affective behavior (Van Someren et al., 2015). The duration of sleep, its timing, and quality each play a significant role in how sleep benefits the day to day functioning of the body, impacting physical health, emotional health, general safety, and the ability to carry out daily tasks (Czeisler, 2015).

Sleep and wakefulness are regulated by eight different areas of the brain including the hypothalamus, suprachiasmatic nucleus (SCN), brain stem, thalamus, pineal gland, basal forebrain, a portion of the midbrain, and the amygdala (NINDS, 2019). Chemicals produced in the brain play a crucial part in the sleep-wake cycle and include GABA, melatonin, and adenosine (NINDS, 2019).

Although the complete purpose of sleep is poorly understood, sleep is observed in all animals in some way. Humans sleep for about one third of their lifetime. While not clearly understood, sleep is understood to be crucial for restoration and revitalization and is potentially controlled by the secretion of growth hormones which peaks during sleep. Sleep is also understood to play an important part in energy conservation and enhancing the removal of neurotoxic waste (Kirsch, 2019). During the period of sleep, the body moves through a series of changes, noted by patterns of brain activity seen on electroencephalography (EEG), muscle tone changes measured by electromyography (EMG), and electro-oculography (EOG) which measures eye movements. Additionally, oxygenation of the blood and respiratory efforts are measured. Obtaining these measurements is generally completed in a sleep laboratory and the testing is called overnight polysomnography (PSG). These measurements reveal the stages of sleep, and type of sleep, such as rapid eye movement (REM) and non-REM (NREM) sleep (Faust et al., 2019).

NREM sleep is categorized into three gradually deepening stages of sleep, with stage N1 reflecting very light sleep, stage N2 representing the largest percent of sleep time and stage 3 being deep sleep and accounting for 10-20% of total sleep time. REM

sleep differs from NREM sleep, with a distinct brain wave pattern, and inactivity of all voluntary muscles except the eyes, the movements of which are the defining characteristic of this phase of sleep, and the diaphragm for breathing. REM sleep accounts for less than 25% of sleep time and is characterized by vivid dreams. The purpose of REM sleep is not clearly understood, but one theory suggests that it helps to consolidate memories (Kirsch, 2019). Usual sleep patterns cycle through the NREM stages in about 90 minutes, followed by 5-30-minute periods of REM sleep (Faust et al., 2019). The number of sleep cycles experienced each night varies with the total amount of sleep time; as sleep time passes, the REM stage lengthens while NREM stages shorten (Kirsch, 2019).

The regulation of sleep is accomplished by the interaction of complicated internal biological mechanisms, specifically, circadian rhythms and sleep-wake homeostasis. Circadian rhythm determines the timing of sleep, generally causing sleepiness at night and wakefulness in the morning, based on an approximately 24-hour day. Circadian rhythms align with cues from the environment, such as light and social activity (NINDS, 2019) as well as with molecular processes within the body that regulate hormonal levels and core body temperature (Jones et al., 2019). Sleep-wake homeostasis oversees the need for sleep, giving signals to the body to sleep after a given amount of awake time with the urge to sleep increasing with the passage of time from the last waking, and regulates the intensity of sleep (NINDS, 2019). Chronotype, sometimes referred to as circadian preference, is a person's natural tendency towards earlier or later sleep timing, and ties together the circadian cycles and sleep homeostasis (Jones et al., 2019).

Circadian rhythms play an important role in the control of daily hormonal and behavioral rhythms that influence the core body temperature, cortisol levels, and melatonin patterns, as well as the timing of the sleep/wake cycle. Feelings of alertness and performance are all influenced by circadian rhythms (Lack & Wright, 2007). For people who follow the usual pattern of sleeping when it is dark, melatonin levels begin to rise about 2 hours before sleep begins and about 7 hours prior to the lowest core body temperature. These levels continue to rise for 2-4 additional hours, and then wane until barely detectable in the morning. Body temperatures fluctuate as well, with peaks in the early evening and the lowest temperature late in the sleep cycle. Strong associations were noted between the decrease of melatonin, temperature minimums, and waking time (Lack & Wright, 2007).

The suprachiasmatic nucleus (SCN), located in the hypothalamus of the brain, is considered the circadian pacemaker and generates the internal sleep/wake pattern of about 24.2 hours. Through the exposure to light, the SCN receives information through the optic nerve regarding the environmental cycle of light and darkness. Information is transmitted from the SCN to the pineal gland which produces and distributes melatonin to the body to signal upcoming sleep. Melatonin is the body's way to distribute information from the brain to the cells throughout the body regarding the daily light/dark cycle (Lack & Wright, 2007). The SCN manages to keep the circadian cycle close to 24 hours, even as the seasons and daylight shift; this process is called entrainment and can adjust, based on light and social activities. It appears that more regular daily patterns can lead to a stronger circadian function (Harvey et al., 2011). According to Van Someren, et al.

(2015), circadian rhythms are not only generated in the SCN, but also in cells throughout the body. These two aspects work together to drive the circadian rhythm in organs, tissues, and cells, including the transcription of over forty percent of protein-coding genes. The effect then of shortened or mistimed sleep can change the usual actions of core clock genes, which could be the basis of why shortened or mistimed sleep affects so many aspects of health (Van Someren et al., 2015).

The other internal sleep regulating mechanism, sleep-wake homeostasis, regulates sleep based on an increasing sleep pressure that builds up from the end of the previous sleep cycle and dissipates during the next sleep cycle. As the time lengthens since the last sleep period, the pressure to sleep increases. Generally, the circadian and sleep-wake homeostasis processes work together to allow wakefulness in the day and sleep at night (Harvey et al., 2011). External factors can also affect sleep/wake needs, such as health conditions, medications, emotions, caffeine intake, and sleep environment. Light, however, remains the strongest factor affecting sleep patterns (NINDS, 2019).

Additionally, chronotype is another influence on sleep, and is the body's natural urge to sleep at certain times during a 24-hour period, generally categorized as morningness or eveningness (Paine et al., 2006). Others have described those who awake early, go to bed early, and generally feel refreshed from sleep as "larks," while those who tend to stay up longer at night and wake in the morning with more difficulty and still feeling tired as "owls" (Cavallera & Giudici, 2008). Chronotypes can vary during a lifetime, and according to Paine et al. (2006), trend more towards morningness with increasing age and daytime work schedule influences. People with later chronotypes get

less sleep on their workdays, and tend to sleep longer on their free days, apparently to make up for sleep debt from diminished sleep on workdays.

The variation in sleep habits on workdays and free days has become a trait identified as social jetlag (SJL). SJL also affects those who identify with a morning chronotype, although their tendencies are opposite, and they tend to develop sleep deficits on weekends (Roenneberg et al., 2013). Roenneberg et al. (2013)'s study indicates that chronotype and sleep duration are not the same. They report that little is known about the underlying variability in both traits and suggest that animal experiments show genetic traits as well as developmental level, gender, and exposure to light influences these characteristics. Jones et al. (2019) have found genetic variants that suggest that differences in chronotype could be related to biochemical feedback loops of the circadian system and that genetic variants that could also influence external light signals. Other gene variants point to other additional processes that could influence an individual's chronotype. Ronnenberg et al. (2013) note that with industrialization and city dwelling, exposure to natural light has diminished, and a self-controlled light environment replaces that of the natural light cycle. The use of alarm clocks has become necessary as the chronotype of many city dwellers is too late for natural arousal to comply with the usual work time. For those who have a tendency towards an evening chronotype, working early in the day has the same effect as evening shiftwork has on work performance, health, and general wellbeing of those who have a morning chronotype (Roenneberg et al., 2013).

Walch et al. (2016) developed a smartphone application, ENTRAIN, through which data were collected from users around the world. It was found that differences in

sleep timing was more often due to differences in bedtimes, suggesting usual patterns for sleep are altered due to societal causes. Because waking times do not change, this delayed bedtime cuts sleep duration. Questions remain as to whether the cause of the later bedtime is due to changes in exposure to light sources or social demand to stay awake longer.

Sleep Patterns

Sleep consists of two important aspects including quality and quantity. Quantity reflects the duration or number of hours asleep, while quality reflects the depth of sleep. The failure to obtain sleep of either the appropriate quantity or quality negatively affects daytime alertness and the ability to perform normal functions appropriately (Cirelli, 2019). Historically, quantity, or duration of sleep has been the factor used to determine appropriate amount of sleep. More recently, sleep quality has been found to be more indicative of future physical and mental health, especially related to diabetes, hypertension, depression and anxiety (Bin, 2016).

Hirshkowitz et al. (2015) completed a study for the NSF and determined recommendations for the duration of sleep time. Sleep recommendations were given for nine different age categories and were based on cognitive, physical, emotional, and overall health. Suggested sleep duration for young adults (age 18-25) and adults (age 26-64) is 7-9 hours of sleep per night, with older adults age 65 or over, recommended to sleep 7-8 hours per night. It may be appropriate to increase or decrease this amount by 1 to 2 hours, but deviation beyond that amount is not recommended.

According to Liu et.al. (2016), data from the 2014 Behavioral Risk Factor Surveillance System (BRFSS) showed that 65.2% of respondents from the 50 states and the District of Columbia reported having a sleep duration of more than seven hours per 24-hour period, the level considered healthy. Those age 65 or older and those living in the Great Plains states were the most likely to have met the seven-hour guidelines, while minority populations, those living in the southeastern United States and near the Appalachian Mountains, not employed, not married, and not having a college degree having a lower prevalence of meeting the seven hour guideline for sleep (Liu et al., 2016).

There is a common perception that total sleep time has decreased over the years, yet a review of literature from 1960-2013 measuring objective sleep duration of healthy, normal-sleeping adults does not support this assumption. Studies analyzed in this review were required to measure sleep time by polysomnography (PSG) or actigraphy, rather than self-reporting. A limitation of the study was that customary sleep habits may have been changed by the constraints of the PSG being completed in a sleep laboratory, although alterations were not noted when using actigraphy at home (Youngstedt et al., 2016).

