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A systematic review of movement-oriented mind-body interventions and psychoneuroimmunological outcomes for psychological stress and trauma

Emma Wookey

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Pepperdine University
Graduate School of Education and Psychology

A SYSTEMATIC REVIEW OF MOVEMENT-ORIENTED MIND-BODY INTERVENTIONS
AND PSYCHONEUROIMMUNOLOGICAL OUTCOMES FOR PSYCHOLOGICAL STRESS
AND TRAUMA

A dissertation submitted in partial satisfaction
of the requirements for the degree of
Doctor of Psychology

by

Emma Wookey

September, 2023

Shelly P. Harrell, Ph.D. – Dissertation Chairperson

This dissertation, written by

Emma Wookey

under the guidance of a Faculty Committee and approved by its members, has been submitted to and accepted by the Graduate Faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF PSYCHOLOGY

Doctoral Committee:

Shelly P. Harrell, Ph.D., Chairperson

Dominique Malebranche, Ph.D.

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DEDICATION

To my brother Jonny, I have made it here because of you. Growing up, you saw the best in me, empowered me, inspired me each day, and knew me before I knew myself. In 2009, you wrote a letter to me saying, “Emma, I want you to take all that love inside of you and share it with everybody everywhere. Here is my challenge to you Emma, I challenge you to wake up every morning with the goal to help others in a POSITIVE manner.” I try to live each day by these words and have spent the last eleven years working so hard to make it here, thinking of you and missing you every single day.

To my eighteen-year-old self. I felt my world shatter after losing Jonny, and it impacted my physical health, giving me shingles on my face. I found healing, comfort, and purpose in mind-body movements, specifically tennis. I dedicate this dissertation to you and others who have experienced trauma that I hope can find some healing in the mind and body through movement.

To my parents. I feel like the luckiest person in the world to be born your daughter. Thank you for always encouraging me to find my own path, always believing in me, supporting me every single day, loving me unconditionally, and being my most significant role models. Your resilience, generosity, kindness, and strength make me feel so proud. To my amazing sister Katie, you have the biggest heart and are always there for me; I am so blessed to go through life with you by my side. Achieving this doctorate would not have been possible without my family.

To my extended family, the Gamoyda’s, Christie’s, Frazier’s, and friends who have become family. Thank you for bringing so much joy and love to my life in-between all the challenging moments, especially during the last six years of graduate school.

To my clients that I have been so privileged to work with at the Union Rescue Mission, the Simms/Mann Center for Integrative Oncology, and the University of Southern California. You have been my greatest teacher of all. I have learned from you all how cruel life can be, and I have witnessed how humans can be inherently stronger and more resilient than they could ever imagine.

And lastly, to Grayson, I will forever be indebted to the universe for bringing me you. Little did I know that moving to Los Angeles to complete this doctorate would also introduce us. Thank you for lifting me up after long days and always encouraging me to follow my dreams.

ACKNOWLEDGMENTS

Thank you to my mentor and chairperson, Dr. Shelly P. Harrell. I am so lucky to have learned from you. You have always given me tremendous understanding, compassion, guidance, and support. Thank you for making it possible to complete this dissertation and for always encouraging me. Thank you to Dr. Dominique Malebranche for agreeing to serve on my committee and inspiring me to pursue more training in Humanistic Psychology.

To Dr. Aaron Aviera, I am a changed person and clinician from being supervised by you for the entire duration of the program. I will never forget how you help me find my own clinical voice and confidence in our weekly meetings. My life has been touched by your genuine character, compassion for all, expertise, and ability to make your supervisees feel understood by your presence.

To Dr. Edward Shafranske, being supervised and mentored by you has been such a gift. It was always very evident to me how much you genuinely care about your students. Through your supervision, I have become more self-aware and able to understand myself more deeply, which has made me a much better clinician. I am so grateful for the gift of you being completely present whenever we interacted. You live a life of so much purpose and have changed so many lives, and I feel very lucky to be one of the lives you have changed for the better.

Lastly, thank you to all the clients I have been so privileged to work with at the Union Rescue Mission, the Simms/Mann Center for Integrative Oncology, and the University of Southern California. You have been my greatest teacher of all. I have learned from you all how cruel life can be, and I have witnessed how humans can be inherently stronger and more resilient than they could ever imagine.

