

2022-09

# An Intervention to Enhance Mental and Physical Health of Nursing Students

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Ciezar Andersen, S. (2022). An intervention to enhance mental and physical health of nursing students (Doctoral thesis, University of Calgary, Calgary, Canada). Retrieved from <https://prism.ucalgary.ca>.  
<http://hdl.handle.net/1880/115217>

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UNIVERSITY OF CALGARY

An Intervention to Enhance Mental and Physical Health of Nursing Students

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREE OF DOCTOR OF PHILOSOPHY

GRADUATE PROGRAM IN NURSING

CALGARY, ALBERTA

SEPTEMBER, 2022

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## **Abstract**

Nursing students exhibit some of the highest symptoms of depression, anxiety, and stress relative to students in other health-related disciplines and to their counterparts outside of university. Up to 50% of nursing students are sedentary, compromising their physical health and exacerbating risk for musculoskeletal injury. Yoga has been associated with improved mental and physical health in a variety of populations. With the ORBIT Model as a guide to implementation, the first manuscript in this thesis consists of a systematic review exploring existing evidence of the effectiveness of yoga interventions for healthcare professionals and students (design phase, Phase I). This evidence was then used to plan and optimize protocol details for Phases IIa and IIb. The process of undertaking a web-based yoga intervention was explored in a proof-of-concept study (Phase II a). After protocol refinement, a pilot study was conducted (Phase II b), and is described in the second manuscript. All 68 participants who completed the pilot study exhibited a significant decrease in symptoms of depression, anxiety, stress, and improved self-compassion and core endurance scores. While significant mental and physical health benefits following yoga intervention were demonstrated in this sample, 44% attrition rates were encountered during the course of the pilot study. Thus, retention challenges were explored and recommendations for further refinement and protocol optimization were the focus of the third manuscript.

*Keywords:* yoga, nursing students, physical health, mental health.

## **Preface**

We examined and described the effects of yoga intervention on the mental and physical health of undergraduate nursing students. The Obesity-Related Behavioral Intervention Trials (ORBIT) model for behavioral treatment development was followed through the design and implementation of this work (Czajkowski et al., 2015). The ORBIT Model provides a flexible process outline which consists of milestones; Phase I Design (1a Define; 1b Refine), Phase II Preliminary Testing (Phase 2a Proof-of-Concept; Phase 2b Pilot Testing), Phase III Efficacy Trial and Phase IV Effectiveness Trial. The process is iterative in nature allowing for a return to earlier stages for refinement and optimization if needed.

In Chapter 1, rates of mental and physical health problems among post-secondary students, and nursing students in particular, are described. The potential for a yoga intervention to improve mental and physical health outcomes based on research with other groups is described. The chapter concludes with a clear statement of the primary and secondary hypotheses guiding this research.

In keeping with Phase Ia of the ORBIT Model, a systematic review of what is currently known about the effects of implementing a yoga intervention with helping healthcare professionals and students is included in Chapter 2. The small number of studies that have been undertaken with this group to date are narratively summarized. Additionally, methodological challenges (such as lack of transparency of intervention protocols) of previous studies are identified. Findings of this review were used as a guide in the design the Phase IIa (Proof-of-Concept) and Phase IIb (Pilot) studies.

The Phase IIb Pilot study, focused on undergraduate nursing students in Alberta, Canada, is described in Chapter 3. There were significant differences between baseline and post-intervention measures of depression, anxiety, stress, and core endurance of participants. However, high attrition of participants was encountered. Thus, Chapter 4 includes a reflection on why that may have occurred, as well as offering potential strategies for refining the intervention to reduce attrition in future studies.

Finally, the totality of this work is summarized in Chapter 5, along with acknowledgement of strengths and limitations of the research.

## **Acknowledgements**

I would like to acknowledge my supervisor, Dr. Kathryn King-Shier, who went above and beyond to get me to the finish line. I couldn't have done this without her support and encouragement.

## **Dedication**

I would like to dedicate this thesis to my partner in life, Patrick Andersen, and my three amazing children, Willow, Lukas, and Alexander, who have been so patient and encouraging throughout all these years.

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## List of Abbreviations

AC	Arterial Compliance
ACHA	American College Health Association
AI	Ascending Aorta Impedance
APS-S	Almost Perfect Scale- Revised
BHT	Breath holding time
BMI	Body Mass Index
BP	Blood pressure
CASP	Critical Appraisal Skills Programme
CBSM	Cognitive Behavioural Stress Management
CD-RS	Connor Davidson Resilience Scale
CES-D	Center for Epidemiologic Studies- Depression Scale
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CNA	Canadian Nurses Association
CNS	Central nervous system
CO	Cardiac Output
CS-R	Coping Stress Revise Questionnaire
DAMI	Design Algorithm for Medical Literature on Interventions
DASS	Depression Anxiety and Stress Scale
DBP	Diastolic blood pressure
DERS	Difficulties in Emotion Regulation Scale
Eg.	Exempli gratia (for example)
ET	Endurance Test
et al.	Et Alia (and others)
FFMQ	Five Facets of Mindfulness Scale
GARS	Global Assessment of Recent Stress Scale
GHQ	General Health Questionnaire
GSR	Galvanic Skin Resistance
HHP	Helping health professionals
HR	Heart rate
hr	hour
IBI	Inter-Beat Interval
JSE-HPS	Jefferson Scale
LSS	Life Stress Scores
LVET	Left Ventricular Ejection Time
MAP	Mean Arterial Pressure
MBI	Maslach Burnout Inventory
MBSR	Mindfulness-Based Stress Reduction
MCET	Mackenzie Core Endurance Test
min	minute
MOCS-A	Measure of Current Status- Anxiety

ORBIT	Obesity-Related Behavioral Intervention Trials
PANAS	Positive Affect Negative Affect Scale
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
ProQOL	Professional Quality of Life Scale
PSQI	Pittsburgh Sleep Quality Index
PSS	Perceived Stress Scale
RCT	Randomized control trial
RN	Registered Nurse
RPR	Resting pulse rate
RR	Respiratory rate
RYT	Registered Yoga Teacher
SARS	Spielberg Anxiety Rating Scale
SAS	Self-Assessment Scale
SBP	Systolic blood pressure
SCS	Self-Compassion Scale
SF	Short form
SMS	State Mindfulness Scale
SPSS	Statistical Package for the Social Sciences
SSTAI	Spielberg State-Trait Anxiety Inventory
SV	Stroke Volume
SWLS	Satisfaction With Life Scale
TIDieR	Template for Intervention Description and Replication
TPR	Total Peripheral Resistance
VAS	Visual Analog Scale
WHO	World Health Organization
WHOQOL-BREF	World Health Organization Quality of Life Scale Brief Version

## **Epigraph**

Don't sacrifice what you want most for what you want now.

-Peter Vidmar

## **Contribution of Authors**

For this thesis the following three manuscripts have been published or submitted for publication. The first author wrote each of the manuscripts with the guidance of her supervisor, senior authors, and/or supervisory committee. All authors critically revised the manuscripts and contributed intellectually to each work. Following written permission from the publisher and coauthors, the following manuscripts have been reproduced in their entirety as chapters in this thesis.

Ciezar-Andersen, S. D., Hayden, K. A., & King-Shier, K. M. (2021). A Systematic Review of Yoga Interventions for Helping Health Professionals and Students. *Complementary Therapies in Medicine*, 102704.

Ciezar-Andersen, S. D., White, D. Campbell, T. & King-Shier, K. M. (2022). An Intervention to Improve Mental and Physical Health of Undergraduate Nursing Students.

Ciezar-Andersen, S. D., White, D. Campbell, T. & King-Shier, K. M. (2022). Retention Challenges During a Study of the Effect of an Online Yoga Program on the Mental and Physical Health of Undergraduate Nursing Students.



## **Chapter 1: Mental and Physical Health of Nursing Students**

Mental health problems are common among young adults, with the prevalence of the most common disorders, namely depression, anxiety, and stress reaching a peak between ages 19 and 29 (Bayram & Bilgel, 2008; Gustavson et al., 2018; Kessler et al., 2007). Having mental health problems in early adulthood increases the risk of them recurring in later adulthood (Copeland et al., 2013; Johnson et al., 2009; Kessler et al., 2008; Veldman et al., 2015). Poor mental health is associated with an increased risk of onset of a wide range of chronic physical conditions, substance abuse, and suicide (De Beurs et al., 2019; Scott et al., 2016; Walker & Druss, 2017). The mental health of post-secondary students is significantly poorer than that of young adults of similar age outside of post-secondary institutions (Arsandaux et al., 2021; Jimenez et al., 2010; Myers & Mobley, 2004). 33% of post-secondary students report depressive symptoms and 24% report anxiety compared to 16% and 15%, respectively, of non-students of similar age (Arsandaux et al., 2021). Nursing students exhibit some of the highest rates of mental disorders associated with depression, anxiety, and stress compared to students in other health-related disciplines (Basu et al., 2016; Cooke et al., 2006; Jimenez et al., 2010; Myers & Mobley, 2004). Based on a recent survey, 17.6% of nursing students report 'tremendous' stress, compared to 6.9% of the general student body (Bartlett et al., 2016). In addition to complicating their adjustment to postsecondary education, these mental health problems can adversely affect students' physical health, personal development, academic achievement, and quality of life (Bayram & Bilgel, 2008). Mental health has been shown to improve through mindfulness-based programs that promote self-

compassion such as yoga, which may decrease depression, anxiety, and stress (Beaumont et al., 2016; Gard et al., 2012; Shikai et al., 2009; Song & Lindquist, 2015; Warnecke et al., 2011).

The severity and number of mental health problems among university students is on the rise (Chernomas & Shapiro, 2013). According to a recent survey, 52% felt so depressed that it was difficult to function, 69% felt overwhelming anxiety, and 61% of Canadian students felt above average or tremendous stress within the past 12 months (American College Health Association, 2019). Despite launching mental health initiatives across Canadian campuses since publication of the last survey results in 2016 (e.g., the University of Calgary's Campus Mental Health Strategy), the statistics for all three (depression, anxiety, and stress) have continued to rise (American College Health Association, 2016, 2019). 77% of students who might benefit from mental health services tend not to seek out these resources (Auerbach et al., 2016). Further, most university counseling services are limited in the number of students they can help and do not have adequate supports to meet the needs of students (Cook, 2007; Gibson, 2019; Hensley, 2019; Lipson et al., 2019; Xiao et al., 2017).

Nursing students across North America report poor overall mental health, with 70% reporting above average stress (Davidson et al., 2012; Gambla et al., 2017; Griggs, 2017). The prevalence of mental disorders among nursing students is higher compared to students in other health-related disciplines (Bartlett et al., 2016; Basu et al., 2016; Cooke et al., 2006; Dooris, 2001; Jimenez et al., 2010; Myers & Mobley, 2004). The main sources of anxiety and stress among nursing students include clinical practice issues,

academic concerns, and personal matters (Chernomas & Shapiro, 2013; Oner Altioik & Ustun, 2013). Compromised mental health in future nurses may result in negative emotional states and disease, compromised quality of care, and increased error and nosocomial infection rates (Labrague, 2013; Melnyk et al., 2018; Moss et al., 2016; Straub & Cutolo, 2017). Further, upon graduation, these new nurses become part of a highly psychologically demanding profession, without being adequately prepared to cope with the potential demands (Choi & Brings, 2015; Labrague et al., 2017; Pugh et al., 2019; Steege et al., 2015; Tharani et al., 2017).

As nursing students graduate, they may take positions as nurses in stressful or anxiety-provoking roles, further exacerbating depression, anxiety, and stress (Basu et al., 2016). High levels of these mental problems are associated with high levels of burnout—a syndrome whereby the individual experiences overwhelming exhaustion, feelings of cynicism, detachment from the job, and a sense of ineffectiveness and lack of accomplishment (Creedy et al., 2017; Haghghi & Gerber, 2019; Hunter et al., 2019; Martínez-Monteagudo et al., 2019; Maslach et al., 1986; Maslach & Leiter, 2006; Schonfeld & Bianchi, 2016). Burnout syndrome starts at the early stages of training and worsens during practice with work environment stressors (Njim et al., 2018). Based on longitudinal studies of new graduates in Ontario, 66% report burnout (Cho et al., 2006) and 49% are severely burned out within the first three years of practice (Laschinger et al., 2010; Maslach & Leiter, 2006). Kovner and colleagues (2010) found that 41% of new graduate nurses planned to quit their first job within the first three years of practice.

Similarly, Boamah and Laschinger (2016) reported that 55% of new Canadian nurses surveyed intended to leave their current job within three years.

In addition to burnout, poor mental health characterized by depression, anxiety, and stress can culminate in chronic physical problems including hypertension, cardiovascular disease, immune disorders, obesity, musculoskeletal conditions, carcinogenesis, and even suicide (Cohen et al., 2007; Greenglass & Burke, 2016; Guo et al., 2016; McVicar, 2003; Ross et al., 2017). A program teaching self-management of mental health may provide benefits to nursing students in their academic program and may enhance their future professional nursing practice (Song & Lindquist, 2015).

It is well-established that physical activity has a number of physical and mental health benefits (Carlson et al., 2015; Kyu et al., 2016; Micalos et al., 2017; Nguyen-Michel et al., 2006). In addition to improving daily physical functioning and reducing the risk of injury and chronic disease, physical activity is inversely related to depression, anxiety, and stress (Biddle & Vergeer, 2020; Durstine et al., 2013; Fletcher et al., 1996; Penedo & Dahn, 2005; Ströhle, 2009; Stubbs et al., 2018). In a survey of Canadian campuses, 61% of post-secondary students did not meet the American Heart Association's guidelines for sufficient physical activity, and 75.8% of university students surveyed had not exercised in the past week (American College Health Association, 2019).

Nursing students are less likely than students in other health disciplines to participate in regular physical activity (Blake et al., 2017; Micalos et al., 2017) and up to 50% have been found to be sedentary (Deasy et al., 2016; Garrett et al., 2019; Irazusta et

al., 2006; Lehmann et al., 2014). This trend continues as nursing students graduate and join the workforce. Fifty percent of working nurses report low physical activity levels, predisposing them to mental health problems and musculoskeletal injury, particularly back injury (Jinks et al., 2003; Malik et al., 2011; Schall Jr et al., 2016; Torquati et al., 2017).

Back injury is rampant within the nursing profession, surpassing rates among workers in the construction sector, and 80% of nurses sustain musculoskeletal injury over the course of their nursing career (Geiger-Brown et al., 2004; Nelson et al., 2003; O'Brien-Pallas et al., 2004; Thinkhamrop et al., 2017; Vendittelli et al., 2016). High prevalence rates of low back pain among nurses start as early as nursing school (Menzel et al., 2016), and 40% of new graduate nurses report sprains, strains, and back injuries within two years of commencing practice (Brewer et al., 2012).

In a recent systematic review of interventions for musculoskeletal injuries in nurses, Van Hoof and colleagues (2018) highlighted the importance of focusing on key pain provocative behaviours such as sustained and repetitive manual nursing tasks and cumulative stress-related movements. In order to change the patterns of these repetitive tasks, a focus on improving the nurses' physical health, particularly back health through improving core endurance, is needed (Pugh et al., 2019; Van Hoof et al., 2018).

Yoga, originating in India, has gained popularity in the West over the past two decades (Ding & Stamatakis, 2014). While over 46 styles of yoga exist, Hatha and Iyengar styles (closely related) are most commonly studied for their mental and physical benefits in a wide variety of populations (Field, 2016; McCall et al., 2013; Whitehead,

2018). For the proposed study, a combination of Hatha (known for holding postures) and Iyengar (known for meticulous attention to proper alignment) yoga will be used for class design. Yoga practice generally consists of three key aspects; physical postures (asanas), breathing work (pranayama), and mindfulness of movement. Engaging in yoga has consistently shown more beneficial effects than other forms of physical activity at improving a number of health-related psychological and physical outcomes (Govindaraj et al., 2016; Kaviya et al., 2019; Moore et al., 2019; Ross & Thomas, 2010).

The benefits of yoga practice to mental and physical health are well-established. Yoga has been shown to reduce depression, anxiety, and stress in a variety of groups including healthy adults, adolescents, and those with chronic conditions (Chong et al., 2011; Duchemin et al., 2015; Field, 2016; Gaskins et al., 2014; Lin et al., 2015; Pascoe & Bauer, 2015; Pascoe et al., 2017; Riley & Park, 2015; Sharma, 2014; Sieverdes et al., 2014).

The exact mechanism by which yoga practice improves mental health of participants remains unclear. However, one hypothesis is yoga practice enhances mindfulness and positive reframing and improves positive affect and self-compassion (Duhoux et al., 2017; Guillaumie et al., 2017; Riley & Park, 2015; Woodyard, 2011). Mindfulness and self-compassion then lead to decreased depression, anxiety, and stress by enhancing coping ability (Bridges & Sharma, 2017; Field, 2016; Gard et al., 2012; Guillaumie et al., 2017; Mathad et al., 2017; Riley & Park, 2015).

Mindfulness is defined as becoming more aware of thoughts and feelings and opening fully to one's experience. The focus of mindfulness-based interventions is on

altering the impact and response to thoughts, feelings, and sensations (Bishop et al., 2004). Mindfulness-based interventions are inversely associated with depression, anxiety, and stress in nursing students (Shirey, 2007; Song, 2011). Interestingly, while mindfulness appears to be a key precursor to mental wellness, studies comparing Mindfulness-Based Stress Reduction (MBSR) and yoga revealed that yoga may be more effective than MBSR at reducing depression, anxiety, and stress after as little as four weeks of intervention (Falsafi, 2016; Hunt et al., 2018). In addition to the prolific evidence of mindfulness-based programs at improving mental wellbeing (Carsley et al., 2018; Cerna et al., 2020; Janssen et al., 2018; Shapiro et al., 2016; Spijkerman et al., 2016), self-compassion has also been implicated in positive mental health (MacBeth & Gumley, 2012; Neff, 2011; Neff et al., 2005; Neff, Rude, et al., 2007; Raque-Bogdan et al., 2011; Ying, 2009). Enhanced self-compassion has been implicated as the means by which yoga improves mental wellbeing of participants (Erkin & Şenuzun Aykar, 2021; Riley & Park, 2015).

