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**The Effects of Mindfulness on Stress Reduction and Academic Performance in Students
Studying Health Sciences**

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ANE 628: Research Practicum II

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Abstract

Students studying health sciences are often consumed by rigorous curricula and demanding clinical schedules. The extensive concentration and commitment required of these students can be exhausting. This can lead to stress, poor academic performance, substance use and a decreased quality of life (Fauzi et al., 2021, Flowers & Bernard, 2020, Gao et al., 2022, & Melaku et al., 2015). Recent trends in academia have led to an integration of mindfulness-based stress reduction (MBSR) programs into the curriculum of graduate and undergraduate schools. Studies have shown that a consistent practice of some form of mindfulness is associated with a decrease in stress levels and improved academic performance (Flowers & Bernard, 2020; Lampe & Muller-Hilke, 2021).

The Effects of Mindfulness on Stress Reduction and Academic Performance in Students Studying Health Sciences

Student registered nurse anesthetists (SRNAs) regularly experience stress during their graduate studies. As stress and anxiety increase in the SRNA population, well-being decreases according to Mesisca & Manwaring (2021). Stressors experienced by SRNAs can be related to personal, academic, clinical, interpersonal, emotional, and financial demands (Mesisca & Manwaring, 2021). Unmanaged stress during graduate school may result in an array of consequences, most notably, altered memory capacity, weakened immune system, and long-term changes to the nervous system (Sathyapalan et al., 2017). The detrimental effects of stress could potentially interfere with an SRNAs ability to comprehend and retain content, perform well on examinations, or maintain attendance in both class and clinical. In recent years, graduate programs have increased their focus on stress reduction in students studying health related sciences. Many universities have integrated mindfulness programs with successful reduction in perceived stress and positive effects on a student's health and well-being (McConville et al., 2017; Daya & Hearn, 2017).

Based on the literature search, there has been a surge of data around stress and its consequences on nurses and physicians. Over the last three years, the COVID-19 pandemic has brought an immeasurable amount of stress, anxiety, and trauma to health care workers. The possible bright side to this catastrophic time is an increase in awareness of the necessity of self-care and mental health, especially for those working in the medical field.

The experience of stress is inherent to the job of medical personnel. It is pertinent that graduate healthcare programs provide students with the opportunity to learn tools to manage stress and improve overall wellbeing before they enter the workforce. Integration of a MBSR

program is a needed intervention that can provide future nurse anesthetist the tools to cope with the stress and demands of the workplace.

Background

Stress

Stress is characterized by an intrinsic or extrinsic stimuli that provokes a physiological response in the body. The World Health Organization (WHO, 2023) defines stress as a state of worry or tension caused by a seemingly difficult situation. Additionally, stress can be provoked by any type of change that causes physical, emotional, or psychological strain necessitating attention or action by the person. All people experience stress to some degree throughout their lifetime, however, a person's response to stress can influence their overall well-being. In some ways, healthy amounts of stress and anxiety can create motivation to perform and succeed. Conversely, poorly managed and prolonged stress can manifest into a sequela of unwanted consequences (Mesisca & Mianwaring, 2021). Stress can be considered inevitable in graduate student populations. An appreciation of stress' relationship with anxiety, well-being and academic performance are necessary for the future of these healthcare workers (Bullock et al., 2017).

Stress in SRNAs

Graduate studies in nurse anesthesia are frequently associated with challenging curriculums and demanding clinical schedules. The experience of stress and anxiety is often thought of as unavoidable during enrollment into the program. Perceived stress can often be looked at on a continuum; a small amount of stress being advantageous to performance, and on the opposite end, more severe states of stress being detrimental to performance (Mesisca & Manwaring, 2021). Major stressors that may be present during nurse anesthesia school include

academic stressors, clinical stressors, and external stressors. Furthermore, additional sources of stress can include experiencing new environments, information overload, adaptation to various instructor teaching styles, test anxiety, loss of income, role ambiguity, and first-time experiences (e.g., first test, first clinical case, first induction or first intubation; Chipas et al., 2012).

A survey was conducted with 1,282 SRNA participants looking at the relationship between perceived stress and negative outcomes such as sick days, decreased health and wellness, and depression. The mean overall stress score was 7.1 based on a self-reported 10-point Likert-type scale; zero being no stress and 10 being extreme stress (Chipas et al., 2012). The researchers of this study discovered that 47.3% ($n = 554$) of the SRNAs reported feeling stressed at some point during school and 21.2% ($n = 245$) had suicidal ideations (Chipas et al., 2012). Students also exhibited symptoms of stress in the form of agitation, irritability, cravings, compulsive behavior, decreased concentration, physical ailments, and sleep disturbances. Despite some students admitting to feeling ill during their studies, most chose not to call out sick from clinical due to the pressures of program administration and lack of sick days (Chipas et al., 2012).

Gender and race proved to show statistically significant differences in stress levels as well. Male students tended to have a lower perception of stress than female students ($p < 0.5$), and students of minority backgrounds tended to experience more stress than those who identified as white/non-Hispanic ($p < 0.1$; Chipas et al., 2012). Maladaptive behaviors to stress seen in this study population included excessive use of alcohol and other drugs, giving up on their education, refusing to acknowledge current state of mind, self-criticism, and constant vocalization of negative feelings (Chipas et al., 2012).

Stress in Healthcare Professionals

Healthcare professionals (HCPs) are particularly susceptible to an increased amount of stress in the workplace. According to a survey conducted in 2020 by the National Institute for Occupational Safety and Health (NIOSH), 93% of healthcare workers reported feeling stressed and 82% reported being emotionally and physical exhausted (CDC, 2020). With sustained and unmanaged stress, HCPs often experience burn out and compassion fatigue which can have negative effects on healthcare safety, efficiency, and patient-centered care (Braun et al., 2023). Some of the challenges that HCPs face include long work hours, rotating and irregular shifts, intense physical and emotional labor, exposure to human suffering and death, and an increased risk of exposure to disease and violence (CDC, 2022). Healthcare workers have notoriously reported a lack of support from their employer which could contribute to their poor mental state (Braun et al., 2023; Shah et al., 2021). Stress and burnout have also been the cause for medical errors, decreased patient satisfaction, and limited staffing in hospitals (Shah et al., 2021). Healthcare workers have been on the frontlines throughout the fight against COVID-19. Stress during this time has taken a toll on the mass population of HCPs, which has led to large percentage reporting they have left their jobs or consider leaving in the year of 2020 (Salari et al., 2020).