VITA

EDUCATION

Pepperdine University **Los Angeles, California***Doctor of Psychology, Clinical Psychology (APA Accredited)* *May 2023*

Dissertation Title: "Movement-oriented Mind-Body Interventions and Psychoneuroimmunological Outcomes for Psychological Stress and Trauma"

- Chairperson: Shelly Harrell, PhD
- Passed Preliminary Orals: February 2021
- Anticipated Dissertation Defense: May 2023

Clinical Comprehension Examination

- Passed with Distinction: May 2021

Columbia University **New York, New York***Master of Arts in Clinical Psychology* *May 2019*

Master's Thesis: Power Breath: A Breath-Based Mind-Body Intervention for Veterans

Rollins College **Winter Park, Florida***Bachelor of Arts in Psychology; Minor in Global Health* *May 2016***HONORS/SCHOLARSHIPS**

Peer Consultation Award Union Rescue Mission *August, 2021***Clinical Competence Exam: Pass with Distinction-Pepperdine GSEP** *May, 2021***Conrad N. Hilton Foundation Fellow, Union Rescue Mission** *September 2019***Teachers College, Columbia Provost's Grant for Professional Development** *November 2017***Martin E. Farkash Award for Outstanding Contribution to Community Mental Health** *May 2016***Rollins College Athletics Coaches Award** *May 2016***Jean. L Reinhardt Scholarship for Community Leadership** *September 2013-May 2016***Rollins Tars Women's Athletic Tennis Scholarship** *September 2013-May 2016***Duke of Edinburgh Bronze Award** *May 2012***Greenwood College School Athlete of the Year (2 years)** *May 2010-May 2011***DOCTORAL CLINICAL EXPERIENCE**

Doctoral Intern **Toronto, Ontario***Toronto Area Residency Consortium (TARC)**August 2022-Present*

Supervisors: Sandra C. Paivio, Ph.D. and Immaculate Antony, Ph.D.

- Split time between two simultaneous part-time rotations at Toronto Metropolitan University, Centre for Student Development and Counselling (CSDC), with a focus on Emotion Focused Therapy (EFT)/Cognitive Behavioral Therapy (CBT)/Motivational interviewing, and at the York University Psychology Community Mental Health Clinic (YUPC), with a focus on EFT for complex trauma
- Provide weekly supervised supervision to a first-year Ph.D. clinical psychology student for two adult clients
- Provide short-term psychotherapy, long-term therapy, crisis intervention, and group therapy to multiculturally diverse adult clients each week
- Emphasis on EFT for complex trauma at the YUPC and currently see a caseload of clients weekly that have experienced multiple traumatic events, usually beginning in childhood, including neglect, sexual abuse, and physical abuse
- Co-facilitate a weekly group at TMU CSDC, Stepping Into Healing, for survivors of adult sexual violence (16+) and/or intimate partner abuse
- Receive weekly supervision of video recordings of sessions in weekly individual supervision (4 hours) and group supervision (2 hours)

Advanced Practicum Trainee*University of Southern California Counseling and Mental Health Services**Supervisor: Miriam E. Barillas, Psy.D.***Los Angeles, California***August 2021-August 2022*

- Provided short-term psychotherapy, long-term therapy, single-session solution-focused sessions, and group therapy to a multiculturally diverse caseload of emerging adults and graduate students enrolled at University of Southern California
- Utilized a variety of evidenced-based approaches including psychodynamic, ACT, EFT, CBT, human-centered, solution-focused treatment, as well as crisis counseling, couples therapy, and outreach services
- Co-facilitated a weekly workshop, Effective Living Skills, utilizing DBT for students who have a challenging time managing intense emotions
- Provided campus outreach and weekly drop-in 30-minute “Let’s Talk” solution focused sessions to students
- Received weekly supervision of video recordings of sessions in weekly individual supervision (2 hours) and group supervision (1 hour)
- Received training in crisis triage, suicide screening and assessment, solution focused therapy, short-term dynamic therapy, motivational interviewing, and specialized training for specific disorders (eating disorders, depression, anxiety, trauma/stress related disorders, and adjustment disorder)

Pre-doctoral Psychology Practicum Trainee*UCLA Simms/Mann Center for Integrative Oncology**Supervisors: Valentina Ogaryan, Ph.D. and Kauser Ahmed, Ph.D.***Los Angeles, California***July 2020-August 2022*

- Provided psychosocial support, including brief and ongoing individual therapy to patients with cancer and their caregivers experiencing a range of psychosocial distress, including stress related disorders, depression, grief/loss, and existential crises
- Utilized a variety of evidenced-based approaches, including ACT, CBT, psychodynamic, mindfulness, and human-centered interventions in a biopsychosocial framework
- Conducted initial intake assessments, referrals and triage, crisis intervention, and provision of resources
- Participated in case conferences and didactic training geared towards medical integrative psychology
- Cofacilitate a weekly group therapy for individuals diagnosed with metastatic and recurrent cancer utilizing an existential and meaning centered psychotherapy approach to facilitate expression of emotion, active coping, and encouragement of mutual support between group members
- Facilitated a Pre-Surgical educational class to assist women undergoing breast surgery at UCLA (lumpectomy, mastectomy, reconstruction) to help prepare for the emotional aspects of their upcoming surgery including mindfulness techniques and emotional coping strategies
- Participated in weekly tumor board and pre-clinic case conference before seeing patients in UCLA Santa Monica Multidisciplinary Breast Clinic
- Cofacilitated a weekly mindfulness group help individuals who have or have had cancer, with the aim to reduce cancer-related stress
- Cofacilitated a manualized Meaning-Centered Psychotherapy 9-week therapy group for individuals with an advanced cancer diagnosis