Self-compassion is an emotionally positive self-attitude or self-kindness, that protects against the negative consequences of self-judgment, isolation, and rumination (Neff, 2003). In a meta-analysis MacBeth and Gumley (2012) concluded that a strong association exists for the relationship between self-compassion and mental wellbeing. Other studies have reported similar positive associations between self-compassion and mental well-being (Neely et al., 2009; Neff & McGehee, 2010; Shapiro et al., 2007). Self-compassion also has been shown to be positively related to scholastic performance, optimism, positive affect, and resilience, and negatively to self-reported anxiety and

depression (Neff et al., 2005; Neff, Kirkpatrick, et al., 2007; Neff, Rude, et al., 2007).

The potential benefits of yoga to decrease depression, anxiety, and stress through increasing mindfulness and self-compassion have not been explored among nursing students in Canada.

In addition to its psychological benefits, yoga practice has an array of physical benefits including strengthening the core (Field, 2016; McCall et al., 2013). The core, or the lumbopelvic-hip complex, is composed of a number of muscles and serves as a muscular corset to stabilize the body and spine. Strengthening these muscles is key to providing core stability to improve functionality and reduce the probability of musculoskeletal injury (Akuthota & Nadler, 2004; McGill, 2015; Willson et al., 2005). Core strengthening accomplished through yoga has been directly linked to the alleviation of low back pain (Amin & Goodman, 2014; Chang et al., 2015; Field, 2016; Gordon & Bloxham, 2016; Highland et al., 2018; Ni et al., 2014; Sagadore et al., 2017). Additionally, authors of a recent Cochrane systematic review concluded that yoga appears to be more effective than non-exercise and other exercise interventions at relieving low back pain (Whitehead, 2018).

Stability and control of the spine is dependent not only on the muscles but also on the central nervous system (CNS) which must determine the requirements of stability to plan and implement strategies that meet these demands (Panjabi, 1992). Mindful movement through yoga practice has the additional benefit of creating this increased body awareness, or proprioception (Holzel et al., 2011; Shim et al., 2018; Wooten et al., 2018). The hypothesis was that proprioception helps yoga participants use proper body



mechanics and alignment to prevent physical injuries (Ghiasinezhad et al., 2016). Riva and colleagues (2016) reported that proprioceptive awareness reduced the likelihood of various sprains and low back pain by as much as 81%. Yoga practice has the potential to improve the core physical endurance and proprioception of future nurses, thereby improving their core stability and lowering their risk of musculoskeletal injury. Endurance tests, such as the Mackenzie Core Endurance Test used in the present study, are the most reliable predictors of core stability and improved musculoskeletal health (Mackenzie, 2005; McGill, 2015; McGill et al., 1999; Translating Research Evidence and Knowledge, 2019; Waldhelm & Li, 2012).

While yoga interventions delivered online are quite novel, evidence is emerging that these web-based classes may be just as effective as in-person intervention delivery (Martini et al., 2017). Huberty et al. (2019) found yoga intervention delivered online reduced fatigue, anxiety, depression, and sleep disturbance in cancer patients. Online yoga classes have also been demonstrated to be effective at improving muscle strength, endurance, and flexibility (Martin & Candow, 2019). Web-based yoga interventions may be particularly well-received by university students and may even decrease attrition by allowing for flexibility in timing and eliminating the need for travel to and from class (Casucci & Baluchi, 2019; Strahm et al., 2016).

In summary, yoga has the potential to have a positive effect on the mental and physical wellbeing of nursing students. However, this has not been empirically examined. Thus, the purpose of this study was to examine the effectiveness of a yoga intervention on improving mental and physical health of undergraduate nursing student participants.

**Primary Hypotheses:** The participants will demonstrate significantly improved mental health scores (including symptoms of depression, anxiety, stress) and self-compassion scores over time.

**Secondary Hypothesis:** The participants will demonstrate significantly improved physical health scores as measured by core endurance over time.

## Chapter 2: Literature Review

In Chapter 1 the importance of mental and physical health to the overall well-being and future success of nursing students is illustrated. Little is known about the effects of a yoga intervention on helping health professionals and students, and less is known about its effects on nursing students. The manuscript that follows was designed to examine the effectiveness of yoga interventions for the prevention and reduction of mental and physical disorders among HHPs and HHP students. It was published in *Complementary Therapies in Medicine* in May, 2021. The systematic review protocol was published with Prospero (CRD42019138179) prior to commencement. Permission to include manuscript in the dissertation has been obtained from co-authors (Appendix A) and the publisher (Appendix B).

This chapter is published as:

Ciezar-Andersen, S. D., Hayden, K. A., & King-Shier, K. M. (2021). A systematic review of yoga interventions for helping health professionals and students. *Complementary Therapies in Medicine*, 58, 102704.

## **A Systematic Review of Yoga Interventions for Helping Health Professionals and Students.**

### **2.1 Abstract**

Helping Health Professionals (HHP) and HHP students are among the highest risk occupational groups for compromised mental and physical health. There is a paucity of information regarding preventive interventions for mental and physical health in this group of healthcare providers. The objective of this review was to examine the effectiveness of yoga interventions for the prevention and reduction of mental and physical disorders among HHPs and HHP students. An exhaustive systematic search was conducted in May, 2020. Databases searched in the OVID interface included: MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily, Embase, and PsycINFO. EbscoHost databases searched included: CINAHL Plus with Full Text, SPORTDiscus with Full Text, Alt HealthWatch, Education Research Complete, SocINDEX with Full Text, ERIC, and Academic Search Complete. Scopus was also searched. The search yielded 4,973 records, and after removal of duplicates 3,197 records remained. Using inclusion and exclusion criteria, titles and abstracts were screened and full text articles (n=82) were retrieved and screened. Twenty-five studies were identified for inclusion in this review. Most frequently reported findings of yoga interventions in this population included a reduction in stress, anxiety, depression, and musculoskeletal pain. It is our conclusion that mental and physical benefits can be obtained through implementation of yoga interventions for HHPs and HHP students

across a variety of settings and backgrounds. However, researchers would benefit from following recommended guidelines for the design and reporting of yoga interventions to improve study quality and rigour.

## **2.2 Introduction**

Helping Health Professionals (HHP) and HHP students are among the highest risk occupational groups for compromised mental and physical health [1-6]. Effects of this include increased stress, anxiety, depression, obesity, insomnia, and alcohol or drug abuse [7, 8]. Other consequences include compromised quality and safety of patient care, and lead to significant economic losses through increased absenteeism, poor retention, higher turnover rates and a rise in health care costs [9-11].

There is a paucity of information regarding the effectiveness of preventive interventions for mental and physical health of HHPs and HHP students [1, 12]. Systematic reviews have been undertaken to examine the effectiveness of yoga in a variety of conditions [13-17]. Despite the high-risk profile of HHPs, to date, the effectiveness of yoga in reducing stress in the healthcare worker population, has been examined in only one non-exhaustive review which used only two databases and poorly defined search criteria [18].

A potential preventive intervention, yoga practice may be of particular benefit to HHPs and HHP students given their high risk for compromised mental and physical health [16, 19-21]. The objective of this review was to examine the effectiveness of yoga interventions for the prevention and reduction of mental and physical disorders among HHPs and HHP students. A systematic review protocol was registered with PROSPERO (CRD42019138179) prior to commencement.

## **2.3 Methods**

### **2.3.1 Review Question**

What is currently known about the effects of a yoga intervention for HHPs and HHP students?

### **2.3.2 Participants/Population**

To the best of our knowledge, a singular definition of what constitutes the concept of a ‘helping health professional’ does not exist. A stepwise systematic approach was taken to elucidate the concept of ‘helping health professional’ and clearly identify boundaries of the population in question and avoid ambiguity (Appendix C). The definition incorporates ‘health professional’ and ‘helping professional’ based on the WHO’s aggregate data definition, World Health Professions Alliance’s Definition, International Labour Organization’s Definition, and ‘Health Professionals’ as defined by the Alberta Health Professions Act [22-26]. Following these guidelines, we defined HHPs to include members of an organized association incorporating self-regulation, advanced training, and specific expertise whose primary objective is the promotion of mental and/or physical health, from which they derive an income. The focus on health rather than self-actualization excludes professions such as ministry, teaching, or coaching, which would otherwise be included as ‘helping professionals.’ All HHPs including specialty medical doctors, nurses, dentists, dental hygienists, dieticians, physiotherapists, occupational therapists, paramedics, psychologists, as well as residents and students in all of these professions were included.

### **2.3.3 Intervention/exposure**

For the purposes of our search, a yoga intervention was defined as one that must encompass three elements: asanas (postures), pranayama (breathwork), and meditation/mindfulness. Studies were included regardless of the duration or frequency of the intervention.

### **2.3.4 Study Design**

An exhaustive systematic search was developed by a senior research librarian (KAH) in collaboration with the research team, and in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [27]. The search strategy included subject headings (translated for each database) and keywords held constant (See Table 1 for the Medline search, conducted in May 2020). Databases searched in OVID included: MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily, Embase, and PsycINFO. EbscoHost databases searched included: CINAHL Plus with Full Text, SPORTDiscus with Full Text, Alt HealthWatch, Education Research Complete, SocINDEX with Full Text, ERIC, Academic Search Complete. Scopus was also searched. Reference lists of included studies were also reviewed. The search yielded 3,197 records after removal of duplicates. Using inclusion/exclusion criteria, titles and abstracts were screened independently by SCA and KKS. Consensus was reached and electronic copies of full text articles (n=82) were retrieved for further screening. Twenty-five studies were identified for inclusion in this review.

### **2.3.5 Inclusion and Exclusion Criteria**

Using the population, intervention (design), control, and outcome (PICO) approach, eligible studies were included if the intervention was: (1) clearly defined as ‘yoga’ and encompassed asanas, pranayama, and meditation/mindfulness; (2) not part of a multimodal intervention program; (3) targeted HHPs or HHP students; and (4) published in an English-language peer-reviewed journal.

Excluded articles were those intertwining multimodal interventions with yoga (e.g., yoga and stress management lectures), interventions not incorporating all three elements of yoga, study samples not exclusively consisting of HHPs or HHP students, or observational studies that did not employ an intervention.

### **2.3.6 Data Extraction and Analysis**

EndNote™ X8 was used to facilitate data management and duplicate removal. A data extraction table, informed by the Template for Intervention Description and Replication (TIDieR) Checklist [28], was used to organize data. Extracted data included country of origin, study design, sample characteristics, intervention details, data collection, and reported outcomes. Study designs were classified using the Design Algorithm for Medical Literature on Intervention (DAMI) tool [29]. Once the team completed a calibration exercise with the extraction table, one reviewer (SCA) extracted study data with a second reviewer (KKS) verifying the extracted data. Discrepancies in extracted data were resolved through discussion. A meta-analysis was not possible because of insufficient and heterogenous data.



### **2.3.7 Quality Appraisal of Individual Studies**

The Critical Appraisal Skills Programme (CASP) tools were used to appraise the studies in this review, including those for appraising randomized controlled trials, cohort, and qualitative studies (<https://casp-uk.net/casp-tools-checklists/>). Studies were categorized as high, moderate, or low quality based on risk of bias; a categorization based on randomization quality, selection bias, blinding of assessors, handling of missing data, and reporting methods. Once the team completed a calibration exercise with the risk of bias tools, one reviewer (SCA) assessed the studies, while a second reviewer (KKS) verified the data.

## **2.4 Results**

### **2.4.1 Strategy for Synthesis**

A narrative synthesis of findings was compiled structured around the type of intervention, target population characteristics, and outcomes. Narrative synthesis is a textual approach in which the research evidence of a diverse literature base is appraised to explain the findings [30]. This availed a focus on synthesis of findings rather than meta-analysis of data, a recommended approach when the topic of interest is emerging and poorly defined [30].

### **2.4.2 Description of Studies**

After the screening process, 25 studies met the inclusion criteria. Most studies were undertaken in India (n=10)[31-40] or the United States (n=8)[41-48]. Twelve of the studies were randomized controlled trials [33, 35-40, 46, 49-52], one quasi-experimental [43], nine employed single group pre-post designs (before-after) [31, 32, 34, 44, 47, 48,

53-55], two were qualitative (narrative inquiry [42] and phenomenology [45]), and one employed mixed methods (a pilot RCT and reflective writing) [41]. The majority of studies focused on medical (9/25) [31, 33, 35, 36, 40, 44, 47, 54, 55] and nursing (4/25) [34, 37, 42, 50] students. One study focused on speech and language pathology students [41] and another three on dental interns [32, 39, 48]. The remaining studies focused on practicing HHPs (nurses=6; [38, 45, 49, 51-53] dental hygienists=1; [43] mental healthcare providers=1; [46]).

There were 1,778 participants across all 25 studies, with 73% overall female; 8/25 studies [33, 37, 38, 41, 49-51, 53] engaged exclusively female participants and only five studies reported an even gender distribution [31, 36, 39, 40, 44]. The attrition rates ranged from none to 26%. Fourteen studies focused on young adults under the age of 30 [31-37, 39-42, 50, 54, 55].

### **2.4.3 Appraisal of Studies**

A summary of CASP quality assessments can be found in Tables 2-3. Sample sizes were predominantly small and a power calculation was provided for only 2/18 quantitative studies [37, 39]. The sample size ranged from 18-300, with a median of 64 participants. Nine of the twenty-three quantitative studies lacked a control group [31, 32, 34, 44, 47, 48, 53-55]. A replicable intervention protocol was reported in 9/25 studies [31, 32, 35, 38, 45, 47, 50, 54, 56]. Specific qualifications of the instructor delivering the intervention were reported in 9/25 studies [31, 42, 44, 46-48, 50, 55, 56], and intervention fidelity was addressed in one study [41]. Based on the CASP quality assessments, two studies were

scored high [46, 47], 14/25 studies were scored moderate [31, 33, 37-41, 44, 45, 49-51, 54, 55], and 9/25 were scored low [32, 34-36, 42, 43, 48, 52, 53] quality.

#### **2.4.4 Intervention Characteristics**

Duration of the intervention ranged from 20 minutes to 3 hours per session over a period of 1 week to 6 months. The majority of interventions took place once (8/25; [32, 37, 45-48, 50, 54]), or twice (6/25; [43, 44, 49, 52, 53, 55]) weekly, and all were delivered in person at the place of work or study, in groups of 6-44 participants. Three interventions incorporated an at-home individual practice component [39, 51, 54]. Hatha yoga was most frequently employed [42, 44, 53, 55] followed by Vinyasa [40, 43, 50]. Half of all studies (13/25; [31-36, 39, 41, 47-49, 52, 54]) did not specify the style of yoga beyond incorporation of the three elements (asanas, pranayama, and mindfulness/meditation).

#### **2.4.5 Effectiveness of Intervention**

A number of health-related outcomes were examined. These included reduction in stress (15/25; [32, 33, 36, 37, 39, 41, 42, 44-46, 49-51, 53, 55]), anxiety (8/25; [31, 33-36, 39, 46, 47]), improvement in overall wellbeing (8/25; [34, 35, 38, 42, 44, 48, 51, 52]), increased self-compassion (4/25; [37, 41, 42, 46]), increased concentration (4/25; [35, 44-46]), and reduction of depressive symptoms (5/25; [31, 38, 44, 46, 55]). Other outcomes included improved quality of patient care (3/25; [32, 42, 45]), mindfulness (6/25; [37, 42, 46-48, 56]), and a more positive outlook on life (6/25); [34, 37, 41, 44, 46, 50]. Physical health outcomes including heart rate and blood pressure were examined in five studies [33, 40, 46, 47, 54], and serum levels of stress and immune response chemicals were measured in one study [33]. Musculoskeletal aches and pains were examined in three

studies [32, 38, 43]. Health-related outcomes were predominantly through self-report.

The Perceived Stress Scale (6/25; [32, 37, 41, 44, 48, 55]), the Five Facets of Mindfulness Questionnaire (3/25; [46-48]) and the Spielberg State-Trait Anxiety Inventory (4/20; [33, 35, 36, 39]) were most common.

Most frequently reported findings of yoga interventions were improved general mental health including a reduction in stress and anxiety (15/25; [31, 33-39, 42, 44-46, 50, 53, 55]), and depression (7/25; [31, 38, 44-46, 53, 55]). It is not clear how long the benefits of the intervention persist following cessation of the intervention, as only three studies followed-up on participants; in both studies, health benefits were maintained at 4-weeks [41, 46, 52], and appeared to be maintained to 6-month follow-up in 1 study [46].

Reported physical benefits of yoga interventions included a significant reduction in musculoskeletal pain including low back pain (3/25; [32, 38, 43]), headaches, neck pain, and wrist discomfort (3/25; [32, 35, 43]). Other findings included cardiovascular improvements such as a reduction in blood pressure (4/25; [35, 46, 47, 54]). Overall, the synthesis of studies demonstrated that a yoga intervention has beneficial effects on a number of mental health outcomes, primarily reduction in depression, anxiety, and stress, in HHPs and HHP students. Physical benefits, particularly decreased musculoskeletal pain, were also reported in several studies.

#### **2.4.6 Participant Experiences**

Participants often reported benefits of incorporating principles learned during the intervention into daily routines such as controlled breathing patterns to manage anxiety and stress (4/25; [41, 42, 45, 49]) and increased self-awareness (7/25; [35, 37, 41, 42, 45-49]).

47]). An increased commitment to self-care practices and enhanced ability to focus on patient needs also emerged (5/25; [32, 35, 41, 42, 45]).

#### **2.4.7 Strengths and Weaknesses of Reviewed Studies**

A strength of the studies in this review included relatively low attrition rates. This is likely because study participants were largely volunteers who already had an interest in yoga. This may introduce bias however, as participants who already have a focus on improving their wellness, may respond more favorably to the intervention.

While researchers reported a number of benefits as a result of the yoga intervention, quantitative studies were often insufficiently powered to demonstrate statistical significance in a number of other outcomes (e.g., Mathad and colleagues [37] demonstrated a marked reduction in stress following intervention that failed to reach statistical significance). Additionally, an effect size (ES) was reported in only one study [37]. This is essential information for researchers when making sample size calculations [57, 58]. Finally, there was insufficient detail regarding intervention dose (6/25; [31-33, 42, 49, 52]), implementation detail (14/25; [33, 34, 36, 37, 39, 42-44, 46, 49, 51-53, 55]), or fidelity, for studies to be replicable (24/25; [31-40, 42-55]).