While sleep quantity (duration) is important, so is sleep quality. Factors that affect sleep quality include difficulty falling asleep, waking from sleep during the night and waking up before the desired time in the morning, which together with daytime sleepiness is considered to be insomnia (Cirelli, 2019). Insomnia is almost always associated with factors such as medical or mental health concerns, stress, other sleep

disorders, medications, substance use/abuse, environmental factors and lifestyle or habits (American Academy of Sleep Medicine [AASM], n.d.). Arousals during the night can lead to daytime sleepiness, even if the arousals are unnoticed because they are very brief or caused by a noise that does not lead to awakening (Cirelli, 2019).

Societal Impacts on Sleep Patterns

While circadian rhythms are generally tied to natural light cycles, the use of electricity and indoor lighting means that sleep is no longer based on daylight hours. Human exposure to indoor artificial light has been increasing over time, affecting the circadian pacemaker. The effects of exposure to light is immediate but can also last beyond the actual exposure to the light source. Humans have been found to have a high sensitivity toward light at the short wavelength range of 446-483 nm, considered blue light (Chellappa et al., 2013). Chellappa et al. (2013) report that the initial sleep phase may be affected by polychromatic light and monochromatic blue light (446-483 nm) with a reduction in slow wave activity during this NREM sleep phase.

Few American adults, about 10%, prioritize sleep over other activities even though about two thirds feel that sleep improves effectiveness in completing tasks the following day. Only 20% of Americans often plan for getting the sleep they need, another 20% plan somewhat often, leaving 60% of Americans not planning to go to sleep at a time that allows for adequate sleep (NSF, 2018b).

Long work hours, 24-hour access to media, as well as other diversions are leading to many people sleeping less than their bodies require (NINDS, 2019). In an analysis of trends in sleep duration of Americans, data were taken from the National Health

Interview Survey for the years of 1985, 1990, and 2004-2012. People were asked about the amount of sleep they got in a 24-hour period. While 22.0% of those surveyed in 1985 reported sleeping less than or equal to 6 hours, the number had significantly increased to 29.2% in 2012, while those sleeping 7-8 hours in 2012 was 62.3% which, after an age adjustment was significantly less than the 65.9% in 1985. These findings did not change much between the years of 2004-2012, however. Since the recommendation by the National Institute of Health advise 7-8 hours of sleep per night for adults, it is important to continue to decrease the number of people not sleeping enough hours (Ford et al., 2015).

Effects of Poor Sleep

According to a 2015 Consensus statement from the American Academy of Sleep Medicine (AASM) and Sleep Research Society (SRS), it is recommended that for optimal health, adults aged 18-60 should regularly sleep seven or more hours per night. Sleeping less than the recommended seven hours per night is related to several adverse health conditions, like cardiovascular diseases, mental health conditions, decreased immune functions, pain, metabolic diseases, weight gain, impaired ability to perform tasks, and an increased risk of accidental injury (Watson et al., 2015). These recommendations from the AASM and SRS Consensus statement were based solely on the parameter of sleep duration, while acknowledging that sleep quality, timing, regularity, and the lack of sleep disorders also play an important role in optimal sleep (Watson et al., 2015).

Effects of Poor Sleep on Mental Health

Poor sleep, which can include increased latency of sleep onset, decreased total sleep time or perceived sleep quality is known to have a negative effect on mood and is

related to depression. The interaction between poor mood and poor sleep can create a downward cyclical effect such that poor mood can cause poor sleep quality which can lead to mood disturbances (Kalmbach et al., 2014). According to Van Someren et al. (2015), most research on sleep deprivation has focused on short term sleep deprivation, with less focus on chronic sleep disruption, although chronic sleep disruption is more common in everyday life and has far-reaching consequences for those affected.

Effects of Poor Sleep on Physical Health

Kamath et al. (2015) report that problems that lead to decreased sleep, such as lack of good sleep schedules, obstructive sleep apnea, insomnias, and overnight work schedules, can all contribute to cardiovascular and metabolic diseases. Kamath et al. (2015) also state that there is a multidirectional relationship between sleep disturbances, obstructive sleep apnea, and obesity with various medical conditions such that lack of adequate sleep can lead to or cause worsening of the medical conditions, while those same medical conditions can affect the ability to obtain appropriate sleep.

Depner et al. (2014) concur that there are complex relationships between circadian misalignment, sleep deficiency, sleep disorders, obesity, inflammation, and type 2 diabetes. Sleep disorders (sleep apnea, insomnia, narcolepsy), work schedules (shift work, shift work disorders), and shortened sleep times lead to inadequate amounts of sleep which are suspected to play a part in metabolic diseases while obstructive sleep apnea, obesity, and type 2 diabetes can negatively impact sleep.

McMahon et al. (2019) completed a study of young adults over a two-year period measuring sleep disturbances, obesity, and arterial hypertension. They found that modest

association between disruptions in sleep, high blood pressure and obesity. Theorell-Haglöw and Lindberg (2016) conducted a review of cross-sectional, longitudinal, and interventional studies related to hours slept per night and obesity in the adult population, finding a strong relationship between the hours slept and obesity. The direction and nature of the association between these factors, however, was not fully understood, and the authors noted that “it is still too early and too easy solution to suggest that changing the sleep duration will cure the obesity epidemic” (Theorell-Haglöw & Lindberg, 2016, p. 341). According to Czeisler (2015), long term exposure to disrupted sleep such as night shift work increases the risk of various types of cancer including breast, endometrial, colorectal, and prostate cancer, such that the World Health Organization “classifies night shift work as a probable carcinogen” (Czeisler, 2015, p. 5).

Effects of Poor Sleep on Performance and Safety

The lack of adequate sleep is known to make people feel sleepy and leads to decline in performance, while adequate sleep increases alertness, improves attitude, and the ability to perform well (NSF, 2019a). Performance ability is critical when driving, and the lack of adequate sleep contributes directly to safety risks. A drowsy driver may momentarily fall asleep and lose control of their vehicle, causing a crash. Drowsiness also reduces cognitive abilities and behaviors needed for safe driving, with poor decision making and lapses in judgement (Higgins et al., 2017). According to 2017 records from the United States Department of Transportation, drowsy driving accounted for an estimated 91,000 reported crashes nation-wide, with around 50,000 injuries and almost 800 deaths (National Highway Traffic Safety Administration [NHTSA], n.d.). The actual

number of crashes related to drowsy driving may be much higher than reported due to the difficulty in determining whether a crash was caused by drowsiness, and the lack of documentation by authorities even when the cause is known (Higgins et al., 2017) .

Effects of Poor Sleep on High Risk Behaviors

Clark et al., (2015) report a decreased likelihood of smoking cessation and an increased likelihood for high-risk drinking of alcoholic beverages after people began in a pattern of short sleep of less than 6.5 hours per sleep period, while those with other sleep disturbances had higher risk for all the health-related behaviors including high-risk alcohol consumption, lower probability of smoking cessation, becoming overweight or obese, and physical inactivity (which had the strongest association), when compared to those who consistently slept normally (Clark et al., 2015).

Treatments for Poor Sleep

While insomnia may occur as a result of various health conditions, it is now understood that insomnia may occur on its own. When treatment for underlying conditions does not resolve the insomnia, behavioral treatments or medications may be options. Behavioral options include therapies such as relaxation, sleep restriction therapy, cognitive behavioral therapy, and cognitive behavioral therapy for insomnia. Another choice for the treatment of insomnia is sleep medication. There are a variety of classes of sleep medications available, and the effectiveness, risk of side effects, and potential for physical and psychological addiction, must be weighed against the potential benefits of improved sleep quality and daytime functioning. Often a combination of therapies is prescribed to help improve symptoms (Bonnet & Arand, 2020).

The overall negative effect of chronic sleep insufficiency caused by either short sleep duration or poor sleep quality has been shown to be related to physical and mental health concerns, accidents, and a diminished quality of life (Cirelli, 2019), as well as a decreased ability to avoid risky behaviors (Clark et al., 2015). With these potential risks to physical and emotional health, as well of quality of life in general, it is important to look at potential causes of diminished sleep, one of which could be the use of electronic screen devices.

Patterns of Screen Time

The use of electronic screen devices is a potential cause of sleep problems, and more Americans are using these devices regularly. According to the Pew Research Center's 2019 Mobile Fact Sheet, 96% of Americans own a cellphone of any kind, and 81% own a smartphone, compared to only 35% in 2011. While over 90% of those aged 18-49 own a smart phone, nearly 80% of those between 50-64 own smartphones as well. Other electronic information devices are frequently owned by U.S. adults including 75% owning a computer, half own a tablet computer, and about one-half own e-reader devices (Pew Research Center, 2019). While in 2011, about half of all Americans used at least one social media platform, that number has grown to 72% today (Pew Research Center, 2019). In July 2019, PRC reported that 28% of American adults state that they are now online "almost constantly", a level that has risen from 21% in 2015, while 81% use a mobile device at least daily. Just 10% of adults reported not using the internet at all (Perrin & Kumar, 2019). With over 80% of all working age adults owning smartphones

and using them at least daily, it is important to consider how these devices impact the sleep practices of American adults.

Screen Time and Sleep

Considering the increasing use of electronic devices, Fossum et al. (2014) state that behaviors around sleep time can potentially affect sleep and assessed for the effects of in-bed use of television, computer, cell phone, game devices, tablets or audio players. The findings showed that extended viewing, such as of movies or television programs had a positive relationship with symptoms of insomnia, as well as active mobile phone use in bed being related to a later chronotype. It is noted that the relationship could be bidirectional, in that those having a naturally late chronotype have a natural preference for staying awake longer.

SEL or the time between going to bed and purposefully attempting to sleep, was considered as a factor in symptoms related to sleep difficulties, including sleep onset latency, sleep quality, and weariness, as well as whether the actual activity engaged in during the SEL period had any effect on the insomnia symptoms. It was found that longer SEL was related to higher insomnia scores. Fatigue was more strongly associated in those with an eveningness (owl) chronotype preference and longer SEL. With increasing age, it was noted that there was stronger relationship between SEL, sleep onset latency, and sleep quality. For all ages, more interactive screen use was related to a decline in sleep quality, while more passive use was associated with a more extended sleep onset latency (Exelmans & Van den Bulck, 2016).