Students studying health sciences complete their programs and go on to work in the field as trained providers. Stress levels tend to decrease once the students enter the workplace however, presentation of new stressors is likely, despite the absence of school (Chipas & McKenna, 2011). Providing students with an opportunity to learn stress management tools through MBSR programs could greatly benefit them, as future providers, and the workforce as a whole.

Chronic Stress

The human nervous system is designed to function on a continuum of sympathetic (fight or flight) and parasympathetic (rest and digest) states (Hannibal & Bishop, 2014). A delicate balance is required to maintain harmony and homeostasis within the nervous system and physical body. The parasympathetic nervous system (PNS) promotes healing, repair, immunity, and anabolic growth required for restored energy reserves and longevity. The sympathetic nervous system (SNS) is designed to promote catabolic tissue breakdown and fat metabolism to mobilize glucose for energy and promote arousal, alertness, motivation, and goal-directed behavior. The SNS has been instinctually programmed to activate during times of stress or fear. When the SNS is stimulated, blood is shunted to vital organs and suppressed to nonvital organs to provide energy to the brain and neuromuscular system (Hannibal & Bishop, 2014).

The activation of the hypothalamic-pituitary-adrenocortical (HPA) axis is an important function of the physiologic stress response. When stimulated, glucocorticoids, mainly cortisol, are excreted from the adrenal cortex. Cortisol is a catabolic hormone key to the response of the SNS (Hannibal & Bishop, 2014). This hormone has anti-inflammatory properties and provides energy and substrate to vital organs and muscles during a fight or flight experience (Hannibal & Bishop, 2014). Sufficient regulation of cortisol is important for homeostatic maintenance. Excessive or insufficient cortisol can result in harmful effects (Stephens & Wand, 2012). Characteristics of a healthy stress response include an acute rise in cortisol levels, followed by a rapid decline with termination of the stressful event (Stephens & Wand, 2012). After repeated stressors and HPA axis stimulation, the increase in glucocorticoid burden can eventually lead to a dysregulation and dysfunction in the inhibitory feedback portion of the HPA axis (Herman et al., 2016). Dysfunction of glucocorticoid regulatory mechanisms can cause a disruption in

hormonal physiology due to the excessive exposure to the catabolic properties of cortisol, stress peptides and proinflammatory cytokines (Stephens & Wand, 2012). The consequences of hormone disharmony can lead to a variation in diurnal hormone secretion, reduced responsiveness to external challenges, and decreased immune function (Herman et al., 2016).

Stimulation of the SNS has been an adaptive response for survival in the human species. At present, most humans in modern society experience a robust physiologic reaction to stress that is unnecessary for day-to-day life. Chronic states of stress and frequent activation of the SNS leads to cortisol dysfunction and deleterious effects on physical and mental states (Hannibal & Bishop, 2014).

Stress and Memory

Memory is an important function of the brain that can be categorized into short term and long-term. Short term memory relies on the job of the frontal and parietal lobes while long-term memory is reliant on the function of larger areas of the brain, like the cerebral cortex (Sathyapalan et al., 2017). The conversion of memory from short-term to long term is dependent on the hippocampus and glucocorticosteroid receptors that are present within this region of the brain (Sathyapalan et al., 2017). High periods of stress create an increase in cortisol excretion from the adrenal cortex. Cortisol has a high affinity to glucocorticosteroid receptor sites in the brain (Rohleder, 2019). Consequently, the high cortisol levels and constant binding to glucocorticosteroid receptor sites leads to a decrease in the number of dendritic branches and neurons, and a decrease in neurogenesis of the hippocampus tissue (Sathyapalan et al., 2017). These changes in the brain have been linked to a reduction in both short and long-term memory as well as chronic memory disorders (Sathyapalan et al., 2017).

It is important to address the benefits stress can have on memory and academic performance. Stress is not guaranteed to create negative effects on memory. The process of memory is multifactorial and varies greatly depending on a person's situation and timing of events. In certain circumstances, stress can improve memory. These include non-familiar, non-predictable, and life-threatening forms of stimulation (Sathyapalan et al., 2017). Under these conditions, stress can temporarily improve the function of the brain in some instances (Sathyapalan et al., 2017). The process of strengthening a memory is usually reinforced after stress. For example, administration of glucocorticosteroids, or stimulation of stress shortly after learning can facilitate memory (Schwabe et al., 2012). However, stress felt prior and during a learning experience can decrease memory capacity (Schwabe et al., 2012). An interesting finding from Karabult et al. (2021) stated that stress in nursing students was related to intrinsic motivation and academic performance. Students who reported a GPA of 3.01-4.00 were found to score significantly higher on the Nursing Education Stress Scale (NESS) than students who reported a GPA of 0-1.99 ($p= 0.013$). Similarly, those students who reported a greater amount of stress also scored higher on the Academic Motivation Scale (AMS) compared to students who reported lower levels of stress ($p=.008$; Karabult et al., 2020).

The effects of stress on memory are highly variable and dependent on the time of exposure to the stressful stimulus and time needed for memory recall (Schwabe et al., 2012). Much of the literature reviewed continues to show that sustained and unmanaged stress leads to more debilitating effects on memory compared to acute and isolated states of stress (Hannibal & Bishop, 2014; Sathyapalan et al., 2017; Schwabe et al., 2012).

Stress and Immune System

Stress can lead to pathophysiological complications and can trigger or aggravate many diseases and conditions of illness (Sathyapalan et al., 2017). As mentioned previously, acute forms of stress cause SNS activation and cortisol excretion. Cortisol has potent anti-inflammatory properties that can support immune function for a short period of time (Hannibal & Bishop, 2014). Periods of stress that are considered chronic and trigger frequent cortisol excretion can cause a disruption in the HPA axis and an overall decrease in cortisol function (Hannibal & Bishop, 2014).

Constant physical and emotional stress is shown to increase inflammatory cytokine release (Hannibal & Bishop, 2014). Additionally, stress is linked to sleep disorders which are associated with increased levels of inflammation in the body (Pahwa et al., 2022). Signs and symptoms of chronic inflammation include body pain, myalgia, chronic fatigue, insomnia, depression, anxiety and mood disorders, gastrointestinal complications, weight gain or loss, and frequent infections (Pahwa et al., 2022). Chronic inflammation is a risk factor for various illnesses and diseases ranging from depression and anxiety to cardiovascular disease and cancer (Pahwa et al., 2022). According Chipas et al. (2012), common symptoms experienced by SRNAs include nervousness, anxiety, digestive problems, eating disorders, frequent body aches, headaches, and sleep disturbances. These signs and symptoms are similar to those associated with chronic inflammation. There was no literature that addressed chronic inflammation in the SRNA population however, there may be a correlation between stress and physical symptoms experienced by the students.