Most common weaknesses included insufficient recruitment details (11/25; [31-37, 40, 42, 49, 53]), not accounting for all participants who entered the trial (7/25; [32, 33, 35, 36, 45, 48, 53]), and minimal discussion of potential confounders in the design and/or analysis (14/25; [31-37, 40, 42, 48, 49, 52-54]). Additionally, data collection tools employed were not always validated or self-validated (4/25; [31, 32, 35, 39]) or modified from the standard validated version (3/25; [32, 34, 41]). Finally, it was not clear whether

assessors were blinded at the time of data collection (7/25; [33, 36, 40, 43, 50, 51, 54]), whether assessors were qualified to collect pertinent data (7/25; [33, 36, 40, 43, 46, 50, 54]), and whether tools were calibrated prior to use (7/25; [33, 36, 40, 43, 46, 50, 54]).

## **2.5 Discussion**

We identified that yoga is an effective intervention for use in the HHP and HHP student groups to improve a variety of health-related concerns. The most frequently reported benefits of intervention participation included a reduction in stress and anxiety [31, 33-39, 42, 44-46, 50, 53, 55], as well as improved coping in acutely stressful situations [32, 39, 53]. This is in keeping with other systematic reviews of yoga interventions in other participant groups [13, 18]. Yoga interventions in this group also resulted in decreased musculoskeletal aches and pains. This is consistent with previously published evidence demonstrating that yoga has a moderate effect on pain and functional outcomes across a range of musculoskeletal conditions [59-62].

Another frequently reported benefit of yoga intervention in HHPs and HHP students was an improvement in self-compassion and self-care practices [37, 41, 42, 46]. This is consistent with the findings of Gard and colleagues [63], who concluded that increased self-compassion as a result of yoga practice was a mediating factor for overall wellness and stress reduction in a population of young adults. Similarly, Neff and colleagues linked increased self-compassion to a reduction in perceived stress [64], and Raque-Bogdan and colleagues [65] identified self-compassion as a mediator to improved mental and physical health. Enhanced self-compassion may help explain the aforementioned reduction in perceived stress and anxiety as a result of yoga practice.

The main strengths of this review included a detailed systematic, thorough and reproducible search strategy led by a professional health sciences librarian, clearly defined inclusion and exclusion criteria, and objective assessment of the methodologic rigour of each included study. Thus, we are confident that the search was both systematic and complete. The limitations include that only English language studies were included in this review. Also, only peer-reviewed publications were included. Alternative health intervention studies are not always published in main-stream academic journals. Thus, we cannot rule out the possibility that we may have missed studies from other languages or not indexed in the databases searched. We echo Elwy and colleagues [66] contention that researchers examining yoga interventions need to attend more stringently to undertaking rigorously designed and executed studies. For example, despite attempts to standardize yoga intervention design and reporting (e.g. the Essential Properties of Yoga Questionnaire; [67]), the recommended guidelines have not been taken up by the research community [66-69].

## **2.6 Conclusion**

This review demonstrates that mental and physical benefits, particularly reduction in stress and musculoskeletal pain, can be obtained through implementation of yoga interventions for HHPs and HHP students across a variety of settings and backgrounds. Given the growing risk of mental and physical disorders in this group, we are cautiously optimistic that a yoga intervention can be a feasible option for promoting wellness at relatively low cost. However, researchers would benefit from following recommended

guidelines for the design and reporting of yoga interventions to improve study quality and rigour.

### **2.6.1 Funding**

This project was unfunded



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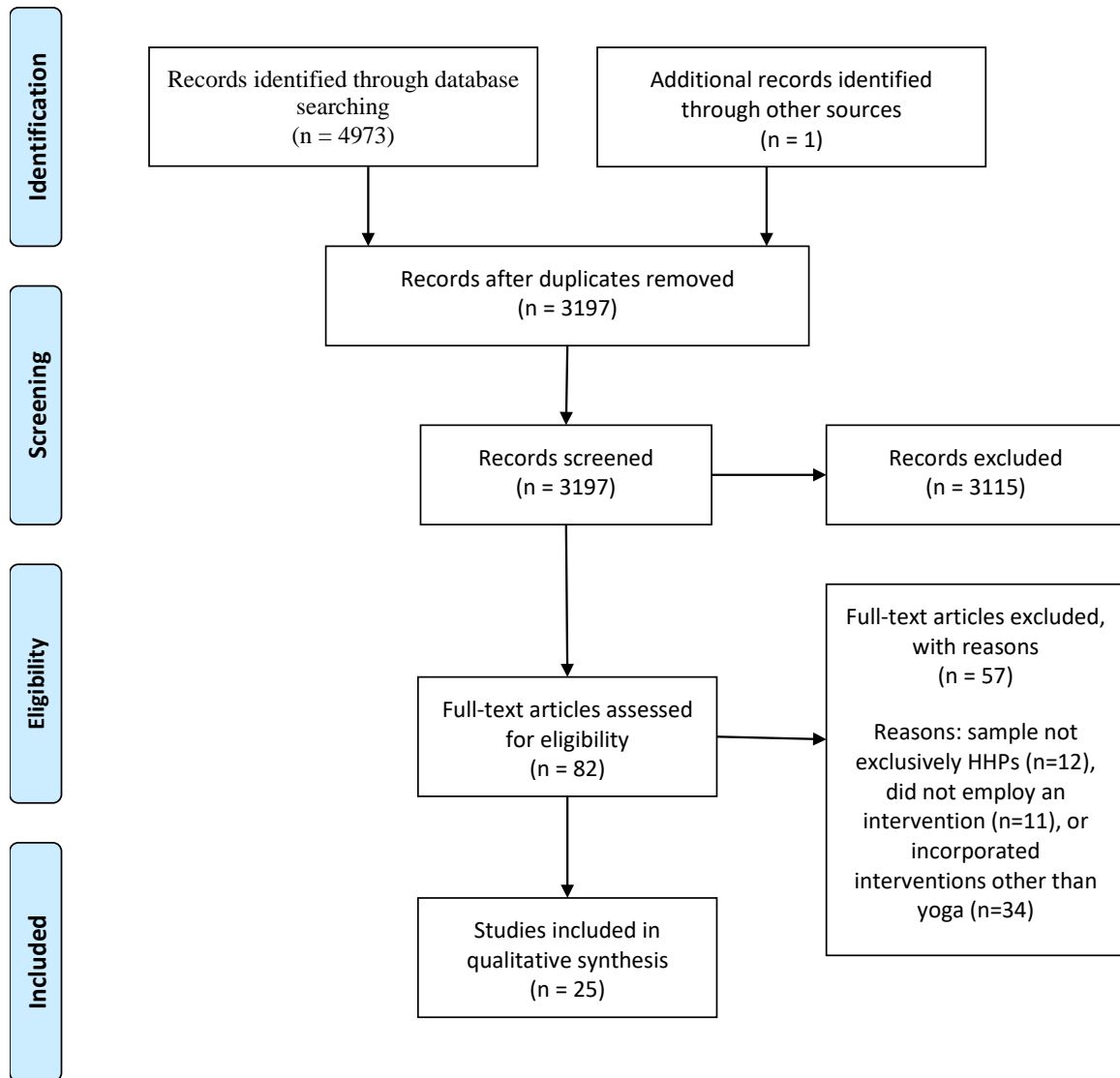
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## 2.8 Supplementary Appendix: Figures and Tables

Figure 1: PRISMA Flow Diagram



**Table 1: Final Search Strategy for Ovid MEDLINE(R) and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Daily 1946 to May 11, 2020.**

	#	Searches	Results
CONCEPT	1	exp YOGA/	2452
YOGA	2	yoga*.mp.	4569
	3	yoga-based.mp.	149
	4	yogic*.mp.	345
	5	yogic-posture*.mp.	8
	6	(hatha or ashtanga or bikram or iyengar or kripalu or kundalini or sivananda or vinyasa or raja or radja or bhakti or jnana or kriya or karma or yama or niyama or asana* or pranayama* or pratyahara or dharana or dhyana or samadhi or bandha or mudra or suryanamaskar).mp.	1935
	7	or/1-6	5798
	CONCEPT	8	exp Students, Nursing/ or exp Students, Medical/ or exp STUDENTS, HEALTH OCCUPATIONS/ or exp Students, Public Health/ or exp Students, Premedical/
HELPING PROFESSIONALS	9	exp "Internship and Residency"/ or exp PHYSICIANS/ or exp PHYSICIANS, PRIMARY CARE/	166786
	10	exp NURSES/ or exp LICENSED PRACTICAL NURSES/ or exp Midwifery/ or exp Nurse Midwives/	100734
	11	exp Medical Staff, Hospital/ or exp Nursing Staff, Hospital/ or exp Dental Staff/ or exp Nursing Staff/ or exp Medical Staff/ or exp Allied Health Personnel/ or exp Health Personnel/	476788
	12	exp DENTISTS/ or exp Dental Hygienists/	23045
	13	exp Nutritionists/ or exp Physical Therapists/ or exp Occupational Therapists/ or exp Social Workers/	2817
	14	exp Emergency Medical Technicians/	5530

15	(helping adj1 health* professional*).tw,kf.	47
16	(physician* or doctor* or resident* or intern or interns or Intensivist or internist* or trainee* or general practitioner* or gp).tw,kf.	697488
17	(nurse* or midwife or midwives* or nurse-midwife or nurse-midwives).tw,kf.	269736
18	(dietitian* or dietician* or nutritionist*).tw,kf.	9214
19	(physiotherapist* or ((physio or physical or occupational) adj1 therapist*)).tw,kf.	16678
20	(speech therapist* or (speech adj pathologist*)).tw,kf.	1561
21	(social worker* or psychologist* or Psychiatrist*).tw,kf.	43227
22	(dentist* or Endodontist* or Orthodontist* or Paedodontist* or Periodontist* or (dental adj1 (hygenist or practitioner* or assistant* or technician* or specialist* or personnel))).tw,kf.	80687
23	(acupuncturist* or naturopath or naturopaths or ayurvedic practitioner* or (chinese adj1 practitioner*)).tw,kf.	851
24	(emergency medical adj2 (personnel or worker* or technician* or practitioner* or professional* or staff)).tw,kf.	1576
25	paramedic*.tw,kf.	7523
26	(Anaesthetist* or anesthesiologist* or Cardiologist* or Gynaecologist* or Gynecologist* or Obstetrician* or Ophthalmologist* or Paediatrician* or Pediatrician* or Pathologist* or oncologist* or Radiologist* or Surgeon* or Stomatologist* or Feldscher).tw,kf.	343339
27	(health care aide* or healthcare aide* or personal care attendant* or nursing attendant*).tw,kf.	158
28	(student* adj3 (medical or nurs* or dentist* or dental* or mbbs or allied health or health profession* or social work or psychology or physiotherapy or physio therapy or physical therapy or occupational therapy or nutrition*)).tw,kf.	69570

	29	(medical adj2 (personnel or professional* or worker* or practitioner* or officer* or specialist* or technician* or staff)).tw,kf.	42391
	30	((health care or healthcare or health) adj2 (personnel or professional* or worker* or practitioner* or specialist*)).tw,kf.	143671
	31	(allied health adj2 (personnel or professional* or worker* or practitioner* or specialist* or staff)).tw,kf.	2430
	32	((surgical or clinical) adj2 (personnel or professional* or worker* or practitioner* or officer* or specialist* or technician* or staff)).tw,kf.	14134
	33	or/8-29	1687670
	34	7 and 33	643
	35	limit 34 to (address or autobiography or bibliography or biography or clinical conference or comment or dataset or dictionary or directory or editorial or interactive tutorial or interview or lecture or legal case or legislation or letter or news or newspaper article or patient education handout or periodical index or personal narrative or portrait or video-audio media or webcasts)	17
	36	34 not 35	626
	37	limit 36 to english language	598

**Table 2: Summary of CASP Quality Assessment for Randomized Controlled Trials.**

Author	Clear focus?	Randomized assignment?	All participants accounted for?	Blinding to treatment?	Groups similar at start?	Groups treated equally?	Size/precision of treatment effect?	Applicable to local context?	All important outcomes considered?	Do benefits outweigh harms/costs?	Overall
Akhani (2019)	✓	✓	x	x	✓	✓	x	✓	✓	✓	Moderate
Fang (2015)	✓	✓	✓	-	✓	-	x	✓	-	✓	Moderate
Gopal (2011)	✓	-	✓	-	-	-	x	-	-	✓	Moderate
Kim (2014)	✓	✓	✓	x	✓	-	x	✓	-	✓	Moderate
Malathi (1998)	-	-	-	✓	-	-	x	-	-	✓	Low
Malathi (1999)	-	-	✓	-	-	-	x	-	-	✓	Low
Mathad (2017)	✓	-	✓	-	-	✓	✓	✓	✓	✓	Moderate
Miyoshi (2019)	✓	✓	✓	x	✓	x	x	✓	✓	✓	High
Patil (2018)	✓	✓	✓	✓	✓	-	x	✓	-	✓	Moderate
Riley (2017)	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	High
Rostami (2019)	✓	✓	✓	x	-	-	x	-	-	✓	Moderate
Shankarapillai (2012)	✓	✓	-	x	-	-	x	✓	-	✓	Moderate

✓ = Yes; - = Unclear; x = No.

**Table 3: Summary of CASP Quality Assessment for Cohort and Qualitative Studies.**

	Clear focus?	Acceptable recruitment? OR Qualitative methodology*	Exposure measure minimize bias? OR Appropriate design*	Outcome measure minimize bias? OR Recruitment strategy?*	Confounders accounted for? OR Data collection?*	Sufficient follow-up? OR Relationships considered?*	Precise/clear results? OR Ethical issues addressed?*	Results fit evidence? OR Data analysis appropriate?*	Clear implications? OR Clear findings?*	Overall
Cohort Study:										
Babbar (2019)	✓	✓	✓	✓	-	✓	✓	✓	✓	High
Bansal (2013)	✓	-	✓	-	x	-	✓	✓	✓	Moderate
Beck (2017)	✓	-	-	-	-	✓	x	✓	✓	Moderate
Braun (2019)	✓	-	x	x	x	-	x	✓	✓	Low
Craighead (2015)	✓	-	-	-	x	-	-	-	x	Low
Deolia (2017)	✓	-	-	x	x	x	-	✓	-	Low
Mehrabi (2012)	✓	-	-	-	x	-	x	-	-	Low
Monson (2017)	✓	✓	-	x	-	x	x	-	-	Low
Parshad (2011)	✓	✓	-	-	x	-	✓	-	✓	Moderate
Prasad (2016)	✓	✓	-	✓	-	-	✓	✓	-	Moderate
Simard (2009)	✓	-	-	✓	-	✓	✓	✓	-	Moderate

	Clear focus?	Acceptable recruitment? OR Qualitative methodology*	Exposure measure minimize bias? OR Appropriate design*	Outcome measure minimize bias? OR Recruitment strategy?*	Confounders accounted for? OR Data collection?*	Sufficient follow-up? OR Relationships considered?*	Precise/clear results? OR Ethical issues addressed?*	Results fit evidence? OR Data analysis appropriate?*	Clear implications? OR Clear findings?*	Overall
Qualitative Study:										
Beck (2017)	x	-	-	✓	-	x	✓	-	✓	Low
Clark (2018)	✓	✓	✓	x	✓	x	x	-	x	Low
Raingruber (2007)	✓	✓	✓	✓	✓	x	x	✓	✓	Moderate

\* Denotes Qualitative Study Characteristic

✓ = Yes; - = Unclear; x = No.



Supplemental Table: Summary of Characteristics of the Included Studies.

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Akhani, P. 2019 India	RCT	<b>Population:</b> Medical students <b>N=</b> 300 <b>Control:</b> Yes, proceed as usual <b>Group assignment:</b> simple random sampling <b>Attrition:</b> 0 <b>Age:</b> 18+ years <b>Sex:</b> 164 males and 136 females <b>Power calculation:</b> No	<b>Yoga style:</b> Vinyasa <b>Dose:</b> 20-30 min/day x 6 days/week x 4 weeks <b>Delivery mode:</b> in person, group size unclear <b>Replicable intervention protocol*:</b> No <b>Training &amp; Fidelity:</b> Trained yoga teacher	<b>Timing:</b> pre/post <b>Outcome variables/Tools:</b> Height, weight, resting pulse rate (RPR), systolic blood pressure (SBP), diastolic blood pressure (DBP), fitness index (FI), tidal volume (TV), vital capacity (VC), breath holding time (BHT), maximum expiratory pressure (MEP), and 40 mmHg endurance test (40 mmHg ET)	<b>Findings:</b> Statistically significant in the intervention group, RPR, SBP, and DBP decreased significantly, whereas FI, TV, VC, BHT, MEP, and 40 mmHg ET increased significantly following Yoga. TV increased after Yoga, but the change was not significant. <b>Comments:</b> The yoga intervention improved a number of physical parameters.	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Babbar, S. 2019 USA	Before-after	<p><b>Population:</b> Medical residents and fellows  <b>N=</b> 25  <b>Group assignment:</b> N/A  <b>Attrition:</b> 4/29  <b>Age:</b> 29.6+/-3.7  <b>Sex:</b> Unspecified  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified  <b>Dose:</b> 55 min/day x 1x/week x 8 weeks  <b>Delivery mode:</b> in person  <b>Replicable intervention protocol:</b> Yes  <b>Training &amp; Fidelity:</b> certified yoga instructor. No fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> Maslach Burnout Inventory, the Depression Anxiety Stress Scale, and the Five Facet Mindfulness Questionnaire, heart rate, blood pressure, weight, BMI.</p>	<p><b>Findings:</b> Statistically significant improvement in depersonalization scores (p=0.04), anxiety scores (p=0.02), Mindfulness Observing score (p=0.01). Statistically significant reduction in systolic and diastolic blood pressure (p=0.01).  <b>Comments:</b> The yoga intervention improved physical (BP) and psychological parameters.</p>	High