Christensen et al. (2016) utilized a smartphone app which ran constantly in the background of participant's phones to objectively measure screen time. The app showed a decreased duration of sleep when there was a longer average screen use. Longer sleep-onset latency and decreased sleep efficiency were associated with smartphone use occurring near or after self-reported bedtime (Christensen et al., 2016). In another study, Vallance et al. (2015), noted that those adults who acknowledged the highest amount of screen time, were more likely to discuss sleep concerns with their doctors, and especially noted difficulty with sleep latency as well as difficulties with waking and returning to sleep during the night. Lin et al. (2018) developed an algorithm based on smart phone behaviors to identify smart phone use during the day and prior to going to sleep, removing the inaccuracy of self-reporting smart phone use before bedtime. It was found that smartphone screen time throughout the day, as well as prior to sleep, delayed the circadian rhythm and led to a reduction in total sleep time. The algorithm was developed into an Android phone app, allowing for collection of more objective sleep data without recall bias. Users of the app were able to permit researchers to gain access to their data, which allowed the researchers to obtain longitudinal data for further circadian rhythm research (Lin et al., 2019).

Impact of Screen Time on Health and Wellness

A recent study in the United Kingdom attempted to determine if the association between the use of television and/or computer screen time (not associated with work), heart disease and all-cause mortality were different based on activity level, hand strength, and general fitness. The results concluded that the association with leisure time screen

activity and poor health outcomes were related to overall physical health (Celis-Morales et al., 2018).

Green et al. (2018) found that the duration of exposure to digital media devices, with screens, in the evening or at night was associated with difficulty concentrating as well as attention difficulties the following morning. An association between smartphone use around bedtime and increased difficulty falling asleep at night was noted. In fact, Xanidis and Brignell (2016) found that an increased reliance on social network sites is associated with a reported reduction in sleep quality and increase in minor cognitive mistakes during the day.

Sleep and Faculty/Staff of Schools

According to Amschler and McKenzie (2010), research on sleep behaviors and school employees is quite limited. The authors examined the sleep habits and struggles of schoolteachers, administrators, and other professional personnel of a rural school corporation in Indiana. When the teachers were compared to the other staff, they were found to have statistically significant poorer scores for both sleep quality and quantity. When compared by gender, the females had statistically significantly poorer scores than males. Nearly one third of the teachers and administrators met the criteria of the Epworth Sleepiness Scale for excessive daytime sleepiness and 43% of the teachers slept six hours per night or less. A qualitative aspect of the Amschler and McKenzie (2010) study allowed respondents to make comments with 46.8% of participants providing a response. A sampling of these concerns listed issues such as:

- “always work to do”

- “I think my job impacts my sleep. Teachers never stop thinking!”
- “I have a hard time falling asleep because I worry about things that happened during the day or what is going on the next day”
- “I’m not as sharp as I should be to be able to perform my job.”

The study results were compared to results of a study of the general population by Hays, et al. (2005), which left the school employees having lower scores than the general population in scales for snoring, sleepiness, adequate sleep, and Sleep Problems Index II (Hays, et al., 2005, as cited in Amschler & McKenzie, 2010). Special concerns noted by the authors, based on the sleepiness of teachers included the possibility of insufficient supervision of children, mood swings in tired teachers, and teaching incorrect materials. Additionally, there are costs to a school district for covering teachers who are out of school due to fatigue (Amschler & McKenzie, 2010).

Similar findings were reported in a 2012 study of 98 high school teachers in Brazil by De Souza et al., where researchers found that bed and waking times varied between weekend and weekdays, with 42 minutes less in bed per day on weekdays, compared to the weekend. Weeknight bedtimes were affected by work responsibilities, computer use, household tasks, and feeling sleepy. Many of the teachers napped most days. During the week, 60% of the teachers relied on alarm clocks to wake up, however 86% woke up without an alarm on the weekends. The average time in bed on weeknights was 6.7 hours, which was less than the 7.5 hours spent in bed by the mean of the Brazilian adult population in 2007. As stated in the article, this difference between

teachers and the general population was similar to differences seen in the 2008 NSF survey of American workers.

Symptoms of excessive daytime sleepiness was noted in 46% of the teachers, which led to napping in 73% of the teachers. De Souza et al. (2012) suggested that there was a possibility that the poor sleep quality and excessive sleepiness together with excessive workload, typical to the profession, might diminish the general health and quality of life for the teachers, although this was not measured in the study. The concern exists that these characteristics could affect the ability to carry out teaching tasks and affect student education (De Souza et al., 2012).

Teachers are often seen as role models for their students, and one study hypothesized that teachers would have more healthy behaviors than other non-teaching workers with similar socioeconomic and demographic backgrounds. Teachers were found to be less likely than those in the alternate occupations to smoke tobacco or cannabis, gamble regularly or be overweight or obese, however, there were no significant differences noted in teachers and non-teachers in alcohol use or sleep duration. It was thought that these two factors would not be as visible to students as the others, thus less relevant to the role model theory. It was thought that sleep might also be affected by the additional factors of job-related stressors or the need to work longer hours to complete all necessary job-related tasks (Gilbert et al., 2015).

Working in a school comes with many responsibilities to students, families, school administration and the community, all of which can be stressful. Teachers struggle with large class sizes and they also identify required testing, excessive paperwork, state

and local mandates on curriculum and a lack of influence on professional development and budget decisions as challenges. In a 2015 survey of more than 30,000 educators, 30% of respondents had faced bullying and 18% reported threats of violence against them within the past 12 months (AFT & BATs, 2017). A survey of 830 members of the American Federation of Teachers (AFT), was conducted in 2017, and researchers found that educators rated their work as stressful either “always” or “often” 61% of the time, compared to that of workers in the general population(who rate their work as “always” or “often” stressful about 30% of the time. In another section of the 2017 survey, open to all educators, it was found that 21% of educators stated that their mental health was not good for at least 11 days of the previous 30. This was compared to a 2014 National Institute for Occupational Safety and Health (NIOSH) national Quality of Work Life survey, showing that U.S. workers in general indicated their mental health was not good for 11 or more days 10% of the time. School faculty and staff reported working more than 50 hours per week on average and working longer than their scheduled hours 13-14 day per month, or more than half of their scheduled days. This survey also reported that 48% of educators slept less than the recommended 7-9 hours per night (AFT & BATs, 2017).

While school districts employees have jobs that are stressful and challenging in normal times, they also must be prepared and able to react quickly to unusual circumstances. At the time this survey was available to the school district employees, the state of Minnesota was learning of the implications of a global pandemic from the novel coronavirus, COVID19. Due to concerns about transmission within schools or any large

groups of people, there was a state-wide school closure. In the past, school closures have been suggested as a means of disease mitigation, such as in the case of influenza pandemics. In considering potential closures, Cauchemez et al. (2009) discussed that these closures may result from deliberated policy decisions or from high absenteeism rates for either students or staff. They advised of the importance of making plans to decrease the negative impacts on students, families, the health care system, and the community. The article did not mention the additional stress on educators, learning to manage a new way of teaching.

The current COVID 19 pandemic required most teachers to change the way they worked dramatically, in a very short period, and with little to no preparation. Teachers needed to improvise their teaching skills, learn to use unfamiliar technologies and determine how to reach each of their students, all from the isolation of their homes. The job of teaching remains exhausting for teachers as they work to remain connected to their students, providing not only educational content, but also emotional support and connection as well, perhaps for the rest of the school year (Turner et al., 2020).

Conclusion

Teachers are stressed mentally and physically and have difficulties with sleep (Naghieh et al., 2015). They have been shown to have lower sleep quality scores than non-teaching staff in the same school system (Amschler & McKenzie, 2010), and almost half of teachers have a shorter sleep duration than recommended (AFT & BATs, 2017). While no research was located about electronic screen devices, teachers and sleep, the use of screens, especially around bedtime, has been shown to negatively affect sleep

(Christensen et al., 2016). Because there is very little known about the sleep habits of school personnel and school personnel state that they have concerns about how their lack of sleep affects their ability to do their job, there is a need to focus attention on the sleep habits of school personnel (Amschler & McKenzie, 2010), including their use of screens, especially due to prevalence of ownership of smart phones and computers among all American adults (PRC, 2019).

Chapter 3

The purpose of this study was to determine if there is a relationship between screen use and the sleep quality and quantity of the faculty and staff of a selected public-school district in southern Minnesota.

Research Questions

1. What is the extent of screen time among the faculty and staff of the selected school district?
2. What are the levels of sleep quantity and quality among the faculty and staff of the selected school district?
3. What is the relationship between screen time and sleep quantity and quality among the faculty and staff of the selected school district?

Research Design

A descriptive, cross-sectional, and correlational research design was used for this study. This design was used to allow a one-time collection of information regarding the relationship between the variables of screen use, sleep quality, and sleep quantity at the time that the survey was administered. In general, this type of study design involves the collection of information regarding the variable(s) of interest in a specific population at one particular time (Aggarwal & Ranganathan, 2019). A correlational analysis was used to assess the degree of association between the variables in this study (Aggarwal & Ranganathan, 2016). This was a useful design for this study, due to the limited time frame for data collection and evaluation of the results, as well as the limited budget for

the study. A survey was utilized to collect descriptive information regarding the amount of time participants used screens at various times, sleep quality, sleep quantity, the relationship of screens and sleep, whether participants believe that the use of screens affect their sleep time, and to gather general demographic data.

Sample Selection and Data Collection Procedures

The population for this study included all eligible faculty and staff of an Independent School District (ISD) in southern Minnesota and was a convenience sample based on the accessibility and proximity of the population to the researcher. This population was chosen due to the limited time frame for data collection and evaluation of results, as well as budget limitations. The population included 117 faculty and staff members, identified through their listing on the school district web site and having a school district issued email address. There were 81 employees of this total who were identified as faculty members (licensed teachers) and educational administrative staff in the staff directory, with the remaining 36 employees (staff) filling various non-licensed roles such as paraprofessionals, custodians, administrative assistants, non-educational administrators, and support staff. The school district included a combined high school/middle school and two elementary schools, one each in two small communities. Permission was obtained from the superintendent of schools to survey all these employees and the superintendent agreed to send the survey to the employees. The surveys were emailed to the employees on February 28, 2020 and were available for 3 weeks, ending on March 20, 2020. IRB approval was obtained from Minnesota State University, Mankato, MN prior to the distribution of the survey (See Appendix A).