Mindfulness

Mindfulness is the practice of being aware of thoughts, feelings, bodily sensations, and the surrounding environment in the present moment. Mindfulness is often united with feeling open, nonjudgmental, friendly, curious, accepting, compassionate and kind to oneself and others (Zhang et al., 2021). A mindful practice can range from various forms of meditation and yoga to simply taking short pauses in everyday life to acknowledge the present moment. The modern world provides many challenges to mindfulness. The constant stimulation from smartphones and television advertisements are designed to keep the user focused on the phone application or advertisement and distracted from the present moment (Kies, 2018). Perpetual stress and relentless external stimulation make it exceedingly difficult for those wanting to stay in the present moment. Mindfulness is a quality that every human can possess however, training and practice are what is needed to make mindfulness a habitual skill (Zhang et al., 2021).

Mindfulness practices are rooted in Buddhist traditions that date back centuries (Shapero et al., 2018). In 1979 while at the University of Massachusetts Medical Center, Dr. Jon Kabat-Zinn developed the first MBSR program to treat stress (Shapero et al., 2018). Since then, his program has been widely used as a template for hundreds of researchers seeking to validate the efficacy of mindfulness as a treatment for physical and mental ailments. Mindful based stress reduction programs have grown popular in hospitals, schools, and university settings.

MBSR Programs

The original MBSR program developed by Dr. Kabat-Zinn was an eight-week workshop taught by trained and certified practitioners. The program consisted of weekly group meetings lasting 2.5 hours followed by a one-day retreat lasting seven hours (Kabat-Zinn, 2023). Mindful based stress reduction programs have since been adapted to suit the various populations and

settings in which they are utilized. These programs often incorporate a combination of mindfulness meditation, body awareness, yoga, and explorative dialogue around patterns of behavior, thinking, feeling and actions (Shapero et al., 2018). The program is designed to provide structured training and education to participants to help them develop skills and tools to practice mindfulness.

Meditation

Meditation is a common practice involving focused attention and awareness (Garrison et al., 2015). This practice can be done sitting, standing, walking, or laying down. Meditation is not considered a religious practice, but it may include similar attributes to rituals of contemplation or prayer. Several meditation forms exist including the following: mindfulness meditation, body-centered meditation or body awareness, contemplation, emotion-centered meditation, mantra meditation, meditation with movement, and visual based meditation (Cleveland Clinic, 2022).

Mindfulness meditation is a practice that is focused on staying aware of what is happening in that present moment rather than letting the mind wander into the past or future. The goal of this meditation is to notice when the mind starts to wander in thought and once recognized, bring the thought back to the present moment. People who use this practice may also incorporate body awareness as an adjunct to have a focal point for their thoughts (Cleveland Clinic, 2022).

Body awareness, also known as body scanning, is a form of meditation that involves focusing on sensations found in the body. Typically, this meditation guides the participant to start at their toes and slowly work their way to their head stopping at various body parts to address any sensations or discomfort in those areas. If discomfort is acknowledged within the

body, the participant is instructed to not react to the discomfort but rather to accept it and breathe through it for as long as possible (Cleveland Clinic, 2022) .

Contemplative meditation typically involves focusing on a specific idea, question, or situation with the goal of receiving insight from a voice within or in the form of a divine being. Emotion-centered meditation is a method where the participant chooses a specific emotion to ponder and eventually manifest; gratitude is a common emotion chosen for this practice. The goal is to think about the feelings of gratitude to such an extent that it turns into a physical sensation and active emotion during the practice (Cleveland Clinic, 2022).

Mantra meditation involves the use of a mantra or specific phrase said repeatedly out loud or internally. This type of meditation can be done sitting, or it can be incorporated with movement. Movement meditation is commonly done through walking or a form of yoga. This type of meditation focuses on synchronizing breath with movement (Cleveland Clinic, 2022).

Mindfulness Dialogue

Many of the MBSR programs involve interactive dialogue between the instructor and participants surrounding emotional regulation and reactivity (Niazi & Niazi, 2011). During this time, participants are encouraged to discuss personal experiences of challenges and successes while practicing mindfulness (Shapiro, 2018). In many programs, information about the physiologic responses of stress and the valuable effects of mindfulness are also presented. The goal is to educate and inform the students about the physiology occurring within their own body during a stress response. The act of acknowledging and being aware of the stress response is both empowering and a form of mindfulness (Shapiro, 2018). This part of the program is also a time to educate students on emotions and emotional regulation with the goal of improving emotional intelligence and self-efficacy (Niazi & Niazi, 2011). Additionally, many programs had students

develop wellness programs to help guide them in identifying stressors and reactions as well as action plans to cope. An example of a wellness program is seen in Figure 1.

Figure 1

Mindfulness in Emergency Medicine Individualized Wellness Plan

STRESSOR (WHAT)	REASON (WHY)	ACTION PLAN (HOW)	POTENTIAL BARRIERS	COUNTER MEASURES
Step 2 CK	Didn't get a high enough score on Step I and worried that it might affect my interviews/match list	When feeling overwhelmed by how much I need to study, take one minute to focus on breathing	Forgetting my action plan	Leave a sticky note above my desk that says "Remember to breathe"

Note. This figure was produced by Chung et al. in 2018 as an example for students to use when developing their own individualized wellness plan. Taken from “A targeted mindfulness curriculum for medical students during their emergency medicine clerkship experience” by Chung et al., 2018 *Western Journal of Emergency Medicine*, 19(4), 762–766. <https://doi.org/10.5811/westjem.2018.4.37018>

Additional Benefits of MBSR

This literature review was designed to focus on the benefits of mindfulness on stress reduction and academic performance. In many instances, there were more benefits to mindfulness, and several common themes were found. Improvement in self-efficacy and emotional intelligence were two of the most common advantages discussed in the literature.

Self-Efficacy

Mindfulness has been shown to improve self-efficacy (Phang et al., 2015; Jiménez-Picón et al., 2018). Self-efficacy is defined as an individual’s perception or belief in his or her capacity to execute behaviors necessary to perform specific tasks (Bandura, 1977). Self-efficacy is also associated with confidence in ability to exert control over one’s own motivation, behavior and social environment (APA, 2009). High levels of self-efficacy have correlated with improved

academic performance and student retention (Conner, 2015). There are four primary influences of self-efficacy, and these include the following: mastery of the task, social persuasion, vicarious experiences and emotional or somatic states (Bandura, 1977). As a result of self-efficacy, students in an educational setting can take on challenging tasks and persevere despite obstacles. These students are better able to regulate their learning process by using various cognitive strategies to facilitate memorization and comprehension (Van Dinther et al., 2011).