Doctoral Psychology Extern*Union Rescue Mission Mental Health Clinic**Supervisors: Aaron Aviera, Ph.D. and Edward Shafranske, Ph.D.***Los Angeles, California***September 2019-August 2022*

- Provided individual therapy, group therapy, and crisis intervention to short and long-term residents at the Union Rescue Mission adults who are experiencing a wide range of difficulties including but not limited to: substance abuse, severe mental illness, homelessness, dual-diagnoses, personality disorders, relational issues, post-traumatic stress disorder, and/or past forensic histories
- Utilized a blend of evidence-based treatments (e.g., psychodynamic, ACT, CBT, EFT, mentalization, relapse prevention) and mind-body interventions (e.g., somatic psychotherapy, mindfulness-based interventions) while engaging in weekly didactic supervision and case management to ensure meaningful treatment outcomes
- Conducted thorough intake evaluations and generate comprehensive intake reports, including formulating accurate diagnoses based on various differentials and developing treatment plans that cater to the client’s specific needs
- Participated in interdisciplinary collaboration with chaplains, case managers, psychiatrists, and social workers
- Led weekly Mindfulness Meditation and Behavioral Health groups for residents of Union Rescue Mission for 18 months

OTHER CLINICAL EXPERIENCE

Registered Behavior Technician

Positive Behavior Solutions

Advanced Behavior and Learning

Orlando, Florida

August 2016-August 2017

September 2016-August 2017

- Provided behavior therapy for individuals ages 2-19 diagnosed with an oppositional defiant disorder, autism spectrum disorder, intellectual disability, Down syndrome, and/or behaviors disorders to help patients achieve greater independence
- Implemented Applied Behavior Analysis procedures following a Behavior Intervention Plan
- Received training in and utilized Pivotal Response Treatment, Discrete Trial Training, Picture Exchange Communication System, and Functional Behavior Assessment
- Trained parents, caregivers, and teachers in the four functions of behavior implemented behavioral goals, and modeled teaching strategies
- Collected, analyzed, and presented data based on observable client behaviors and made detailed notes on child's progress and difficulties during each session

Clinic Assistant

Field-Marsham Medical Center

Kerio Valley, Kenya

June 2016-August 2016

- Delivered psychosocial support to patients of all ages in a remote health clinic and assisted medical staff with daily tasks, rounds, and procedures such as assisting with birth and delivery
- Conducted intakes of mothers and newborns in the Child Welfare Clinic that provided immunization and weight monitoring of children less than 2 years of age
- Coordinated community outreach to remote elementary schools that did not have access to health care or services, specifically at Lewa Primary, Karimba Primary, and Kanyunga Primary School
- Distributed deworming medication, screened for visual problems and chronic diseases, provided wound cleaning/dressing, and educated students about mental health, personal hygiene and disease prevention

Practicum Student

Florida Hospital for Children

Orlando, Florida

September 2015-February 2016

- Provided assessment and created developmentally appropriate therapeutic interventions for hospitalized infants, children, adolescents and their families in the ICU, Bone-Marrow Transplant, Surgical, and Emergency hospital units
- Collaborated with interdisciplinary team that included nurses, doctors, social workers, child life specialists, case managers and physical therapists to create and provide interventions for patients, which included psychosocial care, play therapy, bereavement education/support, and education/preparation for medical procedures
- Developed and presented a case study on a child diagnosed with a grade II Ependymoma brain tumor to the Child Life Specialist team

Teacher's Assistant

Rollins College Child Development & Student Research Center

Winter Park, Florida

September 2014-August 2015

- Trained in interview techniques, case study methods, and objective behavioral observation of children
- Supervised children ages 2-5 of all ability levels and ensured their health, safety, and well-being
- Provided hands-on experiences and activities for children in all developmental and academic areas, with a specialized focus in children's social and emotional development

RESEARCH EXPERIENCE

Co-Investigator

Phase II Pilot Study Evaluating the Feasibility of Cognitive Behavioral Stress Management for Treatment of Anxiety and Depression in Patients with Breast or Lung Cancer, UCLA Ronald Reagan Medical Center

Los Angeles, California

Supervisors: Patricia Ganz, M.D. and Kauser Ahmed, Ph.D.