Instrumentation

The survey utilized for this study was internet based and distributed using Qualtrics® software, a web-based platform. The survey was comprised of 4 scales. The first scale assessed sleep quality and quantity utilizing the Pittsburgh Sleep Quality Index (Buysse et al., 1989) while the Screen-Time Questionnaire (Vizcaino et al., 2019) was used to determine the amount of time participants spent using various types of screens. The third section was comprised of questions developed by the researcher, regarding screen use around bedtime, and the final section collected demographic information, adapted from the United States Census Bureau (2017) and the National Institutes of Health (2015). Public use without individual permission was allowed for both instruments used to develop the questionnaire (See Appendix B).

Pittsburg Sleep Quality Index

The Pittsburgh Sleep Quality Index (PSQI) is a self-administered questionnaire designed to subjectively assess sleep quality and disturbances over a one-month time period (Buysse et al., 1989). The PSQI includes four fill-in-the blank questions regarding sleep habits and five additional Likert-style questions with a variety of 4-point scales. One question includes a series of 10 sub-questions which also follow the 4-point Likert-style question format. The final question on the PSQI was not used in this survey as it requested the opinion of a bed partner or roommate, who would not be available to the participants when taking this survey. This question was not a part of the scoring system, and thus deleting it from this survey had no impact on the outcome of this research survey. According to the authors of this survey,

The Pittsburgh Sleep Quality Index was developed with several goals: (1) to provide a reliable, valid, and standardized measure of sleep quality; (2) to discriminate between “good” and “poor” sleepers; (3) to provide an index that is easy for subjects to use and for clinicians and researchers to interpret; and (4) to provide a brief, clinically useful assessment of a variety of sleep disturbances that might affect sleep quality. (Buysse et al., 1989, p. 194)

The PSQI measures seven components of sleep including subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. The PSQI includes a scoring tool and scoring instructions, which are necessary for the correct scoring and interpretation of the index. Each component of the scale receives a score of 0-3, with a “0” indicating no difficulty and a “3” indicating severe difficulty. A composite score then ranges from 0-21, with lower scores indicating lesser difficulty with sleep. A composite score greater than five indicates that the individual is a “poor” sleeper, while a score of five or less indicates a “good sleeper” (Mollayeva et al., 2016).

In a meta-analysis of the PSQI, Mollayeva et al. (2016), found 1512 articles containing the words “Pittsburgh Sleep Quality Index” in 2014, with 323 of those articles published in 2013, indicating that although the PSQI is 30 years old, it is still commonly used and was the most commonly found sleep assessment in the PubMed search. The intended result of this meta-analysis was to provide information as to whether the PSQI has the ability to adequately describe sleep concerns for all people in non-clinical and

clinical settings. The meta-analysis found that the PSQI was the only standardized instrument to include a wide range of factors pertinent to sleep quality and found “strong positive evidence for reliability and validity (hypothesis testing), and moderate positive evidence for structural validity testing in a variety of non-clinical and clinical samples” (Mollayeva et al., 2016, p. 70).

Screen-Time Questionnaire

The Screen-time Questionnaire (STQ) was created to “quantify different forms of screen time use among American adults” (Vizcaino et al., 2019, p. 2). The STQ is an 18-item online questionnaire created to measure the self-reported use of commonly utilized screen-based devices and was developed to create a tool to accurately measure screen time in the context of health outcomes. The questionnaire accounts for all current types of screened devices and places these devices into five different categories, including television, television-connected devices, such as streaming devices, and video games, laptop or desktop computers, tablets, and smartphones. According to the Nielson Local Watch Report (2019), 65% of homes currently have access to an internet-connected or smart TV and 56% of U.S. adults used an internet connected device or smart TV to stream videos on their television, a nearly 30% increase in two years (Nielsen, 2019). The authors state that it is important to recognize a difference between television and devices connected to televisions based on the current number as well as recent growth trend of adults using subscription and on-demand content viewed on television rather than traditional television programming. The on-demand content was categorized together

with game consoles and multimedia devices as these all reflect content that is not time-bound, as is regularly scheduled television programming (Vizcaino et al., 2019).

The purpose of the Vizcaino et al (2019) study was not only to develop a new screen time questionnaire that quantified the use of multiple screen-based devices, but to assess its reliability as well. With 80 participants having completed all aspects of the study, relative reliability was assessed using intra-class correlation coefficients (ICCs). Relative reliability was found to be good to excellent for items relating to television, laptop/desktop computers, smartphones, tablet use during weekday (ICCs=0.61-0.90), screen use during a weeknight had a fair to excellent reliability (ICCs=0.50-0.82) and weekend days showed excellent reliability (ICC's=0.84-0.87), although smartphone use had poor reliability (ICCs=0.16) (Vizcaino et al., 2019). It was noted that for absolute reliability, standard error of measurement (SEM) results were large for all screen types across the various time periods studied, although the SEM was less among items related to television, laptop/computer, smartphone, and tablet used on a weeknight. Television-connected devices and laptop/computer use on weekdays and weeknights had the smallest measurement error, while weekday smartphone use had the largest SEM.

Screen use time is requested in hours and minutes on the survey and quantified in minutes for statistical reporting. Due to variations in screen time use, the survey authors created separate categories for an average weekday, an average weeknight, and an average weekend day and asked participants to indicate the time they used screens in the background of a primary activity. Day hours were defined as the time from when participants woke up until they went to sleep while night hours included the time from

returning home from work until they went to sleep on both workdays and non-workdays (Vizcaino et al., 2019). For the purposes of this study, the researcher chose to make the following changes to accommodate those with a varying work schedule: the categories were called workdays, work nights, non-workdays, and non-work nights. Non-work nights (defined in the survey “as when you would normally return from work until you go to sleep”) was added as an additional category since the research was looking at relationships between screen time and sleep. This researcher also removed the questions regarding screen use as a background activity from the STQ as the instructions for the previously mentioned questions stated that the participant consider only the screen time that could be considered as the main activity at the time. This removed unnecessary questions to reduce the length of the survey.

Additional Instrument Questions

For the purpose of this research study, three additional questions were added to the combined STQ and PSQI questionnaire. These questions were related to the use of screen devices around bedtime. The additional questions were: 1. Does the use of any screen device cause you to go to bed at a time later than you intended? 2. Does the use of any screen device cause you to go to sleep at a time later than you intended? 3. Does the use of any screen device immediately before sleep cause you to have problems falling asleep? These questions were provided Likert-style responses with four choices, following the design of the PSQI, with response options being “not during the past month,” “less than once a week,” “once or twice a week” or “three or more times per

week.” Each question was followed by the option to indicate which screen device(s), if any, caused the answer to the question. The choices included television, TV-connected devices, laptop/computer, smartphone, tablet, and any other device with a screen.

Demographic Questions

Additionally, demographic data was gathered, including age, sex, ethnicity, race (U. S. Census Bureau, U.S. Department of Commerce, 2017), number of years working as a teacher or number of years working as an employee of any school district.

Procedures

To conduct the study, the school superintendent sent an introductory email to the participants via their official work email account within the week prior to the survey start date to introduce the survey, requesting participants watch for the survey and complete soon after it’s receipt. The informed consent form and a link to the Qualtrics® survey were then emailed to the participants on the selected date, and participants were given a two-week period to complete the survey. At the end of this two week period of time, a reminder email was sent again sent to the entire population, thanking those who had completed the survey for doing so and informing those who had not yet completed the survey that there was a one-week extension. It was requested that they complete the survey as soon as possible, but within this time frame. The researcher went to the local school buildings on the day that the survey was sent out to encourage participation amongst available staff by leaving reminder cards on the tables in the faculty and staff break rooms announcing that the survey was available and requesting their participation.

The survey remained available for a total of three weeks, with participants receiving a reminder to complete the survey after the second week.

Data Analyses

Participant's responses to the STQ, individual research questions (survey questions 10-12a), and the PSQI score were analyzed with descriptive statistics. The relationships between screen time and sleep quality and quantity were analyzed with the Pearson Correlation utilizing Qualtrics® for data collection and IBM SPSS Statistics Version 26 for analysis (Table 1).

Table 1

Table of Specifications

Research Question (RQ)	Survey items or scales used to assess RQ's	Level of Data (Nominal, Ordinal, Interval/Ratio) *	Analysis needed to assess RQ
-What is the extent of screen time among the faculty and staff of the selected school district?	-Total screen time by time frame (i.e. workday, work night, non-workday, non-work night) measured by the Screen-time Questionnaire (STQ) -Total screen time by device measured by the STQ	-Interval/Ratio	-Descriptive statistics (measures of central tendency and dispersion)
-What are the levels of sleep quality and quantity among the faculty and staff of	-Individual items from the Pittsburgh Sleep Quality Index (PSQI) -Global PSQI score	-Interval/Ratio, Ordinal, Nominal	-Descriptive statistics (measures of central tendency and dispersion,

the selected school district?	<ul style="list-style-type: none"> -Selected variables within the PSQI (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, daytime dysfunction) -Individual research questions 	frequencies, and percentages)
<ul style="list-style-type: none"> -What is the relationship between screen time and sleep quality and quantity among the faculty and staff of the selected school district? 	<ul style="list-style-type: none"> -Total screen time by time frame (i.e. workday, work night, non-workday, non-work night) measured by the STQ -Composite PSQI score -Selected PSQI variables 	<ul style="list-style-type: none"> -Interval/Ratio and Ordinal -Pearson Correlation

Note. Level of data is for survey items, not RQs.

Summary

Data was collected from a non-random convenience sample made up of the faculty and staff a local ISD. A questionnaire to assess screen time, sleep quality, and sleep quantity was developed. Time spent using various screened devices was self-reported for workdays, non-workdays, workday nights, and non-work nights utilizing the STQ, while sleep quantity and quality were measured with the PSQI. Researcher-written

questions assessed screen use, bedtime, sleep time and self-reported problems with sleep associated with screen use immediately before sleep, as well as the devices which participants reported using most frequently before bedtime. Data was analyzed using descriptive and correlational statistics.