Emotional Intelligence

Emotional intelligence (EI) is the ability to recognize, understand and handle one's own emotions. It relates to a person's capacity to perceive and empathize with others' emotions and circumstances, also known as social intelligence (Salovey & Mayer, 1990). Key identifiers of emotional intelligence include an awareness of personal strengths and limitations, self-confidence and self-acceptance, the ability to let go of mistakes, a strong sense of curiosity, particularly about other people, and the ability to manage emotions in difficult situations (Mayer et al., 2008). Emotional intelligence is considered both a trait and a skill that can be learned and practiced. One of the incentives to MBSR program implementation is to improve emotional intelligence in student populations.

The dialogue and conversational portion of the MBSR programs are designed to help students learn to identify and articulate their feelings and to help determine adaptive coping mechanisms (Shapiro, 2018). The benefits of EI in graduate student populations could include effective emotional regulation after poor exam results and an ability to quickly recover from the emotional set back of a bad grade. Additionally, improved self-awareness and perception of clinical instructors during clinical training could enhance the students' learning experience. Lastly, an increase in empathy during patient interactions may improve patient satisfaction as

well (Phang et al., 2015). Mindfulness has been shown to improve the perception and expression of one's emotions and emotional understanding and regulation (Jiménez-Picón et al., 2018).

Healthcare providers facing stressful events have benefited from the use of mindfulness techniques to improve emotional intelligence in the clinical setting (Jiménez-Picón et al., 2018).

Measurements of Mindfulness and Stress

Mindfulness Attention Awareness Scale (MAAS)

The mindfulness attention awareness scale (MAAS) was commonly used throughout the literature reviewed. This is a 15-item scale that measures traits of mindfulness. The scale was designed to assess a person's frequency of attention to and awareness of ongoing events and experiences, both internal and external. Response options range from 1 (almost never) to 6 (almost always). The higher the number, the more mindful traits a person is suspected to have (Brown & Ryan, 2003).

Perceived Stress Scale (PSS)

The PSS is an 11-item self-reporting tool used to assess the degree to which an individual appraises life events as stressful (Phang et al., 2015). Items on the scale were created with the intention of finding how difficult, unexpected, uncontrollable, and overloaded respondents perceived their life to be. Examples of items include "how often have you felt difficulties were piling up so high that you could not overcome them?" (Wickrama et al., 2013, p.2). Responses ranged from never (0) to very often (4). Higher scores indicated greater physiological vulnerability and perceived stress (Wickrama et al., 2013).

General Health Questionnaire (GHQ)

The GHQ is a validated instrument mostly used to assess non-psychotic psychiatric symptoms. The number of items in the scale can vary from 20 to 30. The scale is divided into

four subscales which include somatic symptoms, anxiety/insomnia, social dysfunction and severe depression. There are varying ways to score this questionnaire but the higher the number, the more distress the participant is experiencing (Phang et al., 2015).

General Self-Efficacy (GSE)

The GSE is a 10-item uni-dimensional scale for assessing a general sense of perceived self-efficacy. This scale is used to predict the ability to cope with daily hassles and adaptation after experiencing various forms of stress (Phang et al., 2015). An example of an item listed on the scale includes “I can always solve difficult problems if I try hard enough” (Phang et al., 2015, p. 1121). Responses are given on a four-point scale with overall scores ranging from 10 to 40. Higher scores are related to higher levels of self-efficacy.

Literature Review

Methods

A literature search was performed on the following major databases: CINAHL, PubMed, Cochrane Library, and Google Scholar. Randomized control trials (RCT), systematic reviews of RCT's, and experimental studies published within the last five years, 2017-2022 were preferentially selected. Additionally, studies within the last 10 years were also evaluated and a few were selected that were proven relevant to this review.

Keywords for the initial search included “mindfulness and stress reduction” which yielded an abundance of articles from decades of research and various fields of study. Further search terms were used to specify the population group. These included “mindfulness in health-care students”, “mindfulness + academic performance”, “mindfulness + stress reduction + health related sciences” and “mindfulness + stress + medical students” which yielded more precise results related to the research question.

For the article to be included in this review, participants in the study had to be enrolled in a health sciences program similar to that of a student registered nurse anesthetist; medical students, pre-medical students, nursing students, physical therapy, or psychology students were considered. Common themes discussed were stress, resilience, anxiety, burnout, depression, self-efficacy, and academic performance. For this literature review, the focus will be on the themes of stress and academic performance. A version of the original MBSR program formerly developed by Dr. Jon Kabat-Zinn was frequently used as a foundational reference to the interventions developed by the authors in these studies. There were both online versions of mindfulness programs as well as in person classroom discussions. Some studies used mobile meditation applications as their intervention as well. This review will highlight the length of intervention programming, how it was integrated into the curriculum and the method of mindfulness practice. Comparison between the intervention design will also be addressed.

Mindfulness and Stress Levels

In-Person MBSR Programs

The integration of mindfulness-based programs into the curriculum of health professional students has become more popular in recent years. Efforts to help decrease stress and improve the overall wellbeing of students are motivating factors to this incorporation. Having the tools to cope with and minimize stress can create a disseminating effect on a future healthcare providers ability to care for patients. McConville et al. (2017) conducted a systematic review of randomized and non-randomized controlled trials that reviewed the effect of mindfulness training on psychological well-being, learning and clinical performance in healthcare students. The review included 19 articles with a total of 1815 participants. The studies involved both in person and online versions of mindfulness-based interventions (MBI). Most of the studies

included in the review had programs that averaged around seven weeks long, the shortest duration being four weeks and the longest being 10 weeks. These programs included anywhere between one to two hours of weekly mindfulness sessions where an instructor was present and leading the course. A few of the studies also included homework where the participant was required to listen to recorded meditations throughout the week on their own time. McConville et al. (2017) found that there was a significant effect favoring mindfulness on decreasing stress ($p < 0.1$).