February 2021-Present

- Administer HAM-A and HAM-D clinical assessments for participants pre- and post-intervention in a pilot study focusing on providing a Cognitive Based Stress Management Intervention for individuals diagnosed with breast or lung cancer exhibiting symptoms of anxiety and/or depression

Research Assistant

Immersive Virtual Reality for Quality of Life During Bone Marrow Transplant: A Feasibility and Tolerability Pilot Study, UCLA Ronald Reagan Medical Center

Los Angeles, California

Supervisors: Maria Garcia-Jimenez, M.D. and Yang Jiang, M.D.

March 2021-Present

- Recruit and provide information on a mindfulness virtual reality program to patient's receiving a bone marrow transplant for anxiety, pain, mood, and distress

- Conduct a pre and post qualitative psychosocial assessment on anxiety, mood, pain, and quality of life

Lead Research Assistant

Resilience Center for Veterans and Families, Teachers College, Columbia University

New York, New York
September 2017-August 2019

Supervisors: George Bonanno, Ph.D. and Joe Geraci, Ph.D.

- Served as Principal Investigator for study evaluating the effectiveness of a breath-based meditative program called “Power Breath” in reducing veterans’ negative symptoms and improving overall well-being
- Managed and led a team of first year research assistants; including team planning and workflow distribution, review and feedback of weekly tasks, and training activities
- Assisted with the development of short- and long-term research projects that focus on understanding the experiences, strengths and difficulties of veterans and their families, and types of intervention programs best enhance their health and well-being
- Formulated materials for IRB submission and wrote, managed, and submitted grant applications to assist in funding
- Analyzed data on the relationship between alcohol use and criminal involvement in emerging adult veterans
- Participated in community outreach to contact and recruit veterans

Research Assistant

Psychotherapy, Affirmation, & Disclosure Lab, Columbia University

New York, New York
September 2018-August 2019

Supervisor: Barry A. Farber, Ph.D.

- Developed survey on disclosure trends for eating disorders; creating a code for reasons why patients lie in therapy about eating habits and feelings towards body
- Provided literature reviews and formulated hypotheses for how the addiction model applies to eating disorders
- Analyzed existing data on perceptions, process and consequences of self-disclosure within eating disorder populations in psychotherapy
- Contributed to lab meetings on disclosure trends in eating disorders and the addiction model; including interpretation and presentation of relevant publications, participation in discussion on critical analysis of data, and team allocation

Research Assistant

Global Mental Health Lab, Teachers College, Columbia University

New York, New York
January 2018-August 2019

Supervisor: Helen Verdeli, Ph.D.

- Managed data for a Randomized Control Trial evaluating the effectiveness of using Interpersonal Group Therapy (IPT-G) for treating maternal depression in Uganda
- Interpreted and transcribed of weekly therapy notes from providers in Uganda; developed summaries of field report hand-written notes
- Participated in weekly meetings and supervision calls for IPT-G providers in Uganda and Lebanon
- Created critical literature reviews for different areas of research including, “Symptom Networks of Common Mental Disorders in an Adult Primary Care Sample in India”

OTHER RELATED EXPERIENCE**Peer Consultant**

Pepperdine University

Los Angeles, California

August 2021, August 2022

- Provide weekly individual consultation for two first-year doctoral students on their intake, assessment, and psychotherapy skills for over 10 clients
- Participate in clinic outreach and networking activities, clinic program development projects, and quality assurance (chart reviews)
- Participate in weekly trainings on supervision practice based on theoretical and empirical literature

Psychology Coalition at the United Nations Intern

United Nations Group of Friends of Mental Health and Well-being

New York, New York

November 2017-August 2019

- Coordinated and attended monthly meetings open to Permanent Representative and Deputy Permanent Representatives for discussion of current best psychological practices, mobilization of efforts to increase the impact of existing mental health initiatives, and promotion of the inclusion of mental health in United Nations agenda, meetings, and events
- Sent invitations, promoted, and organized documents/relevant handouts for each meeting based on the topic of the meeting, such as The Economic Impact of Not Addressing Mental Health, Climate Change and Mental Health, and, Global Mental Health

Health Psychology Ambassador

Teachers College, Columbia University

New York, New York

May 2018-May 2019

- Co-developed a health psychology concentration for the Health Behavior Studies and Clinical and Counseling Psychology department with Yeraz Meschian, Ph.D.
- Organized and communicated informational events and workshops for students about health psychology, topics include mindfulness, stress management, health promotion, and incorporating healthy behaviors into daily life

Researcher and Development Assistant*Être Movement Class***Toronto, Ontario**

May 2018-September 2018

- Co-developed a movement class for a community in Toronto that uses breath, high intensity movements, and meditation to support overall well-being and help with stress management
- Provided literature reviews on breathing based meditation, journaling, exercise, and well-being in order to provide an exercise class for the public that is supported by evidence-based research

United Nations Commission of Social Development Side Event Intern*Psychology Coalition at the United Nations***New York, New York**