Chapter 4

Results

The purpose of this study was to assess the extent of screen time use among adult employees of a small, rural ISD, as well as the quality and quantity of sleep among employees. In addition, this research examined the relationship between screen time and sleep quality and quantity of employees of the selected ISD. An electronic survey was emailed to 117 employees of the ISD and 39 (33.3%) survey responses were collected from the potential participants. Of those 39 responses, 3 (7.69%) were discarded due to incomplete data. The survey was emailed to all employees on February 28, 2020 and was open until March 20, 2020. On March 12, the Minnesota Department of Education began offering guidance to school districts regarding distance learning due to the evolving COVID19 pandemic (Minnesota Department of Education, 2020). On March 15, 2020, it was announced that the ISD would have two days of distance learning beginning March 16, 2020, followed by a week and a half of school closure for teachers to prepare for distance learning.

Demographics of Sample

The sample included all employees of an IDS who had an official school district email address and were over the age of 18. Survey respondents were predominantly female (77.8%), white (88.9%), and non-Latino (83.3%). Respondents varied in age from 30 to 65 years, with the mean age 46.00 years ($SD=9.59$). The length of time which respondents had worked in their current position was between 1 and 31 years in their position, with a mean of 14.23 years ($SD=9.76$) (Table 2).

Table 2*Participant Demographics (n=36)*

Item	n(%)	Item	n(%)
Gender*		Race*	
	Male 5(13.9)		Asian 1(2.8)
	Female 28(77.8)		White 32(88.9)
Ethnicity*		Position*	
	Latino 2(5.6)		Faculty 22(61.1)
	Not Latino 50(83.3)		Staff 11(30.6)

Note. Demographic choices with no participants are not included.

*Totals not equaling 100% indicates missing data.

Assessment of Research Questions

What is the Extent of Screen Time Among the Faculty and Staff of the Selected School

District?

The data revealed that computer or laptop use during a workday had the highest mean use time (M=221.91, SD=163.26) of all devices over all time periods. Smartphone use on a non-workday, (M=112.35, SD93.69) was reported to have the second highest use. For both work and non-work nights, television (M=83.82,SD=66.38 and M=110.29, SD=67.98) and smartphones (M=82.94, SD=86.02 and M=78.09, SD = 58.36), had the highest use in minutes. Television-connected devices, such as gaming consoles or streaming devices, tablet devices and other devices had the least frequent use throughout all time frames (Table 3).

Table 3*Mean Screen Time Use by Device and Timeframe, (n=34).*

Device	Workday	Worknight	Non-workday	Non-worknight
Television	54.12 (72.85)	83.82 (66.38)	105.74 (100.27)	110.29 (67.98)

TV Connected Devices	22.50 (41.49)	28.24 (45.49)	33.53 (68.79)	20.29 (37.46)
Computer or Laptop	221.91(163.26)	30.44 (37.20)	72.35 (73.90)	43.53 (57.89)
Smartphone	93.09 (74.18)	82.94 (86.02)	112.35 (93.69)	78.09 (58.36)
Tablet	12.35 (33.94)	22.21(60.24)	21.47 (54.61)	11.47 (37.67)
Any Other	2.50 (11.03)	2.50 (11.03)	3.53 (14.33)	2.94 (12.19)
Total	406.47 (165.72)	250.15 (111.94)	348.97 (198.55)	266.62 (138.67)

Note. Time in minutes. Standard Deviation (SD).

What are the Levels of Sleep Quantity and Quality Among the Faculty and Staff of the Selected School District?

The PSQI global sleep scores of the employees of the selected ISD (n=34) ranged from 3 to 17, with the mean of 9.15 (SD= 3.53). A total of 19.4% of the respondents met the criteria for “good sleepers” and 75.0% met the criteria of “poor sleepers.” The criteria of sleep quantity (Table 4) was addressed in the sleep duration and sleep efficiency components of the PSQI. The mean time in spent bed among the participants was 7.66 hours (SD= .79), while the mean time asleep was 6.55 hours (SD=.92). Sleep efficiency, which represents a ratio of the amount of time asleep to the amount of time in bed (total sleep time/time in bed x100) was 85.58% (SD= 10.18) (Table 4).

Table 4

Self-reported Sleep Quantity

	N	Mean	SD	Minimum	Maximum
Time spent in bed	35	7.66	.79	5.5	10.00
Time asleep	36	6.55	.92	5	8.25
Sleep efficiency	35	85.58%	10.18%	60.61%	106.67%*

Note: Time in hours.

*Self-reported time asleep was longer than self-reported time in bed.

Sleep quality was measured through respondent's quality ratings, sleep latency reports, and sleep disturbances. Subjective sleep quality over the past month was rated as very good by 3 (8.3%) participants, fairly good by 19 (52.3%) participants, fairly bad by 12 (33.3%) participants, and very bad by 1(2.8%) participant. Sleep latency is based on both the participant's subjective and objective reporting of the time it takes to fall asleep. The majority of respondents were able to fall asleep withing 30 minutes of going to bed, with 16 (44.5%) participants going to sleep in 15 minutes or less and 13 (34.2%) participants reporting falling asleep within 16-30 minutes of going to bed. There were 14 (38.8%) who reported not being able to get to sleep within 30 minutes of going to be once to three times or more per week, while 21 (57.6%) or respondents noted that this was a problem twice a week or less (Table 5).

Table 5

Sleep Latency

Time it takes to fall asleep	n(%)*	Cannot get to sleep within 30 minutes	n(%)*
≤15 minutes	16(44.5)	Not during the past month	10(27)
16-30 minutes	13(34.2)	Less than weekly	11(30.6)
31-60 minutes	5(13.9)	Once or twice a week	7(19.4)
>60 minutes	2(5.6)	Three or more times a week	7(19.4)

Note. N=36 *Totals not equaling 100% indicates missing data.

The PSQI measures a variety of sleep disturbances by asking participants to subjectively rate how often they have trouble sleeping because of each problem. The most common causes for participants to experience sleep disturbances three or more

times per week were waking up in the middle of the night or early morning (55.6%) and waking to use the bathroom (27.8%). Feeling too hot was also a common reason for waking during the night, with only 19.4% reporting not being bothered at all in the past month with this issue (Table 6).

Table 6

Sleep Disturbances (n=36)

Sleep disturbance	Not during the past month n(%)	Less than once a week n(%)	Once or twice a week n(%)	Three or more times a week n(%)
Wake up in the middle of the night or early morning*	3(8.3)	3(8.3)	9(25.0)	20(55.6)
Up to the bathroom*	9(25.0)	8(22.2)	8(22.2)	10(27.8)
Cannot breathe comfortably*	28(77.8)	6(16.7)	1(2.8)	0(0)
Cough or snore loudly*	21(58.3)	6(16.7)	4(11.1)	4(11.1)
Feel too cold*	19(52.8)	9(25)	5(13.9)	2(5.6)
Feel too hot*	7(19.4)	13(36.1)	9(25.0)	6(16.7)
Have bad dreams*	25(69.4)	9(25)	1(2.8)	0(0)
Have pain*	19(52.8)	8(22.2)	4(11.1)	3(8.3)
Any other reason*	25(69.4)	4(11.1)	2(5.6)	4(11.1)

Note. Number(%) *Totals not equaling 100% indicates missing data.

The use of sleep medications, either prescription or over the counter, was also measured in the PSQI. In this study, 22 participants (61%) did not use sleep medications in the past month, 1(2.8%) participant took sleep medications less than once a week, 5(13.9%) participants took sleep medications once or twice a week, and 7(19.4%) participants used sleep medication three or more times per week.

What is the Relationship Between Screen Time and Sleep Quantity and Quality Among the Faculty and Staff of the Selected School District?

A Pearson's correlation was conducted to assess the relationship between the Global PSQI and total screen time during each of the four different time frames, including workday, workday night, non-workdays, and non-work nights. No statistically significant relationships were found between sleep quality and screen time (Table 7).

Table 7

Pearson Correlations Between Sleep Quality and Screen Time

Time frame	r	(df)	p
Workday Screen time	-.073	31	>.05
Workday night Screen time	.278	31	>.05
Non-workday Screen time	-.038	31	>.05
Non-workday night Screen time	.197	31	>.05

Self-perception of Effect of Screen Use Immediately Before Bed

Participants were asked questions regarding their perception of whether their use of screened devices immediately before bedtime affected the time that they went to bed, the time that they went to sleep, and whether the content they saw on the screened devices affected their ability to go to sleep. Participants (30.6%) reported that the use of screened devices immediately before going to bed affected the time that they went to bed one or more times per week, while 33.4% have gone to sleep later than expected at least once or more times per week due to the use of a screened device. Those having difficulty

going to sleep due to screened devices once or twice or more per week was 13.9% (Table 9).

Table 9

Self-perception of the effect of use of screened devices immediately before bed (n=36)

	Not during the past month n(%)	Less than once per week n(%)	Once or twice a week n(%)	Three or more times per week n(%)
How often have you gone to bed later than you intended due to screen use immediately before going to bed? *	5(13.9)	16(44.4)	9(25)	2(5.6)
How often have you gone to sleep later due to screen use immediately before going to bed? *	8(22.2)	13(36.1)	10(27.8)	2 (5.6)
How often have you had difficulty falling asleep due to what you have seen or heard on any screen device used due to screen use immediately before going to bed? *	16(44.4)	12(33.3)	5(13.9)	0(0)

Note: Number(%). *Totals not equaling 100% indicates missing data.

Participants were also asked to identify which screened devices caused them to go to bed at a time later than intended. Smartphones were indicated as the device which most commonly affected the time that participants went to bed (61.1%) and went to sleep (63.9%). Nearly half of the respondents (47.2%) indicated that none of these devices led to a difficulty in their falling asleep, others indicated that television (5.6%) and

smartphones (19.4%) led to difficulty falling asleep due to what they had seen or heard just before going to sleep.