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Bansal, R. 2013 India	Before/after	<p><b>Population:</b> Medical students  <b>N=</b> 90  <b>Group assignment:</b> N/A  <b>Attrition:</b> 8/90  <b>Age:</b> 18-23 years  <b>Sex:</b> 40 males and 50 females  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified  <b>Dose:</b> 45min/day x 1 month (number of days per week and length of month unspecified)  <b>Delivery mode:</b> in person, 10 in each group  <b>Replicable intervention protocol*:</b> Yes  <b>Training &amp; Fidelity:</b> Trained yoga physician (M.Sc yoga); no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> General Health Questionnaire-28 (GHQ-28), short survey (post-only).</p>	<p><b>Findings:</b> Statistically significant improvement in all four GHQ-28 subcategories (somatic symptoms, anxiety, social dysfunction, depression), <math>p &lt; 0.001</math>. Survey revealed: improved sleep (30%), concentration (40%), anger control (25%), relaxation through day (80%), positive energy (60%).  <b>Comments:</b> The yoga intervention improved participants' mental health.</p>	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Beck, A. 2017 USA	Mixed methods: Before/after quantitative; qualitative descriptive	<p><b>Population:</b> Communication Sciences and Disorders (CSD) and SLP students  <b>N=37</b>  <b>Group assignment:</b> 20-intervention, 17-control (self-selected)  <b>Attrition:</b> (1-control)  <b>Age:</b> 18-26 years  <b>Sex:</b> Female  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified "mindfulness yoga"  <b>Dose:</b> 20 min/day x 7 consecutive weeks  <b>Delivery mode:</b> in person, to 3 groups (n=6; n=6; n=8 based on time preference)  <b>Replicable intervention protocol:</b> Yes  <b>Training &amp; Fidelity:</b> CSD professor and registered yoga instructor; 33% of sessions independently assessed for fidelity by 2 authors.</p>	<p><b>Timing:</b> pre/post/4-week follow-up  <b>Outcome variables/Tools:</b> PSS-10, Self-Compassion Scale (SCS), Almost Perfect Scale-Revised (APS-R), reflective writing.</p>	<p><b>Findings:</b> Statistically significant improvement in PSS-10 scores (<math>p&lt;0.05</math>), SCS scores (<math>p&lt;0.05</math>) in intervention group. No differences in APS-R scores. Reflective writing: Intervention reported as calming/relaxing, improved outlook on life.  <b>Comments:</b> The yoga intervention improved self-compassion and stress in this self-selected group of participants.</p>	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Braun, S. E. 2019 USA	Before-after	<p><b>Population:</b> Dental and dental hygiene students  <b>N=</b> 47  <b>Group assignment:</b> N/A  <b>Attrition:</b> 85/132 did not provide all data  <b>Age:</b> Unspecified  <b>Sex:</b> 12 males and 35 females  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified  <b>Dose:</b> 60 min x 1  <b>Delivery mode:</b> in person, single group of 132  <b>Replicable intervention protocol:</b> No  <b>Training &amp; Fidelity:</b> Certified yoga teacher (Yoga Alliance). No fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> State Mindfulness Scale (SMS), The Five Facet Mindfulness Questionnaire–short form (FFMQ-sf), The Patient Health Questionnaire–9-item (PHQ-9), Maslach Burnout Inventory–Human Services (MBI), Perceived Stress Scale (PSS-10).</p>	<p><b>Findings:</b> Statistically significant improvement in total SMS (P &lt; .0001). Other scores not reported, presumed nonsignificant.  <b>Comments:</b> Interestingly, participants with higher PSS-10 showed more improvement in mindfulness following intervention.</p>	Low

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Clark, C. S. 2018 USA	Narrative inquiry	<p><b>Population:</b> Nursing students  <b>N=82</b>  <b>Group assignment:</b> N/A  <b>Attrition:</b> none  <b>Age:</b> Unspecified  <b>Sex:</b> Unspecified  <b>Power calculation:</b> N/A</p>	<p><b>Yoga style:</b> Hatha  <b>Dose:</b> 3hr/day 4-6x/7 weeks + one 'longer' day (exact duration not reported)  <b>Delivery mode:</b> in person, group size not reported  <b>Replicable intervention protocol:</b> No  <b>Training &amp; Fidelity:</b> RYT-200 registered yoga instructor; no fidelity details.</p>	<p><b>Timing:</b> post only  <b>Outcome variables/Tools:</b> Weekly reflective journal.</p>	<p><b>Findings:</b> Students reported applying self-care principles to everyday, enhanced well-being, self-care, stress reduction.  <b>Comments:</b> The yoga intervention improved students' commitment to self-care practices and stress resilience.</p>	Low

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Craighead, J. 2015 India	Before-after	<b>Population:</b> Nursing students <b>N=94</b> <b>Control:</b> No <b>Group assignment:</b> N/A <b>Attrition:</b> 11/94 <b>Age:</b> 17+ (unclear) <b>Sex:</b> 72 female and 11 male <b>Power calculation:</b> No	<b>Yoga style:</b> Unspecified <b>Dose:</b> 1hr/day 3x/week x 6 weeks <b>Delivery mode:</b> in person, group size not reported <b>Replicable intervention protocol:</b> No <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.	<b>Timing:</b> pre/post <b>Outcome variables/Tools:</b> Positive Affect Negative Affect Scale – Hindi (PANAS-H).	<b>Findings:</b> Statistically significant improvement in PA (p=0.0001). <b>Comments:</b> The yoga intervention improved positive affect scores of participants.	Low

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Deolia, S. G. 2017 India	Before-after	<p><b>Population:</b> Dental interns  <b>N=70</b>  <b>Group assignment:</b> N/A  <b>Attrition:</b> none  <b>Age:</b> 21-24 years  <b>Sex:</b> 64 female and 6 male  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified  <b>Dose:</b> 30-60 min/day x 4 weeks (number of days per week unspecified)  <b>Delivery mode:</b> in person, group size not reported  <b>Replicable intervention protocol:</b> Yes  <b>Training &amp; Fidelity:</b> “qualified yoga instructor”; no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> questionnaire including psychological hazards (based on modified PSS) and physical hazards associated with the profession.</p>	<p><b>Findings:</b> Statistically significant improvement in self-reported quality of patient care (p=0.001); stress (p=0.001), irrationality (p=0.001), anger (p=0.001); confidence (p=0.001), coping (p=0.001), backache (p=0.001), headache (p=0.001), leg/knee pain (p=0.001), neck ache (p=0.001), wrist discomfort (p=0.001), eye troubles (p=0.015).  <b>Comments:</b> The yoga intervention improved psychological and physical parameters including stress and reduced musculoskeletal pain.</p>	Low



First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Fang, R. 2015 China	RCT	<p><b>Population:</b> Nurses N=120 <b>Control:</b> Yes, proceed as usual <b>Group assignment:</b> 54-intervention, 51-control (random number table) <b>Attrition:</b> 7/61 intervention, 8/59 control <b>Age:</b> 25-51 years <b>Sex:</b> Female <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified <b>Dose:</b> 50-60 min/day 2x/week x 6 months (number of weeks unspecified) <b>Delivery mode:</b> in person, group size not reported <b>Replicable intervention protocol:</b> No <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.</p>	<p><b>Timing:</b> pre/post <b>Outcome variables/Tools:</b> <i>Pittsburgh Sleep Quality Index-Chinese (PSQI)</i>, <i>Medical Workers' Stress- Chinese (QMWS)</i>.</p>	<p><b>Findings:</b> Statistically significant improvement in sleep quality (<math>p&lt;0.001</math>), work stress (<math>p&lt;0.001</math>). <b>Comments:</b> The yoga intervention improved sleep quality and work stress.</p>	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Gopal, A. 2011 India	RCT	<p><b>Population:</b> Medical students  <b>N=60</b>  <b>Control:</b> Yes, proceed as usual  <b>Group assignment:</b> 30-yoga, 30- control (random)  <b>Attrition:</b> none  <b>Age:</b> 17-20 years  <b>Sex:</b> Female  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified  <b>Dose:</b> 35 min/day x 12 weeks (number of days/week unclear)  <b>Delivery mode:</b> in person, group of 30  <b>Replicable intervention protocol:</b> No  <b>Training &amp; Fidelity:</b> “trained yoga teacher”; no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> Blood pressure (BP), heart rate (HR), respiratory rate (RR), serum cortisol, serum interleukin (IL-4), Serum Interferon (IFN-a), Global Assessment of Recent Stress Scale (GARS), State Trait Anxiety Inventory for Adults (STAI-A).</p>	<p><b>Findings:</b> Statistically significant improvement in physiologic response to stress; During examination, lower blood pressure (<math>P&lt;0.05</math>), respiratory rate (<math>P&lt;0.05</math>); Significantly higher STAI (<math>p&lt;0.05</math>), GARS (<math>p&lt;0.05</math>), serum cortisol (<math>p&lt;0.001</math>) in control. Serum IFN-a/IL-4 ratio significantly higher (<math>p&lt;0.05</math>) in yoga group.  <b>Comments:</b> The yoga intervention improved autonomic changes and impairment of cellular immunity seen in examination stress.</p>	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Kim, S. D. 2014 Korea	RCT	<p><b>Population:</b> Nursing students  <b>N=</b> 30  <b>Control:</b> Yes, proceed as usual  <b>Group assignment:</b> 15-intervention, 15-control (random permuted block design)  <b>Attrition:</b> 3/15-intervention, 0/15-control  <b>Age:</b> 20-23  <b>Sex:</b> Female  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Cyclic (Vinyasa sun salutations)  <b>Dose:</b> 1hr/day 1x/week x 12 weeks  <b>Delivery mode:</b> in person, group of 12  <b>Replicable intervention protocol:</b> Yes  <b>Training &amp; Fidelity:</b> Instructor certified by Bihar Yoga Bharati in India; no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> Life stress scores (LSSCS), postprandial glucose levels.</p>	<p><b>Findings:</b> Statistically significant improvement in Life Stress Scores (<math>p&lt;0.001</math>) and glucose levels (<math>p&lt;0.001</math>).  <b>Comments:</b> The yoga intervention improved significantly in both life stress and postprandial blood glucose levels.</p>	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Malathi, A. 1998 India	RCT (3-arm)	<p><b>Population:</b> Medical students  <b>N=75</b>  <b>Control:</b> Yes, relaxation techniques/proceed as usual  <b>Group assignment:</b> 25-yoga, 25-relaxation, 25-control (random)  <b>Attrition:</b>  <b>Age:</b> 18-20 years  <b>Sex:</b> 36 female and 39 male  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified  <b>Dose:</b> 1hr/day 3x/week x 3 months (number of weeks unspecified)  <b>Delivery mode:</b> in person, group of 25  <b>Replicable intervention protocol:</b> No  <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.</p>	<p><b>Timing:</b> pre/mid/post  <b>Outcome variables/Tools:</b> HR, BP, Spielberg Anxiety Rating Scale (SARS), galvanic skin resistance (GSR).</p>	<p><b>Findings:</b> Statistically significant improvement in anxiety (<math>p&lt;0.001</math>) systolic BP (<math>p&lt;0.05</math>), HR (<math>p&lt;0.001</math>), GSR (<math>p&lt;0.001</math>) for relaxation and yoga groups.  <b>Comments:</b> The yoga and relaxation intervention improved baseline and stimulus anxiety, pulse, and BP of participants.</p>	Low

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Malathi, A. 1999 India	RCT	<b>Population:</b> Medical students <b>N=50</b> <b>Control:</b> Yes, proceed as usual <b>Group assignment:</b> 25-intervention, 25-control (random) <b>Attrition:</b> none <b>Age:</b> 18-19 years <b>Sex:</b> Unspecified <b>Power calculation:</b> No	<b>Yoga style:</b> Unspecified <b>Dose:</b> 1hr/day 3x/week x 3 months <b>Delivery mode:</b> in person, group of 25 <b>Replicable intervention protocol:</b> Yes <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.	<b>Timing:</b> mid/post <b>Outcome variables/Tools:</b> Spielberg Anxiety score, survey of 14 parameters of wellness.	<b>Findings:</b> Statistically significant improvement in anxiety scores ( $p<0.001$ ) and exam failure ( $p<0.05$ ), wellbeing, concentration, relaxation, attention, efficiency, interpersonal relationships (no p values). <b>Comments:</b> The yoga intervention improved anxiety, overall wellbeing, and exam failure scores of participants.	Low

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Mathad, M. D. 2017 India	RCT (cross-over)	<p><b>Population:</b> Nursing students  <b>N=100</b>  <b>Control:</b> Yes, WLC  <b>Control:</b> Yes  <b>Group assignment:</b> 50-intervention, 50-control (random)  <b>Attrition:</b> 10/50 intervention, 10/50 control  <b>Age:</b> 17-30  <b>Sex:</b> Female  <b>Power calculation:</b> Yes; 64 participants required for effect size of 0.347 with power of 0.80 and alpha 0.05.</p>	<p><b>Yoga style:</b> “integrated yoga therapy”  <b>Dose:</b> 1hr/day 1x/week x 8 weeks  <b>Delivery mode:</b> in person, group of 40  <b>Replicable intervention protocol:</b> No  <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> Freiburg Mindfulness Inventory (FMI), Self-Compassion, Scale- Short Form (SCS-SF), Connor–Davidson Resilience Scale, (CD-RISC), Satisfaction with Life Scale (SWLS), Jefferson Scale (JSE-HPS), PSS-10.</p>	<p><b>Findings:</b> Statistically significant improvement of self-compassion (p=0.037) and mindfulness (p=0.001) of participants. All other variables nonsignificant.  <b>Comments:</b> The yoga intervention improved self-compassion and mindfulness scores.</p>	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Mehrabi, T. 2012 Iran	Before-after	<b>Population:</b> Nurses <b>N=</b> 36 <b>Control:</b> No <b>Group assignment:</b> N/A <b>Attrition:</b> 2/36 <b>Age:</b> 24-52 years <b>Sex:</b> Female <b>Power calculation:</b> No	<b>Yoga style:</b> Hatha <b>Dose:</b> 1hr/day 2x/week x 8 weeks <b>Delivery mode:</b> in person, group of 34 <b>Replicable intervention protocol:</b> No <b>Training &amp; Fidelity:</b> “under supervision of trained Yoga expert”; no fidelity details.	<b>Timing:</b> pre/post <b>Outcome variables/Tools:</b> Coping Stress Revise (CS-R) questionnaire.	<b>Findings:</b> Statistically significant improvement in problem-focused ( $p<0.001$ ), state trait focused ( $p<0.001$ ) coping; decrease in emotion-focused ( $p=0.014$ ) and ineffective coping ( $p<0.001$ ). <b>Comments:</b> The yoga intervention improved stress coping strategies.	Low

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Miyoshi, Y. 2019 Japan	RCT (crossover)	<b>Population:</b> Nurses <b>N= 20</b> <b>Control:</b> Yes, stress relief methods <b>Group assignment:</b> unclear <b>Attrition:</b> 0 <b>Age:</b> 20-39 years <b>Sex:</b> 20 female <b>Power calculation:</b> No	<b>Yoga style:</b> Restorative <b>Dose:</b> 60 min x 1 + 3-30 min/day 3x/week x 4 weeks <b>Delivery mode:</b> In person, groups of 10. At home, individual. <b>Replicable intervention protocol:</b> No <b>Training &amp; Fidelity:</b> No fidelity details.	<b>Timing:</b> pre/post <b>Outcome variables/Tools:</b> Brief Job Stress Questionnaire	<b>Findings:</b> Statistically significant improvement in psychological and physical stress scores (Brief Job Stress Questionnaire) following single yoga session (p=0.000) and again following 4-weeks of at-home practice (p=0.01). Nonsignificant changes in blood pressure, pulse, and weight. <b>Comments:</b> The yoga intervention improved stress scores but not physical factors.	Moderate



First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Monson, A. L 2017 USA	Cross-sectional	<p><b>Population:</b> Dental hygiene students  <b>N=83</b>  <b>Control:</b> Yes, proceed as usual  <b>Group assignment:</b> 38-intervention, 39-control (self-selected)  <b>Attrition:</b> 6/83 (distribution unclear)  <b>Age:</b> 19-37  <b>Sex:</b> 70 female and 7 male  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Vinyasa  <b>Dose:</b> 1h/day  2x/week x 13 weeks  <b>Delivery mode:</b> in person, group of 38  <b>Replicable intervention protocol:</b> No  <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> Harich comparative pain scale, body composition.</p>	<p><b>Findings:</b> Significantly reduced low back pain (<math>p&lt;0.001</math>) and overall decrease in Harich Pain scores (<math>p&lt;0.001</math>) of intervention group.  <b>Comments:</b> The yoga intervention improved musculoskeletal pain of participants.</p>	Low

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Parshad, O. 2011 Jamaica	Before-after	<p><b>Population:</b> Medical students  <b>N=</b>64  <b>Control:</b> No  <b>Group assignment:</b> N/A  <b>Attrition:</b> None  <b>Age:</b> mean 21.3 ± 2.6 years  <b>Sex:</b> 57 female and 7 male  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Unspecified  <b>Dose:</b> 1hr/day  1x/week x 5 weeks + at home 10 min/day  6x/week x 5 weeks  <b>Delivery mode:</b> in person, group size not reported/at home, individual  <b>Replicable intervention protocol:</b> Yes  <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> Cardiovascular parameters: Systolic (SYS) and Diastolic (DIA) BP, HR, Stroke Volume (SV), Mean arterial blood pressure (MAP), Cardiac output (CO), Total Peripheral Resistance (TPR), Interbeat Interval (IBI), Left Ventricular Ejection Time (LVET), Arterial Compliance (AC) and Ascending Aorta Impedance (AI).</p>	<p><b>Findings:</b> Statistically significant decrease in TPR (p= 0.0005), AI (p= 0.0009), increased HR (p=0.04), AC (p= 0.002), SV (p= 0.006) and CO (p= 0.0001), IBI (p=0.02). All other variables nonsignificant.  <b>Comments:</b> The yoga intervention improved some cardiovascular parameters.</p>	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Patil, N. J. 2018 India	RCT	<p><b>Population:</b> Nurses N=88  <b>Control:</b> Yes, physical exercise  <b>Group assignment:</b> 44-intervention, 44-control (random number generator)  <b>Attrition:</b> None  <b>Age:</b> 31.45 ± 3.47 years (yoga), 32.75 ± 3.71 years (exercise)  <b>Sex:</b> Female  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> "integrated yoga therapy"  <b>Dose:</b> 1hr/day  5x/week x 6 weeks  <b>Delivery mode:</b> in person, group of 44  <b>Replicable intervention protocol:</b> Yes  <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> World Health Organization Quality of Life-brief (WHOQOL-BREF) questionnaire.</p>	<p><b>Findings:</b> Statistically significant improvement in physical (reduction in pain and disability, improvement in spinal flexibility; p&lt;0.01), psychological (reduction in stress, anxiety, and depression; p&lt;0.01), and social (interpersonal relationships and support; p&lt;0.01) QOL domains for both groups. Greater reduction in yoga group.  <b>Comments:</b> The yoga intervention improved physical, psychological, and social domains of participants more than exercise.</p>	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Prasad, L. 2016 USA	Before-after	<b>Population:</b> Medical students <b>N=</b> 34 <b>Control:</b> No <b>Group assignment:</b> N/A <b>Attrition:</b> 7/34 <b>Age:</b> 24-32 years <b>Sex:</b> 13 female and 14 male <b>Power calculation:</b> No	<b>Yoga style:</b> Hatha <b>Dose:</b> 1hr/day 2x/week x 6 weeks <b>Delivery mode:</b> in person, group of 27 <b>Replicable intervention protocol:</b> No <b>Training &amp; Fidelity:</b> Certified yoga teacher (RYT-500) with over 15 years of experience; no fidelity details.	<b>Timing:</b> pre/post <b>Outcome variables/Tools:</b> PSS, Self-Assessment Survey (SAS).	<b>Findings:</b> Statistically significant improvement in PSS (p=0.004). Improvement in feelings of peace, focus, endurance, happiness, positivity, personal satisfaction, and self-confidence (no p-values provided). <b>Comments:</b> The yoga intervention improved wellbeing and reduced stress.	Moderate