Of the studies that examined stress, three ($n=198$) had follow up questionnaires at three months to assess the long-term effects of the intervention. There was no significant change on stress levels compared to the results immediately post-intervention, indicating a consistent level of stress reduction even three months out (McConville et al., 2017). The authors suggested that the use of a MBI can decrease stress, reduce anxiety, and increase mindfulness and empathy levels. They related these changes to the potential to improve the overall psychological well-being of health care students and increase their capacity for empathy (McConville et al., 2017). This could translate into better patient centered care as well as an increased aptitude to be present, open, and responsive to their clients (McConville et al., 2017).

Phang et al. (2015) conducted a randomized controlled study looking at the effect of a five-week MBSR program for stress management among 75 medical students. Like other studies, this intervention was adapted from and based on the principles of the original eight-week MBSR program developed by Dr. Jon Kabat-Zinn (Niazi & Niazi, 2011). The focus of the program's exercises was to foster the ability to pay attention to the present moment. The design of this study was different from others in that it labeled the program as "the Mindful-Gym" and had a slogan of "Be Present, Be Calm & Be Grateful" (Phang et al., 2015, p. 1118). This slogan

exemplifies a very thoughtful approach to study design as mantras are a common practice of eastern methodology and align with mindful practices. Participants in the intervention group met with their mindfulness trainer for two-hour sessions every week. The program lasted a total of five-weeks. The sessions included topics with titles such as “Gratitude Work-outs”, “Mindful stretching and muscle relaxation”, “Body scan and kindness” and “Deep and mindful breathing” (Phang et al., 2015, p. 1121).

The students were also recommended to complete daily self-help exercises in between sessions. Results were measured using the MAAS, PSS, GHQ and the GSE scale (Phang et al., 2015). One week after the intervention was completed, the intervention group reported significant reductions in perceived stress scores ($p = .009$) and mental distress scores ($p = .003$), along with improvement in mindfulness scores ($p = .040$) and self-efficacy scores ($p < .001$). The control group did not display any significant improvements in the previous scores (Phang et al., 2015).

At the six-month follow-up, analysis showed that a significant increase in self-efficacy was present compared to the control group. There were no significant improvements in the scores relating to perceived stress, mental distress, and mindfulness (Phang et al., 2015). At the sixth month period, students reported an increase in stress compared to immediately after the intervention. They still felt that the MBSR program was a positive experience and would recommend it to others (Phang et al., 2015). The study did not address how the program was integrated into the student’s schedule. There are several limitations to this study but the most pronounced one being a small sample size ($n=75$). Secondly, the mindfulness trainer for the participants was also the author of the study so this could have resulted in a participation bias.

Minichiello et al. (2020) developed a similar study to Phang et al. (2015) where they looked at the effects of a MBSR program that was executed over a two-month period. There were five classes that lasted one and a half hours long. The courses included discussions about self-compassion and paying attention to the body's signals. Unlike the program developed by Phang et al. (2015), this program had an emphasis on breathing exercises and mindful movements such as yoga (Minichiello et al., 2020). Participants showed a statistically significant decrease in perceived stress and an increase in mindful awareness after the intervention period ($p < .05$; Minichiello et al., 2020). An added benefit to the program design was the courses were integrated into their current didactic schedule which allowed for convenience and likely impacted the positive participation. The study limitations were a small sample size and no control group (Minichiello et al., 2020). There was no longitudinal follow-up with this study so the ability to track its efficacy at a three or six-month mark was unattainable. Additionally, to protect the privacy of residents, attendance was not tracked. Consequently, the researchers were not able to assess any measurement between the frequency of attendance and the quantitative measures overtime (Minichiello et al., 2020).

Clinical rotations are often a requirement for most health-related science curriculums. Although different from didactic education, these rotations often induce stress associated with the psychosocial aspects of patient care (Ireland et al., 2017). Chung et al. (2018) and Ireland et al. (2017) developed studies that incorporated a total of 64 medical students in their emergency medicine clinical rotation. Both studies evaluated the effects of mindfulness training on stress and burnout. Chung et al. (2018) created a four-week program where participants attended 60-minute weekly classroom sessions. Ireland et al. (2017) designed a 10-week mindfulness program where students were to attend a weekly 60-minute session. In both studies, the

mindfulness-based curriculums decreased perceived stress in the intervention group compared to the control group (Chung et al., 2018; Ireland et al., 2017).

The effects of stress reduction and mindfulness behaviors were sustained up to six months after the completion of the program in the research led by Chung et al. (2018). This prolonged effect may be due to the distinctive mindfulness program created by Chung et al. (2018). This program was unique in the way it was individualized and applicable to the curriculum of the medical students. For example, part of the curriculum included a role play scenario that simulated a student's interaction with a hospital patient. The student had to promote stress reduction and mindfulness practices (Chung et al., 2018).

This type of interaction can be beneficial for both the student and the patient. For the student, teaching a mindfulness practice can help reinforce the behavior for themselves. For the patient, they are gaining knowledge about this mindfulness practice and alternative stress reduction modalities. Additionally, the program often had group discussions that involved their feelings surrounding experiences in the clinical setting (Chung et al., 2018). The students were also held accountable to complete their written home assignments and a grading scale of pass or fail was included in the program design (Chung et al., 2018). Another distinction of this mindfulness curriculum was the students were required to develop their own mindfulness wellness plan by the completion of the intervention (Chung et al., 2018). An example of a wellness program is seen previously in Figure 1.

At the conclusion of the study, 75 students revealed they were still using their individualized wellness plans up to six months after the completion of the intervention (Chung et al., 2018). Limitations to this study include small sample size and the possibility of participation

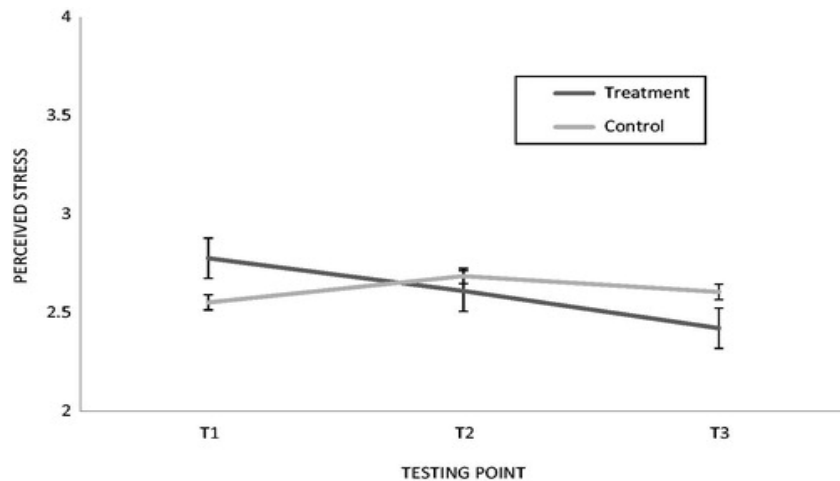
bias. Lastly, their main outcome was measured by a non-validated survey instrument and the questions were limited by their self-reporting nature (Chung et al., 2018).