Table 10

Self-perception of devices that affect going to bed, going to sleep, and sleep disturbances

	TV* n(%)	TV- Connected Devices* n(%)	Computer or Laptop* n(%)	Smartphone* n(%)	Tablet* n(%)	None of these* n(%)
Gone to bed later	16(44)	0(0)	8(22)	22(61.1)	2(5.6)	4(11.1)
Go to sleep later	8(22.2)	2(5.6)	1(2.8)	23(63.9)	4(11.1)	4(11.1)
Difficulty falling asleep due to what was seen on device	6(5.6)	2(5.6)	2(5.6)	7(19.4)	0(0)	17(47.2)

Note. Number(%) *Positive responses only.

Summary of Findings

Assessment of the data collected revealed that the employees of the selected ISD who responded to this survey are predominantly faculty members, female, and white. The mean age was 46 years. Results showed that while the range of screen devices choices provided in the survey were used in all the time frames, computer use on a workday accounted for the highest use. Television and smartphone use were the next most frequently used devices when used on work and non-work nights. TV-connected devices,

such as video consoles or streaming services as well as “other” devices were all used, although to a lesser extent. Upon assessing sleep quantity and quality with the PSQI, it was noted that the global score indicated that three-quarters of the employees are “poor sleepers” while 19.4% are considered good sleepers. Most employees self-rated their sleep quality as good and were able to fall asleep within 30 minutes of going to bed. The most common causes for participants to experience sleep disturbances were waking up in the middle of the night or early morning and waking to use the bathroom. Slightly less than one fourth of the employees used an over the counter or prescription sleep medication at least one time per month.

The relationship between the Global PSQI and total screen time during each of the four different time frames, including workday, work-day night, non-workdays, and non-work nights was evaluated using a Pearson’s correlation. No statistical significance was found between sleep quality and quantity and screen use based on this correlational study.

When asked whether screened devices affected the time that they went to bed, 30.6% of participants reported that the use of screened devices immediately before going to bed affected the time that they went to bed one or more times per week, while 33.4% report going to sleep later than expected due to the use of a screened device. Those having difficulty going to sleep due to screened devices once or twice or more per week was 13.9%. Smartphones were indicated as the most device which most affected the time that participants went to bed (61.1%) and went to sleep (63.9%). Respondents indicated that none of these devices was related to difficulty falling asleep 47.2% of the time.

Chapter 5

Interpretation of Findings

While many people enjoy restful nights with adequate quantity and quality of sleep, others struggle to get enough sleep to feel refreshed and alert the next day. The lack of adequate sleep has been shown to have an impact on the physical health, emotional health, and physical safety of people. There are multiple potential reasons for a lack of adequate sleep, with electronic screen use being just one. With the ever-increasing availability of small handheld devices, regular television, and streamed TV content, interactive gaming, and continuous internet availability, even in the bedroom, it is important to examine the relationship between the two. This study focused on sleep and electronic screen use of employees of an independent school district because working as a teacher, paraprofessional, administrator or staff at a school is demanding and often stressful. This work is also extremely important to the students, their families, and the community. It is important that school employees are able to work at their best, rather than tired or with low physical or emotional energy.

The intent of this research was to identify the extent of use of all electronic screened devices in the selected adult sample and evaluate relationships between the participant's screen use and their overall sleep quality and quantity. This research also examined the self-perception of whether screened devices affected the time participants went to bed, went to sleep, or whether their sleep was affected by disturbances from what was observed on the devices.

Interpretation and Explanation of the Research Questions

The researcher collected data from a non-random convenience sample of employees of a small, rural ISD in southwestern Minnesota. The online survey utilized Qualtrics® technology and included questions adapted from the PSQI (Buysse et al., 1989), the STQ (Vizcaino et al., 2019), questions regarding screen use near bedtime and demographic items. The survey was distributed by the superintendent of the selected ISD, who emailed this survey to all 117 employees with an ISD email. The total response was 39 participants, with 36 employees completing at least a portion of the survey.

Sleep Quantity and Quality of School District Employees

The results of this survey showed that the sampled ISD participants spent between 7 and 8 hours ($M=7.66$, $SD=.79$) in bed each night, with a mean sleep time of 6.55 ($SD=.92$) hours per night. In this study, actual sleep time was 0.45 hours ($SD=.92$) or 27 minutes less than the seven to nine hours of sleep recommended for adults by the NSF (Hirshkowitz et al., 2015). The prevalence of short sleep (less than seven hours) in adults in southern Minnesota is reported as between 24.3-30.8% (CDC, n.d.), while in this study, 58.3% of participants reported sleeping less than 7 hours (<420 minutes) per night. The National 2017 Educator Quality of Work Life Survey reported that 48% of educators (teachers, paraprofessionals, other professional staff, and support staff) sleep less than seven hours per night, with educators in Minnesota sleeping an average of 6.7 hours each night (AFT & BATs, 2017). Amschler and McKenzie (2010) reported that the teachers participating in their study reported an average 6.7 hours of sleep per night, with 43% of the teachers reported sleeping less than 6 hours per night.

A CDC study reported sleep to the nearest hour (Liu et al., 2016). The mean sleep time found in this study, when sleep time was rounded to the nearest hour was 6.72 (SD=.97), indicating that the mean sleep time slightly less than CDC and NSF's recommendations for adequate sleep. In this study, with rounding, 17 (47.2%) of survey respondents reported sleep of less than 7 hours, and 19 (52.8%) reported a healthy sleep duration of 7 or more hours, indicating that employees of the ISD reported a lower percentage of adequate sleep than the general population of Minnesota, yet was consistent with that reported by Minnesota educators.

Measures of sleep quality include sleep latency, sleep efficacy and sleep disturbances. The time that it takes for a person to fall asleep, once in bed, is called sleep latency, and 53.7% of the respondents reported that it took them more than 15 minutes to fall asleep on usual night, while 38.8% had one or more nights per week that they did not fall asleep in 30 minutes. Not falling asleep within 30 minutes of attempting to go to sleep is sleep onset insomnia (Exelmans et al., 2018). Sleep efficacy is percentage of the time in bed that a person is asleep during the night and includes sleep latency, as well as time awake for other reasons during the night. The mean sleep efficacy for the participants of this survey was 85.58% (SD=10.18), falling in the least disruptive category on the PSQI scoring scale, with sleep efficiency scores greater than 85% fitting in the least disruptive category (Buysse et al., 1989). The most cited sleep disturbances participants in this study reported were waking up in the night or early in the morning (80.6%), needing to use the bathroom (50%), and feeling too hot (41.7%).

While there are a multitude of potential reasons that participants might be disturbed from their sleep, including various medical issues or environmental stimuli, perimenopausal women may experience night sweats (hot flashes that occur during the night), or experience problems with falling asleep or waking too early in the years leading up to menopause, which happens on average at age 51 (American College of Obstetricians and Gynecologists [ACOG], 2020). With the majority of participants in this study being female (77.8%) and in the years leading to menopause (mean age 46.00 years, $SD=9.59$) perimenopausal symptoms might be a reason for sleep disturbances. Additionally, waking earlier than desired and not being able to return to sleep for extended periods of time can be used as a diagnostic sign of depression or anxiety. Early waking can also be related to the use of some medications (Shrivastava et al., 2014). Sleep disorders have been linked to the development of mental health issues, and sleep disturbances have been shown to greatly increase the risk of developing depression or anxiety (Bin, 2016). Although mood disorders such as depression or anxiety were not assessed in this study, with 61% of teachers reporting that they feel stressed often or always (AFT & BATs, 2017), the potential exists for depression or anxiety to be related sleep disturbances. This survey did not assess whether screened devices were used when participants were awake in the middle of the night or early morning and thus it is unknown if the screened devices had any effect on a participant's return to sleep.

The use of sleep medications, either prescription or over the counter, was also measured in the PSQI. In this study, 22 participants (61%) did not use sleep medications in the past month, while 1(2.8%) participant took sleep medications less than once a

week, 5(13.9%) participants took sleep medications once or twice a week, and 7(19.4%) participants used sleep medication three or more times per week, compared to 8.2% of United States adults ages 18 and older who reported taking medication for sleep four or more times in the past week in 2017-2018 (CDC, 2019). While it was not assessed as to whether the participants took over the counter (OTC) medications such as melatonin, diphenhydramine (Benadryl, Tylenol PM, Aleve PM), doxylamine succinate (Unisom Sleep Tabs) or valerian (Mayo Clinic, 2019) versus prescription medications, the high rate (19.4%) of participants using sleep medication three or more times per week is cause for concern and leads the investigator to wonder about the reasons for such a high rate of medication use. Since this survey population was of a relatively small group of people who work together regularly and over time, the investigator questions if the use of some type of sleep medication could be part of the “culture” of this group?

Global or overall sleep scores of the employees of the selected ISD ranged from 3 to 17, with the mean global score being 9.15. With a score of 5 or lower considered a “good” sleeper 20.6% of those responding met the criteria for “good” sleepers, while the remaining 79.4% met the criteria for “poor” sleepers. Comparatively, in a Belgium, study focusing on the effects of SEL, 584 adults (mean age 48.5 years) completed the PSQI. The mean PSQI in that study was 4.86 (SD 2.83), with 34% of the respondents being considered poor sleepers. The mean age of participants was 48.5 years. The study reported that shuteye latency was positively related to a longer sleep onset latency, poorer sleep quality and increase daytime symptoms (Exelmans & Van den Bulck, 2016).

Screen time use of school district employees

Employees of the selected ISD were found to use electronic screened devices of all types for an mean time of 6.77 hours (406.47 minutes, SD=165.72) during workdays, 4.17 hours (250.15 minutes, SD=111.94) on work nights, 5.82 hours (348.97 min, SD=198.55) on non-workdays, and 4.44 hours (266.62 minutes, SD=138.67) on non-work nights. Data was collected to determine screen time for the entire time awake (days) and from after work until bedtime (nights) to consider whether screen use throughout the day, or at night was related to sleep quality and quantity. This research looked at the cumulative time spent using all different types of electronic screened devices, and at individual device use. It was noted in the data analysis, that some participants recorded more time spent using screens in the night time frame (from when they returned home from work until bedtime) than the day time frame (from when they woke up until bedtime), which is not possible. It appears that the instructions were not read completely and/or were interpreted in a manner other than intended, leading to the conclusion that there are time frames (work and non-work days) that do not fully capture the screen use of the employees.