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Raingruber, B. 2007 USA	Heideggerian Phenomenology	<p><b>Population:</b> Nurses  <b>N=</b> 49  <b>Control:</b> No  <b>Group assignment:</b> 15-reiki, 13-yoga, 13-tai chi, 8-meditation (self-selected)  <b>Attrition:</b> 14/49 (distribution unclear)  <b>Age:</b> 23-65 years  <b>Sex:</b> 33 female and 2 male  <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Sivananda  <b>Dose:</b> 1hr/day  1x/week x 3 months (number of weeks unspecified)  <b>Delivery mode:</b> in person, to groups (n=15; n=13; n=13; n=8; based on preference)  <b>Replicable intervention protocol:</b> Yes  <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.</p>	<p><b>Timing:</b> post  <b>Outcome variables/Tools:</b> reflective journaling.</p>	<p><b>Findings:</b> Reported self-assessed improvement in relaxation/calm, problem-solving, focus on patient needs.  <b>Comments:</b> The yoga intervention improved problem-solving skills, focus, and stress.</p>	Moderate

<p>Riley, K. E. 2017 USA</p>	<p>RCT</p>	<p><b>Population:</b> Mental health care providers N= 38 <b>Control:</b> Yes, Cognitive Behavioural Stress Management <b>Group assignment:</b> 19-intervention, 19-control (random) <b>Attrition:</b> 10/38 13/38 (2-month follow-up) 19/38 (6-month follow-up) <b>Age:</b> mean age 44.6 years <b>Sex:</b> 32 female and 6 male <b>Power calculation:</b> No</p>	<p><b>Yoga style:</b> Kripalu <b>Dose:</b> 1hr/day 1x/week x 8 weeks <b>Delivery mode:</b> in person, groups of 10 <b>Replicable intervention protocol:</b> No <b>Training &amp; Fidelity:</b> Certified Kripalu yoga instructors, licensed clinical psychologists with training in cognitive behavioral therapy; no fidelity details.</p>	<p><b>Timing:</b> Pre/post/ 2-month follow-up/6-month follow-up <b>Outcome variables/Tools:</b> Depression, Anxiety, and Stress Scale (DASS-21), Quality of Life Short Form (SF-12), Measure of Current Status (MOCS-A), Difficulties in Emotion Regulation Scale (DERS), Five Facet Mindfulness Questionnaire (FFMQ), Self-Compassion Scale-Short Form (SCS), Heart rate, blood pressure, body mass index, Fruit and vegetable intake, physical activity, alcohol and tobacco use, sleep</p>	<p><b>Findings:</b> Statistically significant improvements in both groups of fruit (p=0.037) and vegetable (p&lt;0.001) intake, and decreased heart rate (p=0.018), relaxation (p=0.011) awareness (p&lt;0.001), compassion (p=0.003), burnout (p&lt;0.001), depression (p=0.002), and stress (p=0.001). No significant changes in other variables. <u>6-month follow-up (both groups):</u> Statistically significant improvement in fruit intake (p=0.037), vegetable intake (p&lt;0.001), relaxation (p≤0.001), awareness (p≤0.001), compassion (p=.003), depression (DASS; p=.002. PHQ-9; p=.004), stress (p≤0.001), heart rate (p=0.018), alcohol consumption (p=0.056), and burnout (p&lt;0.001).</p>	<p>High</p>
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First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
				disturbance, Depression (PHQ-9), Professional Quality of Life scale (ProQoL5).	<b>Comments:</b> The yoga and CBSM interventions both improved relaxation, awareness, ProQoL (compassion and burnout), depression and stress.	
Rostami, K. 2019 Iran	RCT	<b>Population:</b> Nurses <b>N=</b> 70 <b>Control:</b> Yes, proceed as usual <b>Group assignment:</b> Simple block randomization <b>Attrition:</b> 0 <b>Age:</b> 25-34 years <b>Sex:</b> Unspecified <b>Power calculation:</b> No	<b>Yoga style:</b> Unspecified <b>Dose:</b> 2x/week x 2 months <b>Delivery mode:</b> unclear <b>Replicable intervention protocol:</b> No <b>Training &amp; Fidelity:</b> Unclear. No fidelity details.	<b>Timing:</b> pre/1-month, 2-month, 6-month post <b>Outcome variables/Tools:</b> quality of life Who-QOL-Brief questionnaire	<b>Findings:</b> Statistically significant improvement in physical (p <0.001), psychological (p <0.001), social relations (p <0.001), and environment (p <0.001) subscales (quality of life Who-QOL-Brief questionnaire) 1-month following yoga and again 2-months following (p <0.001). <b>Comments:</b> The yoga intervention improved physical, psychological, social relations, and environment.	Low

First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Shankarapillai, R. 2012 India	RCT	<p><b>Population:</b> Dental students  <b>N=100</b>  <b>Control:</b> Yes, Stress Management lecture  <b>Group assignment:</b> 50-intervention, 50-control (random alternating)  <b>Attrition:</b> None  <b>Age:</b> 21-23 years  <b>Sex:</b> 44 female and 56 male  <b>Power calculation:</b> Yes; anticipated effect size 0.80 (no reference), power 0.95, alpha 0.05.</p>	<p><b>Yoga style:</b> Unspecified  <b>Dose:</b> 1hr/day  7x/week x 1 week  <b>Delivery mode:</b> in person/audiotapes; group size not reported/at home, individual  <b>Replicable intervention protocol:</b> No  <b>Training &amp; Fidelity:</b> Unspecified; no fidelity details.</p>	<p><b>Timing:</b> pre/post  <b>Outcome variables/Tools:</b> Visual Analog Scale (VAS) level of distress and ability to relax, Spielberger state-trait anxiety inventory (STAI-T and STAI-S).</p>	<p><b>Findings:</b> Statistically significant improvement in VAS anxiety (p=0.00) and STAI-trait (p=0.00) scores before and after surgical procedure in intervention group.  <b>Comments:</b> The yoga intervention improved anxiety scores (anticipatory and post).</p>	Moderate



First Author, Year, Country	Study Design	Sample Characteristics	Intervention Details	Data Collection	Outcome	CASP Evaluation (low, moderate, high)
Simard, A. 2009 Canada	Before-after	<b>Population:</b> Medical students <b>N=18</b> <b>Control:</b> No <b>Group assignment:</b> N/A <b>Attrition:</b> 2/18 <b>Age:</b> mean 22 +/- 2.16 <b>Sex:</b> 15 female and 1 male <b>Power calculation:</b> No	<b>Yoga style:</b> Hatha <b>Dose:</b> 1hr/day 2x/week x 16 weeks <b>Delivery mode:</b> in person, group of 16 <b>Replicable intervention protocol:</b> No <b>Training &amp; Fidelity:</b> Certified Kripalu yoga instructor with 6-years experience; no fidelity details.	<b>Timing:</b> pre/mid/post <b>Outcome variables/Tools:</b> General Health Questionnaire (GHQ-12), PSS-10, Center for Epidemiologic Studies Depression Scale (CES-D), satisfaction questionnaire.	<b>Findings:</b> Statistically significant reduction in PSS scores at 8 weeks ( $p<0.008$ ), sustained to 16 weeks. No other statistically significant findings. <b>Comments:</b> The yoga intervention showed rapid and sustained improvement in overall health, perceived stress and depressive symptoms.	Moderate

### **Chapter 3: An Intervention to Improve Mental and Physical Health of Undergraduate Nursing Students.**

The systematic review described in the previous chapter offers a narrative summary of current knowledge about the effects of yoga interventions on healthcare professionals and students of these professions. However, as identified, previous studies were limited by heterogeneity of interventions and lack of transparency regarding intervention details, resulting in compromised outcome ascertainment and reproducibility of findings. The study described in Chapter 3 (Phase IIb of the ORBIT model) was designed to overcome some of these limitations with the goal of confirming and extending the findings to the undergraduate nursing student population. Relevant findings from the Phase IIa study are included.

This chapter will be submitted for publication as:

Ciezar-Andersen, S. D., White, D. Campbell, T. & King-Shier, K. M. (2022). An intervention to improve mental and physical health of undergraduate nursing students.

## **An Intervention to Improve Mental and Physical Health of Undergraduate Nursing Students.**

### **3.1 Abstract**

Undergraduate nursing students across North America report poorer mental and physical health than their counterparts outside of nursing. Nursing students have more symptoms of depression, anxiety, and stress (by up to 12%) and lower levels of recommended physical activity (by up to 25%) relative to other undergraduate students. It is important to enhance the mental and physical health of nursing students before they enter a demanding profession, where almost half leave their job within three years. Based on existing evidence, a yoga intervention has the potential to improve the health of nursing students.

#### **Objectives**

We aimed to determine whether a tailored yoga program would improve mental (i.e., symptoms of depression, anxiety, and stress as well as self-compassion) and physical (i.e., core endurance) health of undergraduate nursing students.

#### **Study design**

A pre/post-intervention design was used. The yoga program was offered online over a period of six-weeks. Participants were asked to engage in yoga 3 days per week for an average of 40 minutes per class. Participants' symptoms of depression, anxiety, stress, and self-compassion were assessed using the Depression, Anxiety, and Stress Scale and Self-Compassion Scale and core endurance was assessed using the Mackenzie Core Endurance Test prior to commencement and at the conclusion of the program.

### Participants and setting

Participants included undergraduate nursing students from six post-secondary institutions in Alberta, Canada.

### Results

One hundred and fourteen undergraduate nursing students completed baseline data collection, and sixty-eight completed all assessments. A notable proportion of participants reported symptoms of severe depression (19.1%), anxiety (27.9%), and stress (23.6%), as well as low self-compassion (44.1%) and low core endurance (86.8%) at the onset of the study. The mean depression, anxiety, stress, self-compassion and core endurance scores improved significantly ( $p < 0.001$ ) between baseline and study completion to within normative ranges.

### Conclusions

A six-week virtual yoga program improved mental and physical health of undergraduate nursing students. Targeted modifications to the yoga program might enhance participant retention.

### 3.2 Background

Mental and physical health are inter-related components of overall health [1, 2]. Nurses have poorer mental and physical health [3, 4] relative to the general public [3] and other professionals [5] exacerbating already difficult recruitment and retention of nurses globally. Symptoms of depression, anxiety, or stress that are in excess of population norms are indicative of poor mental health [6]. Sedentary behaviour is a risk factor for poor physical health and musculoskeletal injury [7, 8]. Clinical depression in US nurses is double (18%) that of the national average (9%) [9]. Similarly, Canadian nurses have double (10%) the 1-year prevalence of depression compared to the national average (5%) [10]. The findings of a recent systematic review and meta-analysis revealed a 35% pooled prevalence of depressive symptoms in nurses worldwide [11]. Up to three times higher than the national averages [12], the prevalence of symptoms of anxiety (39-42%) and stress (41-50%) in nurses worldwide is equally alarming [11, 13]. There is also a high prevalence of inactivity/sedentary behaviour in up to 76.5% of nurses [14].

Nurses' poor mental health and physical health may begin as early as when undertaking undergraduate education [15-19]. Nursing students experience poorer mental and physical health relative to students in other health-related disciplines and young adults of similar age outside post-secondary school [18, 20-22]. Differences in stress scores between nursing students and their non-nursing counterparts have been reported. A survey of 2326 undergraduate students revealed 57% of nursing students versus 49% of non-nursing students ( $p=0.001$ ) rated their stress as 'severe' on the Student Stress Inventory [18]. Published in 2016, the National College Health Assessment

revealed that 17.6% of nursing students reported symptoms of ‘tremendous stress’ compared to 6.9% of non-nursing counterparts ( $p < 0.001$ ) and had significantly more anxiety diagnoses and treatment for symptoms of anxiety relative to the general student body ( $p = 0.006$ ) [15]. Similar trends were seen in a survey of Canadian nursing students ( $n = 437$ ) who had significantly higher depression, anxiety, and stress scores ( $p < 0.005$ ) as measured by the Depression, Anxiety, and Stress Scale [DASS-42] than their non-nursing ( $n = 1870$ ) counterparts [23]. Unmanaged symptoms of depression, anxiety, or stress have a variety of negative impacts on the individual nursing student and nurse including burnout, and development of chronic diseases [18-24].

Poor mental health is associated with poor physical health, and sedentary behaviour specifically [24]. Nursing students report lower levels of physical activity than students in other health professions. A survey of 361 UK nursing and medical students revealed that 48% of student nurses reported being sedentary compared to 38% of medical students [25], and nursing students were less physically active than paramedic students ( $p = 0.009$ ) [26]. Up to 50% of nursing students are sedentary [4, 25, 27, 28], over 50% report having no established exercise routine, and 37.8% are above their ideal BMI [29]. Despite the upsurge of ergonomic lift/transfer technology and no-lift policies, forty percent of new graduate nurses report sprains, strains, and back injuries within two years of commencing practice [30, 31], likely related to their sedentary behaviour.

The practice of yoga has been examined as a mechanism to improve symptoms of depression, anxiety and stress [32-39] and to improve physical health [38, 40-43]. While many different styles exist, yoga practice generally consists of three key aspects: physical

postures (asanas), breathing work (pranayama), and mindfulness of movement. Yoga practice improved mental and physical health in a variety of groups including healthcare professionals and students [35, 37, 38, 44-48]. Engaging in yoga improved symptoms of depression ( $p < 0.001$ ), anxiety ( $p < 0.001$ ), and stress ( $p < 0.001$ ) in a sample of breast cancer patients [49]. Similarly, yoga activity improved symptoms of anxiety, depression, social dysfunction, and somatic symptoms ( $p < 0.001$ ) in a sample of medical students [50]. Yoga also improved self-compassion and symptoms of stress ( $p < 0.05$ ) in healthcare students [51], and increased stress resilience and commitment to self-care practices in nursing students [52]. A significant reduction in musculoskeletal pain and disability and improvement spinal flexibility ( $p < 0.01$ ), indicators of physical health, were demonstrated in nurse participants [53].

Studies examining the effects of a yoga intervention on healthcare professionals and students including dental interns [54, 55], nursing students [56-58], medical students [59-64], and dental hygiene students [65], revealed similar trends of improved symptoms of mental and physical health. However, based on a recent systematic review [47], the effects of an online yoga intervention on scores of nursing students' symptoms of depression, anxiety, stress, and self-compassion have not been previously explored. Symptoms of stress alone were explored in two studies [52, 56], and stress and self-compassion were explored in one study [58] offering in-person interventions. All reviewed studies had methodological issues including a lack of reporting intervention details to ensure reproducibility [47]. Thus, the purpose of this study was to determine whether a tailored online yoga program would improve mental and physical health

parameters of undergraduate nursing students while addressing methodological issues identified in other studies. We hypothesized that there would be improvement in symptoms of depression, anxiety, stress, self-compassion (a potential mechanism through which yoga reduces perceived stress [34, 35]), and core endurance (linked to lowering the risk of musculoskeletal injury [61, 62]), following the intervention.

### **3.3 Methods**

#### **3.3.1 Study design**

This was a pre-post study design. The primary investigator (SCA), a certified yoga teacher (RYT-200) with over 20 years of yoga experience designed a 6-week program of pre-recorded yoga classes. The Template for Intervention Description and Replication (TIDieR) Checklist [66] was used to guide the design of the intervention and report of the findings. This includes reporting of a clear ‘dose’ and providing sufficient information to ensure study reproducibility; characteristics lacking in previous studies with students in the health professions [67].

Mental and physical health (see below) were assessed before the program began and at the 6-week conclusion. Classes were pre-recorded and accessible to participants online free of charge through yogiapproved.com. All undergraduate nursing students across six Alberta post-secondary institutions were invited to participate in the study. The intervention content was compiled and optimized after a systematic review of previous yoga interventions for healthcare professionals and students [67]. Length, intensity, flexibility, and content of classes were designed to appeal to novice participants with limited time.



### **3.3.2 Ethical considerations**

The study was approved by the Conjoint Health Research Ethics Board (REB19-1640) at the University of Calgary and the relevant ethics boards at other participating institutions. A recruitment email was sent to all undergraduate nursing students at the participating Alberta post-secondary institutions. Following an explanation of the program requirements, written consent was obtained from volunteers who responded to the recruitment email (Appendix D). Participation was voluntary and participants could withdraw at any time.

### **3.3.3 Participants**

Inclusion criteria included enrollment as a nursing student at one of the selected sites and having a computer with reliable internet access. Exclusion criteria were current participation in moderate or strenuous exercise three or more times per week, any recent (within past six months) yoga practice, acute disease including upper respiratory illness, acute arthritis, acute bronchitis, cervical spondylosis, or extensive physical disability. Participants were recruited between January and December 2021. A priori sample size calculation using G\*Power indicated 64 participants were required for a conservative effect size of 0.357 (based on effect size of stress reduction reported in a previous yoga intervention with young adults [68]), with an alpha of 0.05 and power of 0.80. Assuming a 20% attrition rate, we aimed to have 77 participants.