In the article produced by Ireland et al. (2017), the participants had a similar integration of the program into the clinical schedule as participants in Chung et al. (2018). Students attended weekly sessions over a 10-week period that lasted one hour. There was an active control group in which the participants of this group were given break time during the same hour the intervention group held their sessions (Ireland et al., 2017). The authors used the PSS to measure stress levels in the students.

The results of this study revealed participants in the intervention group reported a decrease in perceived stress and burnout over time, whereas participants in the control group described an increase in stress and burnout over the course of the 10 weeks (Ireland et al., 2017). The authors also pointed out that the trends observed for the medical students over the 10-week period were consistent with their expectations of how a 10-week emergency department rotation could affect the stress levels of the student (Ireland et al., 2017). For example, the initial five weeks appeared to be where perceived stress was on a steady incline and the second half of the rotation reveals a tapered effect on stress (Figure 2) (Ireland et al., 2017).

Figure 2.

Mean Estimates Over Time in Perceived Stress for Each Condition



Note. Error bars represent \pm standard error of the mean (SEM). This figure was produced by Ireland et al. in 2017 to reveal the progression of perceived stress in the intervention versus control group. Taken from “A randomized controlled trial of mindfulness to reduce stress and burnout among intern medical practitioners. *Medical Teacher*, 39(4), 409–414. <https://doi.org/10.1080/0142159x.2017.1294749>.

What makes this finding interesting is that the period in which the stress levels start to plateau in the control group is at five weeks (Ireland et al., 2017). Comparatively, the mindfulness program in Chung et al. (2018) was only five weeks long due to the restrictions of the students’ academic curriculum. It would be beneficial to determine whether five-weeks of a mindfulness program is the optimal time needed to produce a statistically significant effect on stress reduction and mindfulness. Further investigation into length of time of programs and duration of positive effects would help support the current literature. Similarly to Chung et al. (2018), Ireland et al. (2017) had a small sample size which proved to be a study weakness. Ireland et al. (2017) also mentioned there was no way to determine if the intervention group communicated their teachings with the control group, leading to the potential that the control group could have benefited indirectly from the mindfulness intervention. However, this

limitation could have underestimated the positive effects in the intervention group compared to the control group (Ireland et al., 2017).

Virtual MBSR Programs

Daya & Hearn (2018) did a systematic review that evaluated the effects of MBI on medical students' stress levels, depression, fatigue, and burnout. This review included 12 studies, seven of which looked at MBI and stress. The authors found that four of the articles reported improvements in stress levels after an online mindfulness intervention (Daya & Hearn, 2018). The four studies that were reported to show improvement in stress levels utilized a multimedia approach to delivering the intervention accompanied with at home assignments (Daya & Hearn, 2018). Meditation and mindfulness sessions were prerecorded onto a compact disc (CD) or digital video disc (DVD) and given to the participants. This method of delivering the intervention via a multimedia modality is comparable to the methods used in some of the studies reviewed in McConville et al. (2017).

Daya & Hearn (2017) also found that two of the seven studies that reported on stress revealed no change in stress levels. Additionally, one study concluded an increase in stress levels after the intervention period. However, this study proved to be weak data based on study design in which the post-test was administered one year after the intervention was completed (Daya & Hearn, 2017). Overall, Daya and Hearn (2017) felt like the data reviewed was inconclusive when it came to determining the effect of a MBI on stress reduction. This finding is contrary to previous articles, but it could support the opinion that a consistent mindfulness practice is needed to sustain a reduction in stress.

The use of an online mindfulness program could provide the benefit of convenience for its users. Comparable to the articles found in Daya & Hearn (2017), Franco (2021) tested the

impact of an online mindfulness program on stress and anxiety in a group of fourth year nursing students ($n=76$). The study design utilized an online website called Therapy Assistance Online (TAO) which was developed by Dr. Susan Benton in 2012 (Franco, 2021). Interestingly, TAO was created in hopes to alleviate the long wait times students encountered when attempting to seek mental health counseling at their university (Franco, 2021). Therapy Assistance Online includes content focused on various strategies of mindfulness such as mindful breathing, letting go, taking a vacation with your mind, mindfully walking, and noticing yourself (Franco, 2021).

The students in this study were assigned to explore and complete the assignments on the TAO website at their own pace for four weeks (Franco, 2021). Students were asked to do three of the 12 mindfulness exercises weekly to total 12 mindfulness exercises during the intervention period (Franco, 2021). Franco (2021) used the Depression, Anxiety, and Stress Scale (DASS-21) to measure their findings. Participants scored lower on stress levels ($M= 4.5$, $SD 4.2$) and anxiety levels ($M= 3.1$, $SD= 3.3$) after the four-week intervention period compared to before the intervention period (Franco, 2021).

The author also collected qualitative data and found that more than half of the students practiced mindfulness outside of the online module and reported that mindfulness was beneficial and time worthy (Franco, 2021). Students explained that taking a few minutes a day to practice breathing exercises was felt to greatly improve their ability to cope with the stress and pressure of nursing school. Additionally, a few students reported that practicing mindfulness decreased their stress in the clinical learning environment as well (Franco, 2021). Limitations to this study include a small homogenous sample from one nursing school in which most of the participants were female. The study also used self-reported assessments that relied on the honesty of the participants and there could have been a response bias (Franco, 2021).

Meditation Programs

Meditation is just one of many different mindfulness practices included in a mindfulness-based program. There were a few articles in this literature review that focused on meditation as the primary intervention and examined its effect on stress management. Foley & Lanzillotta (2021) studied a group of student registered nurse anesthetists enrolled in a doctorate of nurse anesthesia program. The authors were interested in determining the effect of meditation on the students' stress, anxiety, and depression levels. The meditation sessions were provided through a smart phone mobile application called Headspace[®] (Foley & Lanzillotta, 2021). Students were instructed to download the free 10-day trial and to complete a daily meditation for the course of the trial. Pre and post intervention surveys were completed. The authors used the DASS-21 to measure the outcomes (Foley & Lanzillotta, 2021).