In this study, workday computer use was reported to be the time frame and device used the greatest amount of time, 3.7 hours (221.91minutes, SD=163.26). Workday computer use includes the time during work hours and the after-work hours. Participants reported watching television between one to two hours in each of the survey time periods except workdays, when television was watched slightly less than one hour on average. Data from this study did not coincide with the data from the American Time Use Survey (ATUS) which indicated that nearly 80% of Americans, age 15 and older, watch TV on

any given day, for an average of 2 hours and 46 minutes. The ATUS study reports that men watched TV for three hours and women for 2.5 hours on average. The amount of time watching television increased with age, especially after age 45 years, and the number of people watching television increases as the day progresses, peaking at the highest viewership between 8 and 9 pm (Krantz-Kent, 2018).

Lewis et al. (2017) studied television watching and computer use time to evaluate a relationship between screen use and sleep difficulties. They found that four or more hours of screen time related to television and computer use had a significant relationship with sleep disturbances such as extended sleep latency, waking during the night, long sleep duration and snoring. When added together, data for computers, television and television-connected devices for the entire day was greater than four hours on both work and non-workdays.

In addition to television and computers, smartphones are a common source of screen time. According to MaKay (2019), data from RescueTime, a smartphone app which monitors and reports smartphone use data from 11,000 users, indicates that most of those who use the app use their smartphones for 3.25 hours per day on average, with the 20% who use their smartphones the most recording an average use of 4.5 hours per day. Respondents to this survey reported using their smartphones between one and two hours during any of the study time frames, indicating that they use their smartphones at least 75 minutes less than the national average based on the RescueTime app.

Additionally, RescueTime noted that most people check their phones 58 times per day, with about half of those checks being during the workday and the other half in the

evening, creating multiple distractions throughout the day (MaKay, 2019). It might have been difficult for respondents to this survey to accurately understand and report the amount of time that they actually spent on their smartphone, do to these multiple, short phone usages. Likewise, smartphone use does not have a set beginning and end time, as a television show does, again making it difficult to accurately monitor the actual time spent on the device. Most smartphones have an internal monitor to record use, and more accurate results may have been obtained if participants had been asked to determine smartphone use based on this objective data found on their device.

Another survey of 2,077 smartphone users, this time in the United Kingdom (UK) found that participants spent an average of 3 hours and 23 minutes on their smartphones per day (cumulative yearly total is over 50 days per year) and that 78.77% of participants looked at their phone in the hour before going to bed. This study also reported that 64% of people use their phones while watching television, 55% use their phones while in bed and 33% while at work (Feeley, 2019).

Other screen use evaluated by this study included television connected devices, such as video game consoles and streaming devices, with participants reporting mean usage of between 20 and 33 minutes in the various time frames. Also, tablets, iPads, and e-reading devices were measured with mean usage of 11 minutes to 22 minutes in the various time frames. The category of “any other screen devices” had negligible use.

A Pearson’s r correlation was used to determine if there was a relationship between screen time and sleep quality and quantity of the faculty and staff of the local ISD, with no statistically significant relationship being found. When considering these

results, no relationship between screen time and sleep was found. However, many other studies have indicated a relationship between screen time and sleep quality and quantity. Green et al., (2018) reported that exposure to electronic devices in the evening and after bedtime was associated with longer SL, decreased duration of sleep, and increased daytime sleepiness. The authors described a negative relationship between electronic screen devices at night and attentive abilities the next day. Likewise, Fossum et al. (2014) found that smartphone and computer usage at night were positively associated with insomnia symptoms. In a study that directly measured smartphone screen time via an app downloaded on participants phones, Christensen et al. (2016) found that smartphone screen time is associated with poor sleep and Chang et al. (2015) found that using portable devices that emit light immediately before bedtime may disrupt circadian rhythms and cause continuing sleep deficits.

Factors that might have affected the outcome of the survey have been described above and also include underreporting of actual screen time, especially that of television and smartphone use, inaccurate reporting of screen time due to difficulty understanding the questions relating to day hours and night hours, or underrepresenting sleep problems, such as reporting longer than actual sleep time, or minimizing sleep concerns. The results could have also been affected by the small study size, the lack of diversity in the study population, and the rural community in which the school district is located. Another factor that may have affected the size of the study is the potential effect of the COVID-19 pandemic on the response rate for the survey. During the last week that the survey was available, many changes were occurring within the school district at a very rapid pace.

This included many communications between administration, staff, and families, which may have taken precedence over completing a survey (M. Johnson, personal communication, April 27, 2020)

When asked whether screened devices affected the time that they went to bed, 30.6% of participants reported that the use of screened devices immediately before going to bed affected the time that they went to bed one or more times per week, while 33.4% report going to sleep later than expected due to the use of a screened device. Those having difficulty going to sleep due to screened devices once or twice or more per week was 13.9%. Smartphones were indicated as the device which most affected the time that participants went to bed (61.1%) and went to sleep (63.9%). Respondents indicated that none of these devices was related to difficulty falling asleep 47.2% of the time.

Shuteye latency (SEL) is considered time spent in bed before trying to go to sleep. Longer SEL was found to correspond with diminished sleep quality, increased sleep latency and more fatigue, all symptoms of insomnia (Exelmans et al., 2018). Fossum et al. (2014) state that behaviors around sleep time can potentially affect sleep and assessed for the effects of in-bed use of screened devices, finding a positive relationship with symptoms of insomnia. Active mobile phone use in bed was noted to be related to those with a later chronotype (night owls) and so the relationship could be opposite, with those having a naturally late chronotype having a natural preference for staying awake longer.

Conclusion and Discussion

The findings of the study show that the participating employees of the selected ISD slept slightly less, on average, than the recommended minimum of seven hours per

night, with 58.3% of respondents getting less than seven hours of sleep per night. There was also a higher than usual use of sleep medications by the participants. The reported amount of time watching television and using smartphones was lower than the average use in the United States. Based on these findings, a Pearson's correlation did not reveal a statistically significant relationship between screen time and sleep quality and quantity amongst the employees of the selected ISD.

While there is evidence from other research that suggests that a relationship does exist between these factors, the sleep habits and screen use habits reported by study respondents do not reflect this relationship, perhaps due to the demographics of respondents to this survey. Although most teachers do some work from home, teachers who have at least three years of experience usually have less work to do outside of school time (M. Johnson, personal communication, April 27, 2020), which could indicate less screen time for work in the evenings by the participants who had mean of 14.23 years of experience in their positions. The participants were of in an age group that has lower smartphone screen use than those who are younger, and the results may reflect the school district being a part of a rural community. It is possible that some participants misunderstood the questions about screen use time frames and answered questions about the amount time on various screened devices inaccurately, or they may have not estimated their screen use accurately.

Many other research studies have shown a relationship between screen use and sleep. Sonawane et al. (2019) conducted a study using the Smartphone addiction Scale (SAS) and the PSQI which suggested a positive correlation between higher smartphone

addiction scores and sleep quality in young adults age 18-25, while exposure to electronic devices at nighttime was found to be related to decreased sleep hours and longer sleep latency as well as sleepiness and decreased attention to details in the morning (Green et al., 2018). A study using data directly from participant's smartphones found that longer average screen time was associated with less sleep time and decreased sleep efficiency (Christensen et al., 2016). Finding that mobile phones are kept beside the bed 60% of the time, bedtime use of mobile phones was negatively associated with sleep quality factors such as sleep latency, sleep efficiency and sleep disturbances. These affect sleep duration, insomnia symptoms, and fatigue symptoms (Exelmans & Van den Bulck, 2016).

Recommendations for School District Employees and Administrators

Even with no statistically significant results, between sleep quantity and quality and screen time, school employees are not meeting the guidelines for 7-9 hours of sleep per night and are using sleep medications more frequently than the general United States population. While not obtaining an appropriate amount of sleep can contribute to physical and mental health concerns, the frequent use of sleeping medications by the employees signals that this lack of appropriate sleep is a concern and that employees are seeking a way to get more sleep. Employees who find themselves relying on OTC sleep medications to fall and stay asleep could benefit from purposefully discussing this situation with their medical care provider to diagnose any physical problems or emotional reasons for the sleep concerns. Physical problems such as sleep apnea, restless legs (Depner et al., 2014), nocturia, hormonal disorders (NSF, 2019c), pain syndromes, or other problems with their heart, gastrointestinal or neurological systems (Kamath et al.,

2015) can all lead to sleep disruption. Mental health concerns related to sleep are also important to discuss with a healthcare provider, as the interaction between poor mood and poor sleep can create a downward spiral (Kalmbach et al., 2014).

In a study of veterans, it was found that only half of those with insomnia had discussed the issue with their primary care physicians (PCPs) and that PCPs may overlook this problem. Routine screening for sleep disorders is not currently recommended in for primary care visits and providers often do not have the time to bring the topic up (Shepardson et al., 2014), which indicates that patients need to actively discuss sleep concerns with their care provider. While medications for sleep are often prescribed, these medications are meant for short term use as they can lead to tolerance and dependence (Williams et al., 2013).

Employees may also benefit from seeking assistance from a mental health provider who is trained to provide behavioral therapy for insomnia (Shepardson et al., 2014), or by looking for non-medicinal solutions to help manage sleep problems, such as improving sleep hygiene. Many phone apps exist to help people address their sleep difficulties. The app Cognitive Behavioral Therapy for insomnia, (CBTi) utilizes a variety of approaches that are proven methods for improving sleep including “sleep education, sleep hygiene, stimulus control, sleep restriction, relaxation training and cognitive therapy” (Williams et al., 2013, Treatment Overview section). A free smartphone app, Cognitive Behavioral Therapy for Insomnia (CBT-i Coach), developed by the Veterans Administration is a helpful tool that can be used by individuals to log their sleep and learn techniques to improve sleep. This app should not replace

professional therapy for those who need professional help (National Center for PTSD et al., n.d.).