### **3.3.4 Yoga intervention**

Classes were developed based on a combination of Hatha, Iyengar, and Vinyasa yoga and had a duration of 25 to 67 minutes (mode 45 minutes). Participants were

encouraged to contact the yoga instructor (SCA) with any alignment or positioning inquiries. Classes were low to moderate in intensity, progressing from beginner to more intermediate poses (held for 30-60 seconds), consisted of asana, breathwork, and meditation, with a mean class length of 40 minutes. A detailed class outline can be obtained by contacting SCA.

### **3.3.5 Demographic Characteristics**

Demographic characteristics (sex, age, year of program, institution) of the study sample were collected electronically via QualtricsXM software [2022; Qualtrics; Provo, UT, USA], using an investigator developed tool.

### **3.3.6 Mental and Physical Health Assessment**

Pre-intervention baseline data were collected using the [DASS-42; 69], the Self-Compassion Scale [SCS; 70], as well as the Mackenzie Core Endurance Test (MCET; [71]) directly before the participant commenced the program and within 7 days of completing the 6-week program.

The DASS-42 includes three self-report scales designed to measure the negative emotional states of depression, anxiety, and stress [DASS-42; 69]. Each of the three scales contains 14 items, which are divided into subscales of 2-5 items with similar content. Internal consistency coefficients of the original DASS-42 subscales were 0.83 for depression, 0.79 for anxiety, and 0.81 for stress in a sample of undergraduate students [72]. In the current sample, the Cronbach's alpha for depression, anxiety, and stress was 0.947, 0.910, and 0.933 respectively.

The SCS is a 26-item self-report scale that represents the thoughts, emotions, and behaviors associated with self-compassion which are further divided into six subcategories, three positive (self-kindness, common humanity, mindfulness) and three negative (isolation, over-identification, and self-judgement). Internal consistency coefficients of these components range between 0.75 and 0.81 [70]. In the current sample, the Cronbach's alpha for each of the subscales was as follows: for self-kindness; 0.815, self-judgement; 0.853, common humanity; 0.841, isolation; 0.740, mindfulness; 0.754 and over-identification; 0.751. Both scales (DASS and SCS) were completed electronically by participants via Qualtrics<sup>XM</sup> software [2022; Qualtrics; Provo, UT, USA].

Core endurance was measured using the Mackenzie Core Endurance Test (MCET), a reliable predictor of core stability and physical health, that exhibits good construct and test-retest validity and reliability with an ICC of 0.97 (95% confidence interval: 0.94-0.99), and a smallest detectable difference of 5.85 seconds indicating sensitivity to 3% of actual change in core muscle endurance [71, 73]. Participants met with the assessor via Zoom. The timed test involving positioning of the participant in full side view with prompts to change position after 60 seconds (based on the MCET protocol) [71] was performed on camera.

### **3.3.7 Data Analysis**

Data were exported from Qualtrics to SPSS, Version 28 [74] for analysis. Demographic characteristics of the study sample were examined using descriptive statistics and are reported as percentages (number/total) unless otherwise indicated (see

Table 1). The raw scores for depression, anxiety, and stress were categorized into three groups (normal, mild-moderate, severe) and the scores for self-compassion and core endurance were similarly categorized (below average, average, and above average), based on scoring categorizations developed with North American post-secondary students [70, 72, 75]. The differences between pre- and post-intervention mental (depression, anxiety, stress, self-compassion) and physical (core endurance) scores were examined to determine whether the tailored yoga program improved mental and physical health parameters using the paired t-test. Based on a two-tailed test, a p-value of less than 0.05 was considered statistically significant. Only participants with complete data sets were included in the analysis.

### **3.4 Results**

#### **3.4.1 Descriptive summary of participants**

Of the 122 undergraduate nursing students who initially consented to participate in the study, 68 (56%) completed all assigned classes and data collection points (Figure 1). To monitor adherence, participants kept a dated log of all classes completed which they turned in upon completion of the program. The majority (61%) of participants who withdrew from the study did so at the three-week point. Reasons for withdrawal are explored in detail elsewhere (Chapter 4). Of the 68 participants, four were male. The majority of participants (74%) were between 17-25 years old, and 60% of were enrolled in their first or second year of the nursing program at the time of the study (Table 1).

### **3.4.2 Scores over time**

As seen in Table 2, a considerable proportion of participants reported symptoms of severe depression (19.1%), anxiety (27.9%), and stress (23.6%) at baseline. The percentage of participants whose mental health scores fell above the normative range decreased following the intervention; symptoms of depression (47% at baseline to 6% following the intervention;  $p < 0.001$ ), anxiety (74% to 12%;  $p < 0.001$ ), and stress (63% to 15%;  $p < 0.001$ ). (Note that the study protocol included appropriate referral for participants whose depression, anxiety or stress scores were in the severe range.) 44% of participants fell below normative values of self-compassion scores at baseline, and 6% fell within that range following the intervention ( $p < 0.001$ ). 87% of participants' core endurance scores fell below normative values at baseline, decreasing to 41% following intervention completion ( $p < 0.001$ ). The mean depression, anxiety, stress, self-compassion and core endurance scores improved significantly ( $p < 0.001$ ) between baseline and study completion to within normative ranges (see Table 3). Clinically meaningful change, is defined as a return from below normal to within normal range [76]. Clinically meaningful change was achieved by 41% ( $n=28$ ) of participants for depression, 62% ( $n=42$ ) of participants for anxiety, 48% ( $n=33$ ) participants for stress, 38% ( $n=26$ ) participants for self-compassion, and 46% ( $n=31$ ) for core endurance.

### **3.5 Discussion**

The major findings from this study show that a yoga intervention has the potential to improve the mental and physical health of undergraduate nursing students. Improvements were identified in all mental health outcomes (symptoms of depression, anxiety, stress,

self-compassion; DASS, SCS) as well as enhanced physical health (measured by core endurance; MCET) following the intervention. There is a strong link between increased core endurance and back injury prevention [77-79]. To the best of our knowledge, we are the first authors to report the effect size of statistically significant improvements in mental and physical health parameters in a group of nursing students. While an RCT by Mathad and colleagues (2017) of once weekly yoga intervention for nursing students over a period of eight weeks demonstrated a significant improvement in self-compassion ( $p=0.037$ ), and a 7% decrease in perceived stress scores of participants following the intervention, the difference in stress scores did not attain statistical significance ( $p=0.066$ ). Riley et al. [80] reported similar findings in a pre-post study following an eight-week (once weekly) yoga intervention for mental healthcare providers, with significantly decreased symptoms of depression ( $p=0.002$ ) and stress ( $p=0.001$ ), and increase in self-compassion ( $p=0.003$ ). Similarly, following a seven-week yoga intervention, in a narrative inquiry [52] 82 student nurses reported enhanced well-being, self-care, and stress reduction. Contrary to our findings, in a sample of 73 nursing students, Kinchen, Loerzel [81] reported an increase in stress in both the control and yoga intervention groups, potentially due to the timing of their final assessment coinciding with exam times.

While core endurance following a yoga intervention has not been previously measured in nursing students, our findings are similar to those with other participant groups. In an RCT of 60 healthy women 20-29 years of age, Shiraishi and Bezerra [82] demonstrated significant improvements in core endurance in the intervention group

following a 6-week (thrice weekly) yoga program. Our findings also corroborate with those of Cowen and Adams [83], who observed a significant increase (improvements of 52-57% depending on the style of yoga) in muscle endurance in a group of university students following 6-weeks of yoga practice. In a sample of 30 university students, Beazley et al. [84] found significant improvements ( $p < 0.0001$ ) in core muscle engagement during yoga practice. Given that there is an 80% lifetime prevalence of back injury within the nursing profession [85], and there is a strong link between increased core endurance and back injury prevention [77-79], yoga interventions may be particularly helpful with preventing back injury in future nurses.

This study demonstrates that undergraduate nursing students are reporting symptoms of poor mental health and physical health. Our findings revealed high rates of baseline mental health problems based on high depression, anxiety, and stress scores in this small sample of future nurses. In our study, one in five nursing students reported symptoms of severe depression, and one in four reported symptoms of severe anxiety or stress; based on the DASS, a self-administered instrument with well-established psychometric properties in clinical and community samples [69, 86-88]. These findings are consistent with a 2019 survey of 67,972 students attending Canadian post-secondary institutions [89] which showed that 51.6% felt so depressed it was difficult to function, 68.9% felt overwhelming anxiety and 60.9% reported above average stress levels over the previous 12 months. Additionally, a comparison study of nursing students relative to the general student body ( $N=2104$ ) at a major American university showed that nursing students reported significantly higher stress rates than the general student body ( $p=0.0001$ ) [15].

Future research should focus on the genesis of these differences, and ways to improve them.

The majority of students in our study demonstrated below average core endurance (86.8%) at baseline. In a study of 98 nursing students Irazusta and colleagues [28] found that up to 50% were sedentary. Participants in our study showed significant improvements in core endurance (baseline mean 68.19 sec to post intervention mean of 108.51 sec;  $p < 0.001$ ). These findings are particularly relevant given the strong relationship between core endurance, alleviation of low back pain, and musculoskeletal injury prevention [90]

Our study addresses methodological weaknesses identified in previous studies of this type [47]. To our knowledge, five previous studies focused on yoga interventions with nursing students [52, 56-58, 81]. A key limitation of previous studies has been lack of reproducibility, addressed here through the use of both the Essential Properties of Yoga Questionnaire (EPYQ) and TIDieR tools in the design of the intervention [47]. Use of accessible pre-recorded yoga classes to conduct the intervention ensured that all intervention details are available and reproducible in accordance with the Template for Intervention Description and Replication Checklist [TIDieR; 66]. Additionally, well-validated tools (DASS-42, SCS, MCET) were used in the present study to measure symptoms of mental and physical health, a shortcoming of previous studies. While this study has also demonstrated the potential of delivering a yoga intervention via a flexible online platform across multiple sites, future studies could focus on optimizing acceptability to minimize attrition.



The results of our study should be interpreted with caution. A key limitation of this study was the self-selection of participants. Recruitment required multiple strategies to attain the sample and retention was poor (attrition was 44% of those who started the study). The majority of those who withdrew from the study cited mounting demands on their time as the main reason. The participants were also homogenous group (predominantly female aged in their mid-twenties). Both of these factors render limited generalizability of the study findings. Finally, we did not follow-up participants beyond the 6-week conclusion. It would be worth investigating more long-term benefits of a yoga intervention.

### **3.6 Conclusion**

Research exploring interventions to improve mental and physical health of undergraduate nursing students is limited. Our study demonstrates that an online yoga intervention has the potential to significantly improve participant mental health (i.e., symptoms of depression, stress, anxiety, and self-compassion) and physical health (i.e., core endurance). New nursing graduates enter a highly psychologically and physically demanding profession plagued by high burnout rates [91-95]. Given the success of this intervention, post-secondary institutions should consider implementing similar low-cost flexible interventions with high-risk student cohorts.

#### **3.6.1 Funding source**

There were no grants obtained from funding agencies in the public, commercial, or not-for-profit sectors.

### **3.6.2 Financial disclosure**

The authors have no financial relationships relevant to this article to disclose.

### **3.6.3 CRediT authorship contribution statement**

Sylwia Ciezar Andersen: conceptualization, methodology, formal analysis, writing, investigation.

Kathryn King-Shier: conceptualization, methodology, writing-reviewing and editing, visualization, supervision.

Deborah White: conceptualization, investigation.

Tavis Campbell: conceptualization, investigation.

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

### **Declaration of competing interest**

The authors have no conflicts of interest relevant to this article to disclose.

### **Acknowledgements**

The authors thank the participants, without whom this study would not have been possible.

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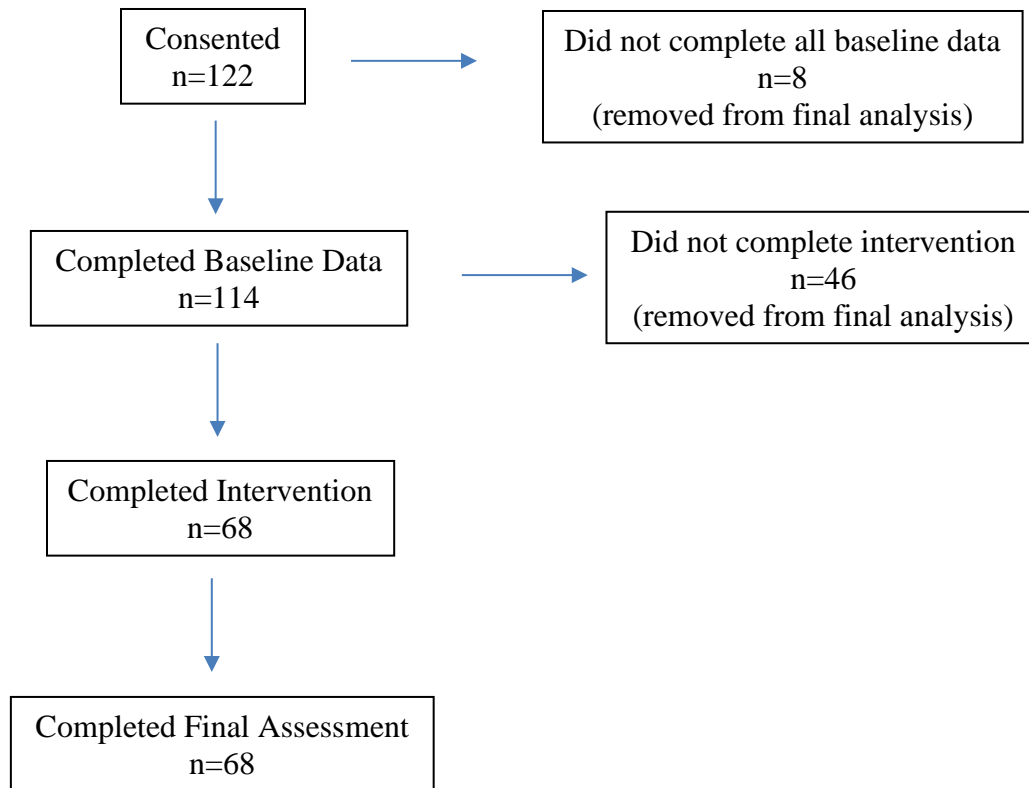
**Figure 1: Participant recruitment and retention flow chart**



Table 1. Demographic Characteristics (n=68)

<b>Characteristic</b>	<b>%(n)</b>
<b>Sex</b>	
Female	94% (64)
<b>Age (years)</b>	
17-20	37% (25)
21-25	37% (25)
26-30	10% (7)
31-35	6% (4)
36 and over	10% (7)
<b>Institution</b>	
1	52% (35)
2	25% (17)
3	3% (2)
4	6% (4)
5	10% (7)
6	4% (3)
<b>Year Program</b>	
1	35% (24)
2	25% (17)
3	22% (15)
4	18% (128)

Table 2. Depression, Anxiety, Stress, Self-Compassion, and Core Endurance Score

Classification (n=68)

<b>Variable</b>	<b>Baseline % (n)</b>	<b>Post-intervention % (n)</b>
<b>Depression</b>		
Severe	19.1% (13)	2.9% (2)
Mild-Moderate	27.9% (19)	3% (2)
Normal	52.9% (36)	94.1% (64)
<b>Anxiety</b>		
Severe	27.9% (19)	8.9% (6)
Mild-Moderate	45.6% (31)	13.3% (9)
Normal	26.5% (18)	77.9% (53)
<b>Stress</b>		
Severe	23.6% (16)	1.5% (1)
Mild-Moderate	39.7% (27)	13.3% (9)
Normal	36.8% (26)	85.3% (58)
<b>Self-Compassion</b>		
Below Average	44.1% (30)	5.9% (4)
Average	45.6% (31)	44.1% (30)
Above Average	10.3% (7)	50% (34)
<b>Core Endurance</b>		
Below Average	86.8% (59)	41.2% (28)
Average	4.4% (3)	13.2% (9)
Above Average	8.8% (6)	45.6% (31)

Table 3. Mean variable scores at baseline and post-intervention.

<b>Variable</b>	<b>Possible Range</b>	<b>Normal Range</b>	<b>Baseline Mean (SD)</b>	<b>Final Mean (SD)</b>	<b>P Value</b>	<b>Effect Size (Cohen's <math>\delta</math>)</b>
Depression	0-28	0-9	11.90 (9.63)	4.03 (4.51)	<0.001	-1.11
Anxiety	0-20	0-7	11.84 (7.70)	5.31 (4.89)	<0.001	-1.04
Stress	0-34	0-14	18.74 (8.71)	9.09 (5.78)	<0.001	-1.34
Self- Compassion	1-5	3	2.75 (0.68)	3.57 (0.75)	<0.001	1.15
Endurance (sec)	0-180	96-116	68.19 (25.15)	108.51 (36.65)	<0.001	1.30

**Chapter 4: Retention Challenges During a Study of the Effect of an Online Yoga Program on the Mental and Physical Health of Undergraduate Nursing Students**

There was a significant association between engaging in a 6-week online yoga intervention and the improvement of mental and physical health scores of undergraduate nursing students. However, an unexpectedly high rate of attrition (44%) compromised the generalizability of the findings. The following manuscript includes a reflection about potential factors which may have contributed to the high participant attrition and offers potential improvements for future research.

This chapter will be submitted for publication as:

Ciezar-Andersen, S. D., White, D. Campbell, T. & King-Shier, K. M. (2022). Retention challenges during a study of the effect of an online yoga program on the mental and physical health of undergraduate nursing students.

## **Retention Challenges During a Study of the Effect of an Online Yoga Program on the Mental and Physical Health of Undergraduate Nursing Students**

### **4.1 Abstract**

Yoga practice has the potential to improve mental and physical health of nursing students. We undertook a study to examine the effect of a six-week online asynchronous yoga intervention on mental and physical health of undergraduate nursing students. Based on similar previous studies, we anticipated an approximate 20% rate of attrition. However, the rate of attrition was more than twice that at 44%. Potential reasons for attrition were associated with individual and intervention characteristics. A sizable proportion (20%-27%) of participants started the study with high depression, anxiety, or stress scores and all were previously sedentary. Factors that may have negatively impacted attrition included: participants lacking a feeling of connectedness to the study; participants having few opportunities to receive positive reinforcement; too great a frequency and duration of classes; and too much variety and flexibility in the online program.