November 2017-March 2018

- Co-organized and promoted the event, "Achieving Poverty Eradication by Sustainable Health, Well-being and Education: The Case of Ebola in West Africa and other Epidemics and Infectious Diseases Worldwide," at the United Nations during the 56th Commission for Social Development
- Attended and recorded weekly meetings at the Sierra Leone Mission for 3 months prior to the event
- Contacted and coordinate speakers including representatives from the World Health Organization and UNICEF
- Oriented, supervised, and coordinated a group of 15 volunteers

Program Developer*Health for Life Kenya***Kerio Valley and Lewa, Kenya**

June 2016-August 2016

- Interviewed teachers at 13 primary/secondary schools to identify most beneficial health topics for students
- Facilitated lessons to students on puberty, mental health, hygiene, trauma, addiction, and female genital mutilation
- Designed health education posters and brochures for all schools and health clinics attended, as well as Kakuma Refugee Camp
- Assisted doctors with medical outreach in schools with limited medical access

Lead Coordinator*Florida Hospital Teen Advisory Council***Orlando, Florida**

September 2016-June 2016

- Facilitated monthly meetings for adolescents at Florida Hospital for Children
- Organized and supervised innovative activities for teens that encouraged interaction with younger patients, socialization for hospitalized teens and their siblings, as well as, focus groups on stress management, self-care/positive health behaviors, art and music activities, and mindfulness exercises

Fundraising Chair*Rollins Global Health Medical Brigades***Winter Park, Florida**

September 2013-May 2015

- Served on the board and helped run an organization that provides health services to those with limited access
- Organized and raised money for a medical brigade in Honduras and held Global Health campus meetings

Peer Mentor and Tutor*Fern Creek Elementary School***Winter Park, Florida**

September 2013-May 2015

- Tutored first grade students at an underprivileged school in math, reading and writing weekly and mentored students in goal development, academic success, and personal values

PRESENTATIONS

Wookey, E. L. (2022, April). Adaptations for Short-Term Therapy in Oncology. Presentation was given to the interdisciplinary team at UCLA Simms/Mann Center for Integrative Oncology, Los Angeles, California.

Wookey, E. L. (2019, November). Anti-bullying Prevention Presentation. Presentation was given at Portola Elementary School, Ventura, California.

Wookey, E. L. & Kuriansky, J. (2019, August). *Myths about HIV/AIDS: The impact of a girls' empowerment program on rural girls in Lesotho Africa*. Poster Presented at American Psychological Association Convention, Chicago, Illinois.

Patmore, J., Feldman, H., Meddaoui, B., **Wookey, E. L.**, Citron, M., De Paoli, B., Farber, B. (2019, April). *Secrets in psychotherapy: Examining client concealment and disclosure of eating and body image concerns in the therapeutic dyad*. Poster presented at Teachers College Columbia Academic Festival, New York, New York.

Wookey, E. L., Kronberg, M., & Kuriansky, J. (2018, June). *A call for health education in rural African context*. Poster presented at the International Congress of Applied Psychology, Montreal, Quebec.

Wookey, E. L., Kronberg, M., & Kuriansky, J. (2018, April). A call for health education in rural African context. Poster presented at Teachers College Columbia Academic Festival, New York, New York.

Wookey, E. L., Kronberg, M., & Kuriansky, J. (2017, November). A call for health education in rural African context. Poster presented at the First Southeast Asia Regional Conference on Psychology and Well-Being, Hanoi, Vietnam.

Wookey, E. L., Lanning, R., Runfola, M., Colling, C. L., & Carnahan, S. (2016, April). Child Development Center teachable moments. Poster presented at Rollins College Psychology Poster Session, Winter Park, Florida.

CERTIFICATIONS**Registered Behavior Technician (RBT)***Advanced Behavior and Learning***Orlando, Florida**

September 2016

Completed online and hands-on training approved by the BACB to obtain credential as an RBT, passed RBT competency assessment, and RBT exam