Amschler and McKenzie (2010) suggest that school district administrations could assist school district employees by providing education on proper sleep hygiene, as well as techniques to improve sleep habits and decrease insomnia as part of wellness programming. These authors recognize that teachers are independent adults, who make their own decisions, but also suggest that appropriate education on the impact of sleep on their wellbeing and ability to do their work can provide positive role modeling and demonstrate a commitment to health to students.

Attempting to accurately assess screen time would be a beneficial exercise for the employees, and the results could be informative for employees, staff and administration. While computer use is essential to the job of many employees, all employees could be engaged in increased self-monitoring and decision making about how much screen time is enough, especially in the evening and around bedtime. Many smartphones now have a built-in monitor that measures daily internet use, and there are many wearable devices to measure sleep, although not all brands or types are particularly accurate (Swalve et al., 2018). Short term, handwritten activity and sleep logs could also help employees to track or log their sleep and screen time.

The school district could evaluate their policy and expectations about work done at home and in the evening, especially work requiring screen time. Reducing screen time at night, before bedtime is important, as the use of stimulating interactive technology,

such as cell phones, gaming consoles, and laptops has been found to be make it more difficult to go to sleep, with sleep being less refreshing (Gradisar et al., 2013).

Recommendations for Future Research

The original version of the PSQI, used for this study, does not distinguish between work and non-workdays, while the STQ does measure work and non-workdays separately. In a study comparing the results of the original PSQI with an updated version asking about workdays and work-free days, it was found that workday scores were similar to the original “usual days,” while work-free day global scores were two points lower (Pílz et al., 2018). Comparing work and non-work sleep scores to work and non-work screen time use would provide additional insights into the relationship between sleep and screen use of employees of the school district. Future research should strive for more specificity when defining time in bed (denominator for sleep latency) as some people chose to spend leisure time in bed, watching television, reading or using a handheld device prior to trying to fall asleep. Defining time in bed to include only time trying to sleep would improve the accuracy of the sleep efficiency percent.

Utilizing the self-monitoring ability of electronic devices, such as smartphone usage data, available on many smartphones, would allow for more accurate data reporting, as would using sleep monitoring apps or wearable devices to accurately report sleep time. Future researchers should also consider that people often use two devices at one time, for example, watching tv and using a smartphone at the same time. Study participants should be given instructions as to whether to count time on each device separately or together. Another suggested research question relates to the frequency of

distractions related smartphones; might these frequent interruptions create lost work time, causing people to need to stay up later to complete their daily tasks, cause disorganized thoughts that might lead to increased anxiety and result in sleep disturbances, or have no effect on sleep? According to Cirelli (2019), brief arousals may occur during the night which are short enough that people are not aware of them, yet can cause disruptions in sleep quality; could these arousals be influenced by lights or sounds emitting from screened devices in the bedroom?

Future researchers should ask the questions about daytime use and night use of electronic screened devices in such a way that participants would clearly understand the time frame being referred to, such as separating day hours and night hours on the survey, with researchers adding them together when analyzing data.

Due to the limited response to the survey, it was not possible to compare the responses between the faculty members and the staff members. Future studies could include a larger, more diverse population by involving additional school districts of varying sizes and demographic backgrounds. With greater diversity and a larger number of participants, it might be possible look for relationships between screen use and sleep in the various subsets of the population studied.

Limitations of the study

This study had a small sample with limited diversity. This was a convenience sample, and the participants were not randomly selected. This study had a limited time for completion and received no outside financial support. The short amount of time available to complete the study was further affected by the unexpected and rapid closure

of schools during the time in which this survey was available for school district employees due to the COVID-19 pandemic. This was a time of rapid change, extensive communication with administration, and general disruption of routines. Due to the extra demands on time, and unsettling nature of the change to distance learning, completing surveys would not, perhaps, have been a priority for school district employees to complete.

County-wide population statistics of the county in which the study occurred describes residents as 91.1% white alone and not Hispanic or Latino, while Hispanic or Latino community members account for another 6.2% of the population, according to census data. Other ethnic groups are less than 1% each (United States Census Bureau, 2019). According to the CDC, sleep durations of less than seven hours (short sleep) are more often experienced by men (30.6%) than women (27.8%). When considering race, those who identify as white have the lowest rate of short sleep at 27.6%, while those of other ethnicities have a higher rate of short sleep, such as 36.2% of Asians, 34.2% of Hispanics and 46.7% of African Americans having short sleep duration. Age is also a factor in short sleep duration, with 34.6% of those aged 25-34 being short sleepers, 31.3% of those between the ages of 35-44 experiencing short sleep, 30.8% of those 45-54 getting short sleep and 28.2% of 55-64 year-olds getting less than seven hours of sleep. In the overall county-wide population of the selected school district has a 24.7-27.5% prevalence of short sleepers (Centers for Disease Control and Prevention [CDC], 2016).

Upon examination of the data related to screen time, it was noted that in several categories the amount of time spent on screened devices at night (defined as return home

from work until bedtime) was greater than that of the category daytime screen use (defined as from when arising to going to bed). While it was understood that these time frames might be confusing, the criteria were defined clearly in the questions on the survey. This discrepancy creates a concern for the results of this research, and future researchers must ask questions regarding screen time in ways that cannot be misconstrued by participants.

Summary

Sleep is vitally important to all people, and the lack of appropriate sleep affects brain function as well as many other physiological functions throughout the body. The lack of the needed quantity and quality of sleep can lead to physical and mental health issues as well as safety issues. Long term sleep disruptions can cause cardiovascular diseases, metabolic diseases, cancer and weight-related problems (Medic et al., 2017).

While a myriad of potential causes exist for sleep disruption, electronic screen time is becoming more and more prevalent in modern society, especially with the reliance on computers for many work and non-work related tasks, the availability of streaming video, television programming and gaming on television and hand-held devices being available to the majority of the United States population. Screen hours throughout the day (Lewis et al., 2017) and around bedtime (Exelmans & Van den Bulck, 2016) disrupt sleep and shorten sleep duration.

Teachers as well as all employees of school districts have important, challenging and stressful work, teaching and caring for children, adolescents and young adults. When

sleep deprived, there is an increased likelihood of instructional challenges and diminished supervision (Amschler & McKenzie, 2010).

Although no statistical significance was found in this study, understanding the concerns related to the potential relationship between electronic screen use and sleep among the general population, as well as the extra concern for school district employees, this issue should continue to be seen as important and efforts to study this issue need to continue.

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Appendix A



February 18, 2020

Dear Mary Kramer, PHD:

Re: IRB Proposal entitled "[1565114-2] Screens, School District Employees, and Sleep: Is There a Relationship?"

Review Level: Level [I]

Your IRB Proposal has been approved as of February 18, 2020. On behalf of the Minnesota State University, Mankato IRB, we wish you success with your study. Remember that you must seek approval for any changes in your study, its design, funding source, consent process, or any part of the study that may affect participants in the study (see <https://grad.mnsu.edu/irb/revision.html>). Should any of the participants in your study suffer a research-related injury or other harmful outcomes, you are required to report them to the Associate Vice-President of Research and Dean of Graduate Studies immediately at 507-389-1242.

When you complete your data collection or should you discontinue your study, you must submit a Closure request (see <https://grad.mnsu.edu/irb/closure.html>). All documents related to this research must be stored for a minimum of three years following the date on your Closure request. Please include your IRBNet ID number with any correspondence with the IRB.

Cordially,

Handwritten signature of Bonnie Berg in black ink.

Bonnie Berg, Ph.D.
IRB Co-Chair

Handwritten signature of Jeffrey Buchanan in black ink.

Jeffrey Buchanan, Ph.D.
IRB Co-Chair

Handwritten signature of Mary Hadley in black ink.

Mary Hadley, FACN, Ph.D.
IRB Director

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Minnesota State University, Mankato IRB's records.

Appendix B

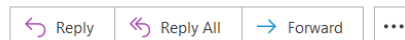
Copyright notice: The Pittsburgh Sleep Quality Index (PSQI) is copyrighted by Daniel J. Buysse, M.D. Permission has been granted to reproduce the scale on this website for clinicians to use in their practice and for researchers to use in non- industry studies. For other uses of the scale, the owner of the copyright should be contacted.

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Re: Permission to use Screen-time Questionnaire



Christopher Wharton <Christopher.Wharton@asu.edu>
To: Bruhler, Marykay L
Cc: Maricarmen Vizcaino



Tue 11/26/2019 5:53 AM

Hi Marykay,
Thanks very much for reaching out, and yes please do. Good luck with your research and let us know how it goes!

Sincerely
Dr. W

Christopher Wharton, PhD
Assistant Dean of Innovation and Strategic Initiatives
Associate Professor of Nutrition
Faculty Coordinator, South Center for Sustainable Food Systems
Arizona State University | College of Health Solutions
200 N. 1st Street, Phoenix, AZ 85081 | Health North Room 052
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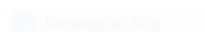
From: "Bruhler, Marykay L" <marykay.bruhler@mnsu.edu>
Date: Saturday, November 23, 2019 at 1:06 PM
To: "cwharton@asu.edu" <cwharton@asu.edu>
Subject: Permission to use Screen-time Questionnaire

Hello,
My name is Mary Kay Bruhler, and I am a graduate student at Minnesota State University, Mankato. I am currently pursuing my Master's degree in Wellness Coaching and Disease Prevention, and am writing my thesis on the relationship between screen time and sleep quality and quantity in the faculty and staff a selected small school district.

I came across your article "Reliability of a new measure to assess modern screen time in adults" in my literature search and felt that your measure, the Screen-time Questionnaire, would be useful in my upcoming research. While I have noted the Open Access statement attached to the article, I would like to confirm that I have permission to use the scale for my research, provided I follow the Open Access requirements.

Thank you for your consideration of my request and I look forward to your confirmation.

Mary Kay Bruhler



Vizcaino, M., Buman, M., DesRoches, C. T., & Wharton, C. (2019). Reliability of a new measure to assess modern screen time in adults. *BMC Public Health*, 19, 1396. <http://dx.doi.org/10.1186/s12889-019-7745-6>