Potential ways to mitigate these problems include: increasing number of check-ins; having less onerous participation requirements; creating more structure to the program; offering synchronous classes; establishing connectivity through an online community; and adding positive reinforcement through gamification to promote habit formation.

While participating in the yoga intervention showed great improvements in mental and physical health of the participants who completed the study, its effectiveness

was compromised by high attrition rates. The theory of habit formation can be used to optimize intervention design and increase retention.

## **4.2 Introduction**

The purpose of the pretest/post-test study was to determine whether engaging in an online yoga intervention would improve the mental and physical health of undergraduate nursing student participants. The yoga intervention entailed 6-weeks of moderate intensity yoga flow classes. Classes ranged between 25-67 minutes in duration (mode 40 mins) and were pre-recorded and delivered via a yoga website (yogiapproved.com). Participants were instructed to complete three classes per week with one day of rest in between. There were two data collection points, one at commencement and one at the end of the program.

Based on ORBIT model [1], a proof-of-concept study (Phase IIa) was first undertaken to assess the feasibility of the intervention and receive feedback on the yoga program design. In this phase of the study, the target number of participants (n= 8) was recruited within 72 hours. More students expressed interest than could be accommodated, and some (n= 16) had to await enrolment in the next phase of study. The proof-of-concept study (Phase IIa) had a 25% attrition rate. The Phase IIb pilot study was initiated three months later. One minor addition was made to the protocol, based on feedback from Phase IIa: an email communication was sent at three weeks into the intervention to assist participants to feel more connected to the program. Based on the Phase IIa recruitment and retention, we anticipated recruitment would be complete within three months and the study would be completed within four-five months. However, to reach the target of 64

complete datasets, recruitment had to be expanded beyond the single site to include five additional nursing schools and took 11 months to recruit the desired sample size. There was a 44% (54/122) attrition rate. Previous studies employing yoga interventions for nursing students in India, Korea, and the USA reported attrition rates of 0-20% [2-5], and a 20% attrition rate was factored into the initial sample size calculation for this study. Our rate of attrition was much higher and warrants some reflection and discussion.

#### **4.3 Potential reasons for attrition**

Study participants were asked why they chose to withdraw (outlined in Table 1). Fifteen (27.8%) of those who withdrew did so because they felt they could not maintain the pace of engaging in three yoga classes per week. One participant said, “I just can’t keep doing this every other day, it’s too much and I’m falling behind and getting discouraged and frustrated.” Eighteen (33.3%) participants cited other demands on their time as reasons for de-prioritizing and discontinuing the program. One participant said, “I just got too busy with school and clinical, and just life ...”. Another stated, “I wanted to continue but all the [course] assignments were coming due, and clinical got really busy. It was just too much.”

At the outset of the study, 20-27% of participants reported high symptoms of depression, anxiety, and stress (categorized according to the DASS-42; [6]). People who are already anxious, stressed and/or depressed may not be as amenable to engaging in exercise interventions relative to those who are not experiencing those challenges. Up to 20% of depressed persons prematurely leave exercise programs [7, 8], and this rate climbs to 42%-48% attrition for asynchronous online exercise programs [9, 10] and non-

exercise programs [11]. Further, comorbid depression, anxiety and/or stress, which evidence suggests has been amplified in university students over the COVID-19 pandemic [12], contributes to poor exercise adherence overall [12]. Finally, an inclusion criterion for this study was that participants did not engage in regular physical activity. Thus, participants were relatively sedentary.

Maintaining a regular physical activity regimen may be particularly challenging for previously sedentary and depressed study participants [7, 13]. Overall, the combination of having 20-27% of participants who reported high [6] symptoms of depression, anxiety, and stress at the study outset as well as having an inclusion criterion that rendered participants relatively sedentary, may have contributed to the higher-than-expected attrition in our study.

While our participants checked-in at the 3-week point during the 6-week intervention, this may have been insufficient. Based on a systematic review of exercise adherence in home-based programs, more frequent check-ins can enhance adherence [13]. In a home-based arm of one intervention study for depressed participants, 9.2% attrition rates were reported, likely due to frequent check-ins (biweekly) and monthly visits from an exercise physiologist [14].

The nature of the yoga program may have contributed to high rates of attrition. First, the program may have been too demanding at three classes per week (25-67 minutes in length). One participant offered this feedback: “Some of the classes were just too long...it was like, ‘oh no’ if the class was closer to one hour (in length). The classes that were 20 minutes or so were the best.” Having requirements of fewer classes per week

may be more feasible, since regimen adherence improves as frequency of dosing decreases [15]. Similarly, classes of a shorter duration may have been of benefit. Exercise interventions targeting sedentary university students have been shown to be more successful when done in short, flexible intervals [16, 17]. Finally, perceived competency with an exercise regimen may be a key to its enjoyment [13, 18]. While aiming to enhance the variety of classes, we may have done so at the cost of undermining participants perceived competency. Routine repetition of yoga poses was not established.

The design of future yoga interventions for study may benefit from requiring fewer classes per week, for shorter durations, and with classes that include repetition. The mechanisms of offering the yoga program may have also led to a higher-than-expected attrition. The great flexibility offered to participants when engaging in the yoga intervention as well as its asynchronous online delivery may have exacerbated issues with attrition. Participants in our study were given freedom to engage in the asynchronous online classes at their convenience. This may have led to participants de-prioritizing class engagement, as the yoga classes were not part of a regular routine. Further, participants are more likely to adhere to an exercise regimen when they know their adherence is being remotely monitored, and when they have a pre-scheduled time for exercise [19]. The authors of a systematic review of internet interventions (primarily cognitive behavioral and coping skill training) targeting mental health of university students, reported attrition rates of 2-50% [19] for unguided interventions (as was ours). All previous studies of yoga interventions for nursing students were designed to provide scheduled in-person rather than online classes [2-5]. Participants in a previous study were enrolled as part of their



undergraduate nursing curriculum [4] and were not given the option to withdraw.

Similarly, in another study, the yoga intervention was structured as an elective course that had to be completed in order to gain credit [3] and had no attrition. Kim [5] as well as Mathad [2] reported 20% attrition rates of participants for a yoga intervention offered to nursing students in person. However, a recent study of a yoga intervention for nursing students that was offered in person and for credit (an incentive we lacked), had a 50% attrition rate [20]. Similar to our study, participants cited being too busy, being stressed related to school, and having work conflicts as the most frequent reasons for withdrawal.

#### **4.4 Suggestions for future research and implementation**

The majority (61%) of participants who withdrew from the study did so at the three-week point. The theory of habit formation may be used to explain this phenomenon. Habit formation occurs in three phases: initiation, learning, and stability [20, 21]. The learning phase (marked by repetition of a new behaviour to strengthen the context-behaviour association) culminates in the stability phase where a plateau of effort is reached [21]. It appears that the three-week point in this study was the transition point between the learning and stability phases, and if participants persisted past this point, they entered the stability phase. In the stability phase automaticity of behaviour is established decreasing the likelihood of quitting the activity [21]. The observed attrition of participants around the three-week point may have been due to an unsuccessful transition from the learning to stability phase. Participants nearing the end of the learning phase of habit formation who did not perceive having forthcoming incentives to continue, may have de-prioritized program participation relative to prioritizing their perceived

more immediate demands. Thus, they did not move into the stability phase. On days when participants' motivation to engage in physical activity is weak, they will engage in the physical activity only if the activity has become habitual and requires minimal effort, the stability phase [22]. Habit formation is strongly encouraged through having a routine and engaging with groups [23]. In future studies, habit formation could be encouraged through creation of an online community via live lessons or an app that connects participants in online environments. An online community would also have the added benefit of creating a social group for participants.

Social influence and social reinforcement are potent predictors of exercise adherence in young adults [13, 24-26] and university students [16, 17]. The social group takes on a different meaning when exercises are offered via technology-based platforms [27], and online exercise classes continue to have more successful completion rates if they promote social interaction and social cohesion [28]. Establishing a sense of belongingness through a virtual community such as synchronous classes could be one way to enhance retention rates in future studies [29, 30]. When seeking alternatives to live classes, platforms such as Instagram, TikTok, WhatsApp and Snapchat may be used to create a sense of community and offer cues to support behaviour change.

When combined with the social support found in a virtual community, positive reinforcement has also been found to be a strong predictor of exercise adherence [13]. One way to achieve this is through a virtual reward system [25]. An option for establishing a virtual reward system is through gamification of intervention participation. Gamification is emerging as a popular way to encourage participation in physical activity

[31]. Gamification based on competition has been found to incentivize participants of all ages, including those who have been previously sedentary, to engage more closely in physical activity programs while also building a virtual social community [32]. Other gamification strategies could incorporate the establishment of weekly goals, progress tracking, and resulting ‘badges’ for milestone completion in order to further motivate participants [33]. Gamification may be another way that future studies of this type could increase adherence to the program.

#### **4.5 Conclusions**

Yoga interventions have the potential to improve mental health outcomes including symptoms of depression, stress, and anxiety, as well as the physical health of future nurses. We encountered higher-than-expected attrition rates when undertaking our study that may be remedied in future studies through a variety of identified strategies (e.g., having less onerous participation requirements, increasing check-ins, creating more structure to the program, offering synchronous classes, etc.) that promote habit formation. Our recommendations for future program design also include modifications to incentivize participants to maintain program participation through establishing a sense of community and/or use of gamification. Our study continued to demonstrate that yoga has promise at improving mental and physical health of undergraduate nursing students. Fine tuning study design and implementation processes is required to see the greatest benefit.

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## Chapter 5: Discussion

We began this work with a systematic review of previous yoga interventions for healthcare professionals and students (Ciezar-Andersen et al., 2021). We concluded that mental and physical health benefits can be gained by healthcare professionals and students participating in yoga interventions. Thereafter, we offered recommendations for the design and implementation of future studies. Given the paucity of information about online yoga interventions and the limited findings of previous in-person studies, we aimed to examine the effects of a 6-week online yoga intervention program on the mental (symptoms of depression, anxiety, stress, self-compassion) and physical (core endurance) health of nursing students. We designed a replicable yoga intervention that was offered to a sample of nursing students in Alberta. We found statistically significant improvements in symptoms of depression, anxiety, stress, self-compassion and core endurance of participants following the intervention ( $p < 0.001$ ). However, we encountered a 44% attrition rate during the online intervention. We proceeded to explore factors which may have contributed to this unexpected outcome and offered potential solutions for future research to help minimize attrition in similar interventions.

## **5.1 The Current State of Canadian Undergraduate Nursing Students' Mental and Physical Health**

Canadian post-secondary students report poor mental and physical health. The American College Health Association's 2019 report of Canadian universities revealed that 19.1% of students were diagnosed or treated for depression, 23.7% were diagnosed or treated with anxiety, and 60.9% reported above average stress within the previous 12 months. Nursing students in our study reported poorer mental health than the general student body; with 47.1% reporting symptoms of depression, 73.5% reporting symptoms of anxiety, and 63.2% reporting symptoms of stress at the outset of the study. The COVID-19 pandemic has been further compromising the mental health of nursing students who are on the frontlines witnessing patients dying from COVID-19 and working under crisis conditions for months, increasing stress and posttraumatic stress symptoms (d'Ettorre et al., 2021; Thomas, 2021).

Unmanaged depression, anxiety, or stress has a variety of negative impacts on the individual nursing student and practicing nurse including burnout (Botha et al., 2015; Cohen et al., 2007; Enns et al., 2015; Greenglass & Burke, 2016; Guo et al., 2016; McVicar, 2003; Ross et al., 2017). Upon graduation, new nurses become part of a psychologically and physically demanding profession, often without being adequately prepared to cope with these demands (Choi & Brings, 2015; Ciezar-Andersen et al., 2021; Labrague et al., 2017; Pugh et al., 2019; Steege et al., 2015; Tharani et al., 2017). Burnout is characterized by emotional exhaustion, depersonalization, cynicism, and reduced feelings of personal accomplishment (Maslach et al., 1986). Starting early in

their career, new graduate nurses across Canada exhibit severe emotional exhaustion (feeling emotionally drained and worn out because of one's job), and increasing cynicism over time, core components of burnout (Maslach et al., 1986). As many as 66% of newly graduated nurses report burnout within the first three years of practice, which may lead to leaving the profession (Cho et al., 2006; Spence Laschinger & Fida, 2014).

It is well-established that physical activity improves mental and physical health of participants (Anderson & Durstine, 2019; Béland et al., 2020; Chandrasekaran & Ganesan, 2021; Chekroud et al., 2018; Roberts & Barnard, 2005). Adults aged 18-64 years should engage in 150 minutes of physical activity per week (Centers for Disease Control and Prevention, 2017; Tremblay et al., 2011; WHO, 2014). Nearly 44% of post-secondary students, and 50-80% of nursing students do not meet these guidelines. (American College Health Association, 2016, 2019; Graves et al., 2020; Irazusta et al., 2006; Smith et al., 2020).

The habits and lifestyles that nursing students develop carry over into their careers as practicing nurses (Mc Sharry & Timmins, 2016; Wills & Kelly, 2017). Approximately 77% of nurses self-identify as inactive (Cheung & Yip, 2015) and 50% do not meet physical activity guidelines of 150 minutes of physical activity per week (Centers for Disease Control and Prevention, 2017; Tremblay et al., 2011; Tucker et al., 2011; WHO, 2014). A sedentary lifestyle is associated with decreased core endurance and strength, muscle mass, and elasticity resulting in increased risk of physical injury (Gonzalez et al., 2018; Lurati, 2018), a major problem within the practice of nursing (Budhrani-Shani et al., 2016; Fronteira & Ferrinho, 2011; Stieglitz et al., 2016). Seventy one percent of

nursing students experience back pain within the first year of their education (Mitchell et al., 2008). This trend continues as they graduate; practicing nurses are more affected by musculoskeletal disorders than other healthcare workers and other occupational groups (Amaro et al., 2018; Fronteira & Ferrinho, 2011). The prevalence of back pain in nurses is as high as 90% (Attar, 2014), and they have an 80% lifetime prevalence of back injury (Edlich et al., 2004). This further impacts the nurse's ability to provide care and compromises his/her clinical practice by increasing sick time and absenteeism.

In addition to musculoskeletal disorders, poor health is also associated with chronic disease for the individual nurse (Cohen et al., 2007; Enns et al., 2015). A synthesis of literature showed that nurses have higher rates of hypertension, cardiovascular disease, and breast cancer than the general population (Fronteira & Ferrinho, 2011). Seventy-two percent of Canadian nurses suffer from at least one chronic disease, compared to 44% of the general population (Public Health Agency of Canada, 2018), further compromising the health of the nursing workforce. Nursing students introduced to yoga practice may benefit from enhanced mental and physical health in the short term and as future nurses.

## **5.2 Implications of Implementing a Yoga Intervention for Undergraduate Nursing Students**

Our study findings revealed that the implementation of a yoga intervention for nursing students can have positive effects on their mental and physical health. We targeted nursing students who did not participate in regular physical activity (3+ times/week) because sedentary nursing students are at the greatest risk for adverse events

including poor mental and physical health, leading to burnout, musculoskeletal injury, and chronic disease (described earlier).

Burnout, musculoskeletal injury, and chronic disease negatively affect the individual nurse and reduce their overall quality of life (Tracera et al., 2020). Burnout can result in flu-like and gastrointestinal symptoms, sleep deprivation and insomnia, and back and neck pain (Hammond et al., 2018; Kaeding et al., 2017; Yang & Hayes, 2020). Individuals struggling with burnout are at increased risk of developing anxiety and depressive disorders, suffering secondary traumatic stress, general psychological distress, and maladaptive coping strategies (Fong et al., 2016; Hammond et al., 2018; Papathanasiou et al., 2017; Yang & Hayes, 2020).

The practice of yoga shows promise to improve nursing student wellness by having the two-pronged benefit of improving both mental and physical health of participants (Alphonsus et al., 2019; Brinsley et al., 2021; Park et al., 2018), and was therefore the intervention for our study.

### **5.3 Strengths and Limitations of this Work**

Our work makes a significant contribution to the understanding of the effects of yoga on the mental and physical health of undergraduate nursing students, while also offering a transparent and reproducible intervention and potential solutions to challenges associated with online interventions. However, our study should be interpreted in light of its limitations. The main limitation of the study is the nature of the survey data, collected at only two time intervals (at baseline and 6-week conclusion of intervention). Based on the lack of more long-term follow-up we are not able to extrapolate whether the effects of

our intervention have lasting benefits, and further exploration in future studies is warranted. Additionally, mental health outcomes were self-reported and are therefore subject to reporting bias, further limiting our study.

Selection bias and high attrition threatened the validity of our findings. The participants recruited for our study self-selected to participate and may have shared similar characteristics not representative of the population including a readiness to change. Baseline sedentary behaviour, an inclusion criterion, is not representative of the mental and physical health of all nursing students. Additionally, the attrition rate of 44% in our study prevented us from collecting follow-up data of a significant proportion of the sample and the effects of the intervention on these participants remain unknown. However, comparison of baseline characteristics showed no statistically significant differences between characteristics of participants who completed the study and those who dropped out prematurely.

Finally, the findings presented in this work focus on Canadian undergraduate nursing students, potentially compromising generalizability. Our participants were recruited from Albertan post-secondary institutions offering programs of nursing study. However, given that our findings align with internationally reported rates of nursing students' mental and physical health, we have little reason to believe that the findings of our study would have been substantially different if national or international data were available.

#### **5.4 Future Directions and Educational Implications**

The World Health Organization defines wellness as a “state of complete physical, mental, and social well-being and not merely the absence of disease” (WHO, 2019). Poor mental and physical health of university students is well documented in research, and nursing students appear to be at particularly high risk. Given the detrimental effects of poor mental and physical health on the individual, the patients they care for, and the future of the nursing profession, the need for change is evident.

In recent years, the need to improve the mental and physical health of post-secondary students has received increasing worldwide attention. The World Health Organization World Mental Health International College Student (WMH-ICS) initiative has recently been deployed to aid in improving mental health problems among post-secondary students. The initiative consists of three core elements; a web-based survey to assess the magnitude and nature of mental health problems of post-secondary students, testing of internet-based interventions aimed at the prevention and early intervention, and dissemination and quality improvement monitoring of evidence-based interventions. The WMH-ICS trials are being implemented in Germany, the Netherlands, Taiwan, the United States, and a number of Latin American countries (Cuijpers et al., 2019). Similarly, a need for university programs to integrate physical activity into their curricula has been identified as a promising way to change sedentary behaviours of post-secondary students (Deliens et al., 2015; Smetaniuk et al., 2017). However, logistics and costs are identified barriers to incorporating mental and physical health interventions into the post-secondary infrastructure.