ADVANCED SPECIALIZED TRAINING/PRESENTATIONS

- Emotion-Focused Therapy for Complex Trauma 4-day Training** **Toronto, Ontario**
York University Training Institute
 October, 2022
 Sandra C. Paivio, Ph.D.
 Clinical Psychologist; Director of the Psychotherapy Research Centre at the University of Windsor
- Emotion-Focused Therapy Level 1 4-day Training** **Toronto, Ontario**
York University Training Institute
 May, 2022
 Serine Warwar, Ph.D., and Alberta Pos, Ph.D.
 Clinical Psychologist; Director of the York University Emotion-Focused Therapy Clinic
- Adverse Childhood Experiences (ACEs) and Mental Health** **Los Angeles, California**
University of Southern California
 September, 2021
 Brena Ingram, EdD, MSW, LCSW
 Program Director, Relationship and Sexual Violence Prevention and Services USC Student Health
- Providing Psychological Services to Homeless Persons who are African American** **Los Angeles, California**
Union Rescue Mission
 November, 2019
 Rick Williamson, Ph.D.
 Clinical Psychologist and Consultant; Emmada Psychology Center
- Motivational Interviewing in Multicultural Settings** **Los Angeles, California**
Union Rescue Mission
 October, 2019
 Robert Scholz, M.A., LMFT, LPCC
 Member, Motivational Interviewing Network of Trainers (MINT)
- Providing Psychological Services to Homeless Persons who are Latino/a** **Los Angeles, California**
Union Rescue Mission
 October, 2019
 Miguel Gallardo, Psy.D.
 Professor of Psychology and Director- Aliento, The Center for Latina/o Communities, GSEP, Pepperdine University; Past President, CA Latino Psychology Association
- Drugs and Drug Abuse in Los Angeles' Skid Row Community** **Los Angeles, California**
Union Rescue Mission
 October, 2019
 Neva Chauppette, Psy.D.
 Clinical Psychologist and Consultant
- Homelessness in Los Angeles County** **Los Angeles, California**
Union Rescue Mission
 September, 2019
 Cary Mitchell, Ph.D.
 Professor of Psychology, GSEP, Pepperdine University
- Cognitive Behavioral Therapy for Cancer Patients** **New York, New York**
Mt. Sinai School of Medicine
 October 2018
 Sponsored by The National Cancer institute, led by Dr. Yeraz Meschian, Ph.D., Dr. William Redd, Ph.D., & Dr. Benjamin Brewer, Psy.D
- Group Interpersonal Psychotherapy and the World Health Organization Mental Health Gap Humanitarian Intervention Guide** **New York, New York**
Teachers College, Columbia University
 July 2018
 Hosted by the Global Mental Health Lab and WHO, led by Dr. Lena Verdeli, Ph.D., M.Sc. Ms. Kathy Clougherty, L.C.S.W., Dr. Myrna Weissman, Ph.D., & Dr. Peter Venetovogel, M.D., Ph.D.

ABSTRACT

Objective. The mind and body are inseparable and share bidirectional influences. Psychological stress and distress related to traumatic events are significant contributors to morbidity, mortality, and healthcare costs worldwide. Mind-body movement-oriented interventions have been found to benefit one's physical and mental health via down-regulation of the hypothalamic–pituitary–adrenal (HPA) axis and the sympathetic nervous system. This systematic review aimed to identify and synthesize the research on movement-oriented mind-body interventions for trauma and stress as informed by psychoneuroimmunology. The review focused on exercise, yoga, tai chi, qi gong, and dance movement therapy that target the physiological systems impacted by psychological stress/trauma. **Methods.** Data was collected from four electronic databases (EBSCOHost, SCOPUS, Pubmed/Medline, Psychiatry online) between 2005-2021. All studies were required to include adult subjects exposed to psychological stress or trauma, a movement-oriented mind-body intervention, an objective physiologic psychoneuroimmunological outcome measure, and a self or clinician-reported psychological or psychosocial symptom measure. A Data Collection and Extraction form was used to record the variables for each study that met the inclusion criteria. **Results.** In total, 20 studies were included in the descriptive synthesis and summary of existing quantitative studies. The results found yoga to be the most researched movement-oriented mind-body intervention. Most included studies found mental health improvements alongside positive impacts on inflammatory and immune processes after yoga, tai chi, qigong, or dance-movement therapy. Fourteen of the 20 selected studies indicated at least one significant finding for a physiological PNI-related outcome measure and psychosocial outcome measure. **Conclusion.** The findings of this systematic review suggest that movement-oriented mind-body interventions may be a promising approach for promoting mental and

physical health in individuals with psychological stress and trauma. Future research in this field should include longitudinal studies, standardizing the movement-oriented mind-body interventions in research, operationally defining stress and trauma, increasing inclusion of diversity in participants, and increasing sample sizes.

Chapter 1: Background and Rationale

Statement of the Problem

A significant amount of research worldwide shows that the mind and body are inseparable and share bidirectional influences (Segerstrom & Miller, 2004; Song & Leonard, 2000; Soria et al., 2018; van der Kolk, 1994). Illness and health cannot be understood in isolation from psychological, mental, and emotional processes and life experiences (including stress and trauma). High levels of psychological stress and distress related to the experience of traumatic events are a major contributor to morbidity, mortality, and healthcare costs worldwide (Salleh, 2008). Many psychiatric disorders are directly linked etiologically to stress, including unipolar major depressive disorder (MDD) and posttraumatic stress disorder (PTSD). These mental health disorders are among the top causes of disability and disease burden worldwide (World Health Organization, 2020). Therefore, it has been suggested as particularly appropriate that treatments for stress-related physical and mental health problems would benefit from an integrative mind-body approach (Park, 2013; Seppälä et al., 2014). The systematic review research proposed here aims to identify and synthesize the research on movement-oriented mind-body interventions for trauma and stress as informed by psychoneuroimmunology.