Results showed significant reductions in stress ($p < .01$), depression ($p < .01$), and anxiety ($p < .01$) scores (Foley & Lanzillotta, 2021). On average, students spent a total of 51.2 minutes meditating during the 10-week period. There was a 32% reduction in depression and anxiety compared to preintervention scores and a 47% reduction in the participants stress levels after the intervention (Foley & Lanzillotta, 2021). Of the 43 participants, 41 of them claimed they would practice some form of mindfulness meditation after the conclusion of the project (Foley & Lanzillotta, 2021).

There are several limitations to the study presented by Foley & Lanzillotta (2021). The participants included could have experienced more stress than the average Headspace user which would contribute to the larger reduction in stress. There was also no control group to compare the intervention findings. Like other studies, the author of this study was also the project director which could have led to the Hawthorne effect. There is a chance participants overreported their

stress levels in hopes to help the positive effect of the intervention (Foley & Lanzillotta, 2021). Lastly, there was no follow up questionnaire to determine the long-term effects of a 10-day meditation course.

Yang et al. (2018) conducted a similar study to Foley & Lanzillotta (2021) using a group of medical students in various years of their training. The authors also used the Headspace mobile application as their primary intervention (Yang et al., 2018). A total of 88 students were enrolled in the study; 45 were randomized to the intervention group and 43 students were randomized to a control group (Yang et al., 2018). The students were encouraged to use the meditation application as much as they could over the course of a 30-day period. Data was collected using the PSS, FFMQ, General Well-Being Schedule (GWBS), and additional open-ended questions to evaluate the sources of stress (Yang et al., 2018).

Questionnaires were filled out at the 30 and 60-day marks by both the intervention and control groups. The students reported that life became more stressful after starting medical school and the stress was related to things like outside relationships, a reduction in sleep, constant pressure, financial stress, lack of personal time and self-confidence, less time for exercise, no longer top of class, eating and cooking less, weight changes, and time management stress (Yang et al., 2018). Based on the per-protocol findings, the intervention group showed a statistically significant decrease in stress levels according to the PSS compared to the control group. The intervention group also showed improvement in well-being over time (Yang et al., 2018). Interestingly, only the observing subscale of the FFMQ showed a significant increase in the intervention group versus the control group. The other four subscales of the mindfulness questionnaire showed no difference in groups over the course of the intervention (Yang et al., 2018).

The authors of this study relayed that their primary purpose was to determine the feasibility, efficacy, and effectiveness of a mobile phone application for meditation in medical students (Yang et al., 2018). They concluded that a mobile phone application would certainly be an approachable tool to assist in stress management in medical students. However, they did feel that they may have overestimated the amount of time medical students were willing to allot to the mobile meditation. Of the 45 students in the intervention group, only 27 (60%) of the group used the Headspace app at least once during the intervention period (Yang et al., 2018).

The authors admitted that their intention was to provide the students with only the instructions to log on and download the application. After the initial instructions were given, there was no further contact with the students until the end of the 30-day period (Yang et al., 2018). The purpose of this design was to see whether the medical students were motivated enough to follow through with the intervention without outside reminders or accountability (Yang et al., 2018). This is unlike the studies that used mindfulness-based programs where weekly contact with participants and frequent accountability measures were crucial for their study design. Limitations of this study include selection bias and response bias in the setting of self-reported questionnaires. The authors also noted that the intervention period was shorter than previous studies of similar design (Yang et al., 2018).

In contrast to meditation alone, Lavadera et al. (2020) designed a study that combined meditation and aerobic exercise to reduce stress and improve overall wellbeing. The authors looked at a group of 47 medical students in their first and second year of training (Lavadera et al., 2020). The study intervention was based on a brain fitness program called MAP Train My Brain™ that combines mental and physical (MAP) trainings. The program traditionally consists of a 30-minute silent meditation followed by 30 minutes of aerobic exercise (Lavadera et al.,

2020). Lavadera et al. (2020) decided to also incorporate a 30-minute didactic portion prior to the meditation and exercise.

The authors described this didactic portion of the program as a way to educate the students on the benefits of meditation and aerobic exercise for brain and body health (Lavadera et al., 2020). The program lasted eight weeks and students were to attend the sessions once weekly. Participants in both the intervention and control group completed questionnaires before and after the training. The authors used PSS to measure stress levels (Lavadera et al., 2020). Results showed a statistically significant reduction ($p < .05$) in the PSS after MAP training when compared to the control group. It is difficult to isolate the effects of exercise versus meditation on stress levels in this study. Furthermore, this is the first study with medical students that included a combined intervention of meditation and aerobic exercise. There was a high dropout rate which the authors reported as a limitation for this study as well (Lavadera et al., 2020).

Mindfulness and Academic Performance

This literature review also aimed to look at the effect of mindfulness practices on academic performance in students studying health sciences. There was a large body of literature that examined mindfulness and academic performance in school aged children, however, there was minimal evidence looking at older students in health-related sciences.

In a study conducted by Lampe & Muller-Hilke (2021), medical students completed mindfulness training over the course of six weeks. The authors aimed to find a relationship between mindfulness, perceived stress, and academic performance. Evaluations were completed at three different intervals which resided around three various exam subjects (physiology, anatomy, pathophysiology). A comparison of the anatomy exam scores of the control and

intervention group was completed. Results indicated students who completed the MBSR program scored significantly better on the exam than the control group ($p < 0.0014$; Lampe & Muller-Hilke, 2021). Interestingly, there was no difference between the control and intervention group's exam scores in the subjects of pathophysiology and physiology (Lampe & Muller-Hilke, 2021). When reviewing the entire cohort, the authors discovered that stress was inversely related to exam results in physiology ($p = 0.0004$; Lampe & Muller-Hilke, 2021)

Niedermeier et al. (2021) conducted an observational study with nursing students looking at the relationship of exercise and mindfulness on mental health and academic achievements. A total of 121 students participated in the study. Data was collected using the Generalized Anxiety Disorder-7 (GAD-7), the Patient Health Questionnaire-9 (PHQ-9) and Cognitive and Affective Mindfulness Scale-Revised (CAMS-R; Niedermeier et al., 2021). The authors found a small positive association between mindfulness and grade point average (GPA), though not statistically significant. This data suggests that an increase in mindfulness could be associated with an increase in GPA (Niedermeier et al., 2021). The authors also found no definitive correlation between exercise and GPA or between depression/anxiety and GPA (Niedermeier et al., 2021). According to the authors, the small sample size was felt to be a major limitation to the study, specifically in relation to the study design (Niedermeier et al., 2021). Lastly, the questionnaires and GPA scores were self-reporting which could have led to an inflation in what students were reporting for their grades and exercise routines.