Online interventions are receiving increasing attention as a feasible, easily scalable, and cost-effective option to deliver wellness interventions to post-secondary students (Cowpertwait & Clarke, 2013; Ebert et al., 2018; Josephine et al., 2017; Webb et al., 2010). Studies have shown that there are no significant differences in the effectiveness of using online versus in person mental and physical health interventions (Andersson et al., 2014; Carlbring et al., 2018; Cuijpers et al., 2019; Herbert et al., 2020; Kaltenthaler et al., 2008). Internet interventions have many advantages over traditional face-to-face interventions, as they are easily scalable to target large populations, require no travel time or wait lists, and can be accessible at any time (synchronous versus asynchronous interventions). Additionally, internet-delivered interventions overcome key barriers to seeking help for mental health disorders including stigma, avoidance, and accessibility to in-person counselling. Nearly 60% of post-secondary students report not participating in in-person mental health services due to stigma, and 48% report accessibility as a key barrier (Wang et al., 2020). Currently (May, 2022), the wait list to access in-person mental health services at the University of Calgary is minimum two weeks (personal communication, Jill Russell, UCalgary Mental Health Services). Post-secondary students are also typically very familiar with technology (Cuijpers et al., 2019; Webb et al., 2010).

Recognizing the potential of online intervention delivery to post-secondary students, the Royal College of Psychiatrists in the United Kingdom advised universities to increase the availability of evidence-based online interventions (Royal College of Psychiatrists, 2011) and Australia now has an official e-mental health strategy (Meurk et



al., 2016), further expanded in 2020 (Australian Government Productivity Commission, 2020). While only 23% of post-secondary students with mental health disorders (as classified by the DSM-IV) seek out in-person mental health interventions (Auerbach et al., 2016), 35-50% express an interest in participating in similar interventions *online* (Ryan et al., 2010; Wong et al., 2018). However there continues to be a paucity of information regarding effective online interventions that minimize participant attrition while improving the wellness of post-secondary students (Baumel et al., 2019; Cuijpers et al., 2019), the focus of our research. We offer potential solutions to high online attrition including establishment of an online community, virtual rewards, gamification, and adjustment of class length and duration. Future research would benefit from exploring these potential strategies to minimize attrition bias in online interventions.

Another strategy for minimizing attrition could be to implement wellness interventions such as yoga as a core, rather than elective, part of the nursing curriculum to benefit all enrollees. An online wellness intervention that is part of the core curriculum is likely to exhibit lower attrition rates than an elective intervention. In a study of 23,500 US college students enrolled in online courses, Wladis and colleagues (2014) concluded that courses that are a program requirement have 18.3% lower attrition rates than elective courses.

In addition to minimizing attrition, having an entire class participate in a health-promoting intervention such as yoga would help address self-selection bias, mitigate the potential stigma associated with seeking help, and circumvent singling out those in poorer health relative to their colleagues (Dekker et al., 2020). Several interventions

using a preventive rather than reactive approach, including yoga, mindfulness, stress management, and walking, aimed at improving the mental and physical well-being of medical students, have been successfully pilot tested in the US with the conclusion that they ought to be incorporated into the core medical school curriculum (Aherne et al., 2016; Brennan et al., 2016; Slavin et al., 2014; Waechter et al., 2021). In a longitudinal study spanning five years, incorporation of wellness courses into the medical school curriculum reduced students' symptoms of depression by 16%, anxiety by 21% and mean stress from 16.9 to 13.5 on the PSS ( $p < 0.001$ ) (Slavin et al., 2014). Nursing students, at high risk for compromised mental and physical health (Herbert et al., 2020), would be similarly likely to benefit from establishing a wellness intervention such as yoga as a core part of the curriculum. Compared to other interventions, yoga is likely to be a well-accepted integration to the curriculum, as it is viewed positively by young adults. In a sample of medical students, yoga was viewed most favourably and exhibited the lowest attrition rates (27%), compared to a walking intervention (63%) and a mindfulness intervention (29%) (Waechter et al., 2021).

Universities worldwide are recognizing the need to promote mental and physical health of post-secondary students. The findings of our intervention show promise as a potential strategy to improve mental and physical health of nursing students, but more research is needed to confirm reproducibility of findings. Future studies could explore the feasibility and effectiveness of online yoga interventions as a core requirement of the nursing curriculum, a group of post-secondary students identified to be at particularly high risk for poor mental and physical health. Advantages to offering the intervention

online include low implementation costs for the educational institution and demonstrated health benefits, convenience, and accessibility and flexibility for participants.

Additionally, strategies to minimize attrition while optimizing mental and physical health benefits of online yoga interventions embedded within the nursing curriculum should be explored in future studies.

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*Kathryn King-Shier*

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Kathryn King-Shier

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A handwritten signature in blue ink that reads "Debbie White". The signature is written in a cursive style with a large initial "D".

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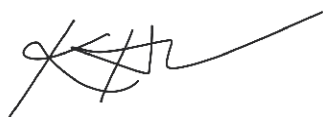
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## **APPENDIX C: Definition of Helping Health Professionals**

To the best of our knowledge, singular definition of what constitutes the concept of a ‘helping health professional’ does not exist. A stepwise systematic approach was taken to elucidate the concept of ‘helping health professional’ in order to clearly outline the boundaries of the population in question and to avoid ambiguity. The definition of ‘professional’ is followed by ‘*helping* professional’ and finally ‘helping *health* professional.’ The final definition incorporates aspects of the WHO’s aggregate data definition, World Health Professions Alliance’s Definition, International Labour Organization’s Definition, and ‘Health Professionals’ as defined by the Alberta Health Professions Act.

### **Professional**

Professionals are members of a profession who belong to an organized association, incorporate self-regulation, advanced training and specific expertise from which they derive an income (Cruess et al., 2004; Miller & Considine, 2009, p. 405).

### **Helping Professional**

According to Graf et al. (2014), a helping profession is defined by the “professional *interaction* between a helping expert and a client, initiated to nurture the growth of, or address the problems of a person’s physical, psychological, intellectual or emotional constitution” and includes “medicine, nursing, psychotherapy, psychological counseling, social work, education or coaching” (p. 1). Helping professionals, according to Graf and colleagues, are unique in their *interactions* with clients in that they employ communication as a means to solve the client’s problem. This goal-oriented

communication is unique to the helping professional, and “its overall purpose of solving tasks as well as the possibility to add another’s perspective” are identified as the central elements of helping professions (Graf et al., 2014, p. 2).

Additionally, this type of interaction requires “intensive physical and emotional involvement between service providers and their clients” (Miller & Considine, 2009, p. 405). A central psychological motivator behind the interaction of a helping professional with his or her client has been conceptualized as ‘compassionate motivation’ (Kanov et al., 2004). Therefore, a helping professional is defined as such when his or her interaction with the client is goal-oriented and motivated by compassion.

### **Helping Health Professional**

A Helping Professional as defined above, whose primary objective is the promotion of mental and/or physical health. This focus on health rather than self-actualization excludes ministry, teaching, and coaching professions, who would otherwise be included as ‘helping professionals.’

The following table constitutes an extraction of Helping Health Professionals (as per amalgamation of: World Health Organization, International Labour Organization’s International Standard Classification of Occupations, World Health Professions Alliance, and Alberta Health Professions Act) based on the above definition. The classification is based on an understanding of “what is done on the job” rather than specific job categories.

**Helping health professionals and trainees:**

**Generalist and Specialist Medical Doctors:** medical doctor, medical practitioner, physician, medical officer, resident medical officer, anaesthetist, cardiologist, emergency medicine specialist, gynaecologist, obstetrician, ophthalmologist, paediatrician, pathologist, preventive medicine specialist, psychiatrist, radiation oncologist, radiologist, surgeon, internist, intensivist.

**Nursing and Midwifery:** nurse (captures RN, LPN, clinical nurse consultant, district nurse, nurse anaesthetist, nurse educator, nurse practitioner, operating theatre nurse, professional nurse, public health nurse, specialist nurse), midwife.

**Complementary Medicine:** Acupuncturist, ayurvedic practitioner, Chinese herbal medicine practitioner, homeopath, naturopath, unani practitioner.

**Paramedical Practitioners:** Paramedic, clinical officer, feldscher, surgical technician, ambulance driver.

**Dentistry:** Dental practitioner, hygienist, dentist, endodontist, orthodontist, paedodontist, periodontist, stomatologist.

**Others:** dietician, dietitian, occupational therapist, physiotherapist, physical therapist, nutritionist, psychologist, social worker.

## APPENDIX D: Participant Consent Form



### UNIVERSITY OF CALGARY CONSENT TO PARTICIPATE IN RESEARCH

**TITLE:** Yoga for Undergraduate Students: An Intervention to Enhance Physical and Mental Health of Nursing Students

**SPONSOR:** Dr. Kathryn King-Shier

**FUNDER:** None.

**INVESTIGATORS:** Dr. Kathryn King-Shier, Sylwia Ciezar Andersen, Dr. Debbie White, Dr. Tavis Campbell.

Dr. King-Shier (403) 220-4643

Sylwia Ciezar Andersen (403) 505-1087

#### INTRODUCTION

Dr. King-Shier and associates from the Faculty of Nursing at the University of Calgary are conducting a research study.

This consent form is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something described here, or information not included here, please ask. Take the time to read this carefully and to understand any accompanying information. You will receive a copy of this form for your records.

You were identified as a possible participant in this study because you are an undergraduate nursing student. Your participation in this research study is voluntary.

#### WHY IS THIS STUDY BEING DONE?

The purpose of the study is to examine the effectiveness of a yoga intervention on improving mental and physical health of undergraduate nursing student participants. Mental health measured by the Depression, Anxiety, and Stress Scale (DASS), and physical health measured by core stability (Mackenzie Core Endurance Test) will be assessed at baseline (pre-intervention), 3-weeks (midpoint, Proof-of-Concept only) and



conclusion of the intervention to determine whether statistically and clinically meaningful benefits have been derived.

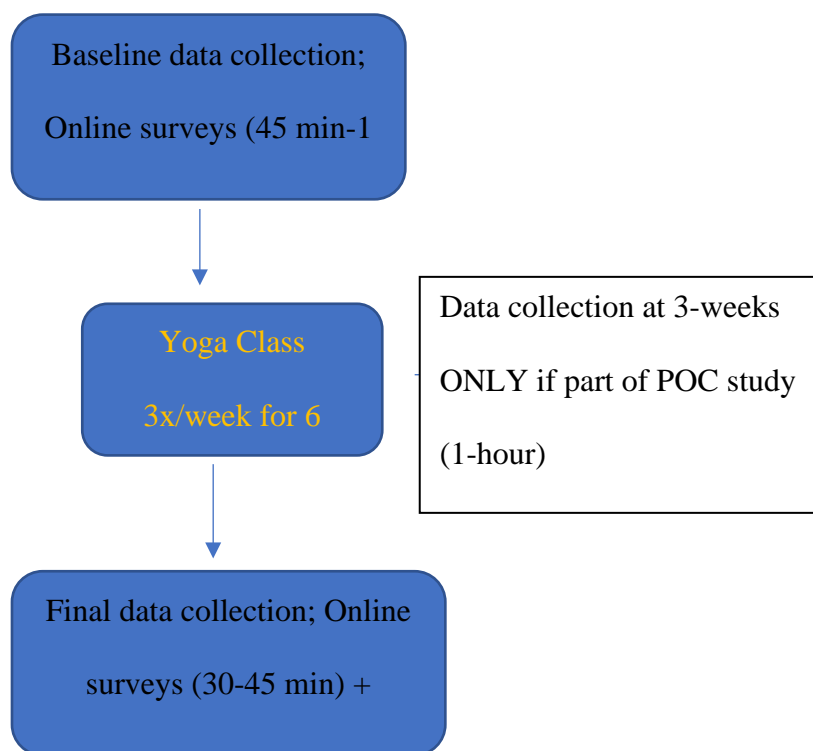
#### HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?

About 103 students will take part in this study from post-secondary institutions in Alberta.

All classes will be offered virtually through an online yoga platform (yogiapproved.com) and participants will be provided free access. Participants will be expected to follow the class schedule provided, which outlines 3 classes/week (maximum of 1 hour/class) for six weeks. Participants will be required to partake in all data collection episodes.

#### WHAT WILL HAPPEN IF I TAKE PART IN THIS STUDY?

Consenting to participate in the study would entail:



#### HOW LONG WILL I BE IN THIS STUDY?

You will be in the study for a total of 8 weeks.

#### ARE THERE ANY POTENTIAL RISKS OR DISCOMFORTS THAT I CAN EXPECT FROM THIS STUDY?

There is a risk associated with participation in yoga, as with any physical activity, including but not limited to strains and sprains, and in extreme cases, more severe injury or death.

Participants who are identified to be experiencing distress (those who score 'Severe' or higher on any of the Depression, Anxiety, or Stress Sub-Scales) will be contacted via email and telephone to follow-up and committee members will be notified. These participants will be encouraged to connect with the Student Wellness Center on campus or the Calgary Distress Center.

#### ARE THERE ANY POTENTIAL BENEFITS IF I PARTICIPATE?

If you agree to participate in this study there may or may not be a direct benefit to you. If you are in the study because you have been identified as an undergraduate nursing student, your condition may be improved during the study but there is no guarantee that this research will help you. The information we get from this study may help us to provide better treatments in the future for stressed-out and inactive undergraduate nursing students.

#### WHAT OTHER CHOICES DO I HAVE IF I CHOOSE NOT TO PARTICIPATE?

Participation in the study is completely voluntary and you may withdraw at any time by contacting the PI. If new information becomes available that might affect your willingness to participate in the study, you will be informed as soon as possible.

#### CAN I STOP BEING IN THE STUDY?

Yes. You can decide to stop at any time.

#### CAN THE RESEARCHERS REMOVE ME FROM THIS STUDY?

The researcher reserves the right to withdraw you from the study should you pose a risk to yourself or others.

#### WITHDRAWAL OF STUDY DATA

We will be able to exclude any data collected from you up to the point of analysis. You may request that your data be withdrawn for up to 1 month after collection. Raw data will be retained for 5 years.

#### DO I HAVE TO PAY FOR ANYTHING?

You will not incur any costs.

#### WILL INFORMATION ABOUT ME AND MY PARTICIPATION BE KEPT CONFIDENTIAL?

The researchers will do their best to make sure that your private information is kept confidential, unless required by law. Information about you will be handled as confidentially as possible, but there is always the potential for an unintended breach of privacy. The research team will handle data according to the Data Management Plan as outlined below:

All identifiable information about you will be replaced with a code. A master list linking the code and your identifiable information will be kept separate from the research data.

All research data and records will be maintained in a secure location at the University of Calgary. Only authorized individuals will have access to it.

Some research data and records will be stored on a laptop computer that is password protected and has encryption software.

Some research data and records will be stored electronically on a secure USB with encryption and password protection.

Qualtrics is an online survey platform with servers located in Toronto, Ontario, Canada.

All data are encrypted and stored directly on its servers. Researcher access to the survey data is password-protected and the transmission is encrypted. Survey responses cannot be linked to your computer.

The study investigators will make every effort to maintain the confidentiality of your research records, to the extent permitted by law (e.g., disclosed child abuse or neglect must be reported) and legal requests (e.g., court applications seeking disclosure of research data are possible in studies of criminal behavior).

#### HOW LONG WILL INFORMATION FROM THE STUDY BE KEPT?

The researchers intend to keep the research data and records for 5 years. Any future use of this research data is required to undergo review by a Research Ethics Board.

#### WHAT OTHER THINGS SHOULD I CONSIDER BEFORE PARTICIPATION?

Use of My Specimens:

No specimens will be collected.

#### RESEARCHER CONFLICTS OF INTERESTS

The researchers have no conflicts of interest to declare.

#### USE OF DATA AND SPECIMENS FOR FUTURE RESEARCH

My research data may be kept for use in future research to learn about, prevent or treat other health-related problems.

YES

NO

#### CONTACT FOR FUTURE RESEARCH

University of Calgary researchers may contact me in the future to ask me to take part in other research studies.

YES

NO

**IF I SUFFER A RESEARCH-RELATED INJURY, WILL I BE COMPENSATED?**

It is important that you tell the researchers if you believe that you have been injured because of taking part in this study.

In the event that you suffer injury as a result of participating in this research, no compensation will be provided to you by Dr. King-Shier, the University of Calgary, Alberta Health Services or the Researchers. However, you still have all your legal rights. Nothing said in this consent form alters your right to seek damages.

**WHO CAN I CONTACT IF I HAVE QUESTIONS ABOUT THIS STUDY?**

You may contact Sylwia Ciezar Andersen at 403-505-1087 with any questions or concerns about the research or your participation in this study.

**Conjoint Health Research Ethics Board (CHREB):**

If you have any questions concerning your rights as a possible participant in this research, please contact the Chair, Conjoint Health Research Ethics Board, University of Calgary at 403-220-7990.

**HOW CAN I FIND OUT ABOUT THE STUDY RESULTS?**

Study results including a link to publications will be available on request.

**WHAT ARE MY RIGHTS IF I TAKE PART IN THIS STUDY?**

Taking part in this study is your choice. You can choose whether or not you want to participate. Whatever decision you make, there will be no penalty to you.

You have a right to have all of your questions answered before deciding whether to take part.

Your decision will not affect your education or grades in any way.

If you decide to take part, you may leave the study at any time.

**HOW DO I INDICATE MY AGREEMENT TO PARTICIPATE?**

Your signature on this form indicates that you have understood to your satisfaction the information regarding your participation in the research project and agree to participate as a participant. In no way does this waive your legal rights nor release the investigators or involved institutions from their legal and professional responsibilities.

**SIGNATURE OF STUDY PARTICIPANT**


---

Name of Participant

---

Signature of Participant

---

Date

SIGNATURE OF PERSON OBTAINING CONSENT

\_\_\_\_\_  
Name of Person Obtaining Consent

\_\_\_\_\_  
Contact Number

\_\_\_\_\_  
Signature of Person Obtaining Consent

\_\_\_\_\_  
Date

A signed copy of this consent form has been given to you to keep for your records and reference.

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