The Psychoneuroimmunological Model of Health

“Psychoneuroimmunology is the most integrative health science discipline in existence” (Daruna, 2012, p.7). Psychoneuroimmunology can be defined as the study of interactions between behavior, neural and endocrine function, and immune processes (Ader, 1995). The psychoneuroimmunology model of health works to describe the relationships between and among stress, brain function (i.e., mind/ thoughts), psycho-social-behavioral components, and physiological components (i.e., neuroendocrine-immune system interactions).

The research in the field of psychoneuroimmunology has found that many physical illnesses are due to severe and overwhelming stress that alters and dysregulates critical systems that are part of the stress response system (Ader, 1981; Ader et al., 1996; O'Connor et al., 2021). The mind and body communicate bidirectionally through chemical messengers, and the experience of emotions interacts with the body's nervous system forming an essential link with our immune defenses. The main neuro-endocrine-immune pathways linked to stress are the sympathoadrenomedullary (SAM) axis, which includes the sympathetic nervous system (SNS), and the hypothalamic-pituitary-adrenocortical axis (HPAA; Besedovsky et al., 1985). Chronic stress results in dysregulation of both axes (Sapolsky et al., 2000). When chronic stress or trauma occurs, the SAM axis triggers the SNS to release norepinephrine, which induces a "fight or flight" response, resulting in the HPAA releasing endocrine-based glucocorticoids, primarily in the form of the hormone cortisol (Chrousos & Gold, 1992). Elevated levels of cortisol activity can be detrimental to one's health because it causes immunosuppression and eventually contributes to chronic immune dysregulation (Besedovsky et al., 1985).

Research in psychoneuroimmunology has concluded that repeated and overactivation of the HPAA system results in increased allostatic load and has been found to cause long-lasting suppression of the immune system linked with adverse health outcomes (Chrousos & Gold, 1992; McEwen, 2003). Furthermore, in populations that include chronically ill individuals, suppressed immune function linked with long-term stress is further associated with increased susceptibility to illness, delayed wound healing, and prolonged recovery from illness (Glaser et al., 1999).

In the context of stress and trauma, the psychoneuroimmunology of PTSD is established by linking psychological symptoms to three central physiological mechanisms a) autonomic

dysregulation (hyperarousal), b) activation of the hypothalamic-pituitary-adrenal (HPA) axis, and c) activation of the inflammatory immune response. PTSD is associated with autonomic nervous system (ANS) dysregulation (increased heart rate, cardiac output and blood pressure) along with decreased parasympathetic nervous system (PNS) activity (Schneider & Schwerdtfeger, 2020). In addition, the HPA plays a critical role in the allostatic process, and the HPA axis is often dysregulated among people with PTSD.

Defining Stress and Trauma

Although there has been a significant amount of research on stress in the last century, investigators still need help to come to a consensus of a definition for stress. The term stress in a health context was first introduced by Hans Selye in 1926. In his early writings, he defined stress as the “sum of all nonspecific changes (within an organism) caused by function or damage” or, more simply, “the rate of wear and tear in the body” (Selye, 1973, p. 695).

The research on stress has conflicting definitions. Clark et al. (2007) conceptualize stress as informed by a combination of various perspectives in the literature, stating that “stress may be considered the totality of an individual’s cognitive, emotional, behavioral, and physiological response to a stressor” (Clark et al., 2007, p. 18). The term stress can refer to either a stressful stimulus, the response to a stressful stimulus, or the consequences of this response (Levine, 2005). Stress can be defined physiologically and behaviorally. Diorio et al. (1993) described stress behaviorally as the thought of any stimulus that threatens homeostasis. Stress is a part of everyday life and can be understood as how a change in the environment impacts the normal functioning of an individual (Yaribeygi et al., 2017). A stimulus that threatens homeostasis could be a loss of a job, a new disease diagnosis, chronic illness or injury, the loss of a loved one, and so on. Physiologically, stress can be defined by the activation of the automatic processing, the

HPA axis. When an individual perceives a stressor, the hypothalamus releases the corticosterone-releasing factor (CRP) to the anterior pituitary. The HPA axis is linked to and regulated by a complex neural system, and under stress, cortisol production increases as a result of hypothalamic stimulation (Sapolsky et al., 2000; Straub & Cutolo, 2018; Yaribeygi et al., 2017).