The literature review previously discussed by McConville et al. (2017) also examined the effect of mindfulness on academic performance. Only two articles were reviewed for this subtopic. The articles only used meditation as the intervention and did not integrate any mindfulness-based interventions (McConville et al., 2017). There was no improvement in

academic scores after the intervention period in either article. One study did reveal that students felt the meditation intervention had positive effects on their learning (McConville et al., 2017).

One of the major benefits of having a routine mindfulness practice is learning how to regulate emotions. Emotional regulation is often associated with emotional intelligence. Beauvais et al. (2014) looked at 124 undergraduate and graduate nursing students to determine if emotional intelligence was related to academic performance based on GPA. Interestingly, emotional intelligence in the undergraduate population was not related to academic success, however the authors did find a correlation in the graduate population (Beauvais et al., 2014). Graduate students who scored higher in emotional intelligence also had improved academic scores (Beauvais et al., 2014). What the authors also found was that students who demonstrated an ability to regulate emotions had improved academic performance as well (Beauvais et al., 2014). Beauvais et al. (2014) also discovered a link between psychological empowerment, resilience, and academic success. Students who felt empowered and confident in their academic abilities were more likely to have improved scores (Beauvais et al., 2014). This idea is also referred to as self-efficacy (Phang et al., 2015). Additionally, students who were able to recover emotionally after a stressful event (i.e., poor exam scores) were labeled as resilient and found to have superior academic performance compared to those who did not possess resilience (Beauvais et al., 2014). Building resilience is often correlated with mindfulness practices.

Discussion

Student registered nurse anesthetists are experiencing a substantial amount of stress that is interfering with their physical and mental health (Chipas et al., 2012). The use of mindful based stress reduction programs has proven to be highly effective at decreasing stress in many graduate students (Chung et al., 2018; Minichiello et al., 2020; Phang et al., 2015). Additionally,

academic performance has also been shown to benefit from mindfulness practice (Lampe & Muller-Hilke, 2021; Niedermeier et al., 2021). Although stress is likely inevitable in these intense graduate studies, it is clear there are ways to mitigate its consequences and create space for respite from the stress response.

Long periods of chronic stress can impair memory function in the brain (Sathyapalan et al., 2017). Students enrolled in a nurse anesthesia program are required to memorize and conceptualize large amounts of information in a short period of time. The literature suggests that extreme stress experienced by an SRNA could prove to be a barrier in the efficiency and efficacy of memorization (Sathyapalan et al., 2017). The optimization of brain function and memorization is critical for a student's success. The use of MBSR programs could greatly enhance their performance by decreasing stress and improving memory in both the academic and clinical setting. Stress has also been linked to an increase in inflammatory markers and a decrease in immune function (Hannibal & Bishop, 2014; Pahwa et al., 2020). If students are less stressed, they may be more likely to perform better on exams, require less days off due to illness, excel in the clinical setting and have an overall positive educational experience. The increased success and overall wellbeing of the students could benefit the reputation of the university and its program administration. This further affirms the value of integrating MBSR programs into the curricula.

Based on the literature review, incorporation of MBSR programs directly into the curriculum seems to provide the greatest benefit for students. Accountability is a large factor for the success of these programs. Attendance on a volunteer basis is likely to be an obstacle for students who have no interest in, or awareness of mindfulness. The average five-to-eight-week mindfulness programs require a time commitment of around one to two hours per week.

According to the literature, students experience a greater amount of stress during the first year of education. This tends to decline and plateau over subsequent years in the program (McConville et al., 2017).

The design of the graduate curriculum would likely dictate when the MBSR course was proficiently implemented. For example, a front-loaded program with the first year including only online courses may introduce the MBSR program into their curriculum at this stage. Students in this type of program are likely to have more free time outside of classwork in their first year of school. Integration during this period would provide students with the tools and coping mechanisms to deal with the more challenging parts of the program that tend to follow the first year.

Programs that are considered integrative where didactic work and clinical experience start early in the program, may benefit from implementing the MBSR course at a different time compared to the front-loaded programs. For example, it could be required that students complete an online five-week MBSR course prior to the initial start date of the program. This approach is not unlike the required reading prior to a start date that often accompanies graduate programs. To maintain accountability with this style of integration, students would have to present or submit homework, similar to the homework mentioned in research that was reviewed by McConville et al. (2017).

It is difficult to determine whether an in-person or virtual MBSR program would be better for the students and university administration. Multiple factors would need to be considered for both approaches including, but not limited to, the following: student's accessibility to the online program or access to campus if in-person, cost analysis of having an in-person mindfulness coach versus online prerecorded programs, accountability of students in

an online program versus mandatory classroom meetings, and the value of the MBSR program for students versus the challenge and cost it may bring to the university.

Gaps & Limitations

There are many limitations to this review, the most pronounced being small sample sizes for all the research studies. Additionally, many of the tools used to collect data were self-reporting making it impossible to confirm the validity of results. The investigators of the studies were often the ones teaching or coaching the mindfulness programs as well. This could have affected participation and responses leading to an increased risk of the Hawthorne effect. The only study design that the Hawthorn effect does not apply to is the one that used a mobile meditation application. The design and environmental factors varied greatly throughout the studies resulting in difficulty comparing the findings.

Many of the study populations were largely female dominated. Only one study compared the effect of gender differences and perceived stress levels. More insight around the differences in gender and perceived stress could be valuable. A single study was found that included student registered nurse anesthetists which proves to be a major gap in the literature. Further studies with the SRNA population should be considered given they often endure similar stressors to medical students and residents. Lastly, there is a scarcity of data looking at mindfulness and its effect on academic performance in graduate health science programs. Future research on how to improve academic performance will always benefit the student and would be advantageous to universities with health science programs as well.

Conclusion

Mindfulness based stress reduction programs can provide students with tools to manage their stress and improve their academic performance. A reduction in stress through mindfulness

will likely improve a student's overall wellbeing, increase their capacity to learn, and change the way they interact with both patients and their peers. Additionally, emotional intelligence, self-efficacy and stress management skills are qualities to be gained from mindfulness training as well. These skills and attributes will not only benefit the student during their time in a university setting but will also translate into their everyday life after graduation and in the workplace. It is up to the university administration to determine how much value they place on mindfulness training and how they feel it could be implemented into the curriculum.

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