Trauma refers to more severe stress and involves an event that exceeds the standard human response capabilities (Hubbard et al., 1995). It is important to note that a traumatic event is often linked to the interpretation of the event for the individual. Trauma has been defined in the literature as the experience of adverse events that impair psychological functioning (American Psychiatric Association, 2013). The response to a traumatic event that is deeply distressing or disturbing can lead to overwhelming an individual's ability to cope, which can weaken a person's sense of self and their ability to feel a full range of emotions and experiences (van der Kolk, 1994). Chronic stress and traumatic events are different in that the latter includes one or more acute episodic stressors that can profoundly impact. PTSD can occur after exposure to a potentially traumatic event and is characterized by persistent reexperiencing of a traumatic event, avoidance and numbing systems, and hyperarousal (American Psychiatric Association, 2013). The exact physiological systems are involved in potentially traumatic events and, subsequently, the development of PTSD, as well as acute stress, episodic stress, distant stress, and chronic stress (American Psychiatric Association, 2013; Pai et al., 2017).

Psychological Stress and Physical Health

The negative health implications of psychological stress, trauma, and, subsequently PTSD are now well understood in the literature in that experiencing an overwhelming amount of stress can lead to poor physical health (Kendall-Tackett, 2007, 2009; Segerstrom & Miller, 2004; Spitzer et al., 2009). Those who experience high levels of psychological stress often have

significant physical health problems that continue for years after the experience of the precipitating event. Stress coming from the experience of a traumatic event is often noted as a cause of or contributor to mental and physical health problems across the lifespan (Felitti et al., 1998). The stress reaction can present itself in various ways; however, it is often precipitated by a life event that can be positive or negative, traumatic or non-traumatic. The experience and exposure to stress can prompt chronic emotional, biological, and behavioral dysregulation and raise the risk of physical disease (Schneiderman et al., 2005). Furthermore, psychological stress can precipitate or extend other psychiatric disorders, such as schizophrenia, dementia, and addiction (Sinha et al., 2011; Tsolaki et al., 2009; van Winkel et al., 2008), and can negatively impact the course of several non-psychiatric conditions, including cardiovascular disease, cancer, and HIV infection (Cohen et al., 2007; Kaltsas et al., 2012).

In the last decade, there have been many studies that have found that the experience of a traumatic stressor increases the risk of health problems. In studies that have looked at adult disease, the experience of childhood sexual and physical assault has been associated with an increased risk for medical issues and disease (Korkeila et al., 2010; Sachs-Ericsson et al., 2005). Specifically, the first large-scale study that linked early childhood trauma and organic health conditions was the Adverse Childhood Experience (ACE) study by Felitti et al. (1998). The study included more than 17,000 participants, and the results found that individuals who experienced four or more types of adverse childhood events had higher rates of cancer, stroke, heart disease, chronic lung disease, emphysema, diabetes, skeletal fractures, and hepatitis than individuals who did not experience adverse childhood events. Childhood events include many kinds of maltreatment, including psychological, physical, and sexual abuse, and exposure to parental substance abuse, mental illness, intimate partner violence, or criminal behavior.

Additionally, there was a strong relationship between the amount of exposure to having multiple risk factors for several leading causes of death in adults.

Since the ACE study in 1998, many studies have followed and found similar results. For example, it has been found that individuals who have experienced traumatic events, especially those who develop PTSD, have elevated rates of mortality, morbidity, and healthcare utilization (Sareen, 2014). Qureshi et al. (2009) systematically reviewed PTSD and physical disorders. The results found that physical health conditions like arthritis were associated with a PTSD diagnosis. Similarly, Spitzer et al. (2009) conducted a study on the general population with 3171 adults and assigned the participants to three groups: no trauma ($n = 1440$), trauma but no PTSD ($n = 1669$); and trauma with subsequent PTSD ($n = 62$). After adjustments for sociodemographic factors, smoking, body mass index, blood pressure, depression, and alcohol use disorders, the findings showed that those who had experienced trauma and a diagnosis of PTSD had a higher odds ratio for angina pectoris and heart failure, bronchitis, asthma, renal disease, and polyarthritis compared with non-traumatized participants (Spitzer et al., 2009). The findings from the outlined studies suggest a strong association between PTSD and physical health conditions such as cardiovascular and pulmonary diseases. The impact of psychological stress on one's health is at the intersection of the connection between the mind and body.

Current Treatment for Psychological Stress and Trauma

Current research has sought to understand treatment approaches better to combat the experience of psychological stress and trauma and ultimately prevent the later development of psychological and physiological disorders. The focus of research in this area has been on treatments for PTSD. The use of psychological therapies for those suffering from PTSD has been regarded as more effective than the use of pharmaceutical treatments (Forbes et al., 2007).

While a variety of psychotherapies are available, Cognitive behavior therapies (CBT) are often cited as the most effective in reducing symptoms of PTSD. Specifically, Cognitive Processing Therapy (CPT) and Prolonged Exposure Therapy (PE) have been recommended as first-line treatments for PTSD (Forbes et al., 2007). Both CPT and PE direct a person to recall traumatic events in a controlled fashion and focus on the cognitive processing of trauma-related thoughts, feelings, and memories. However, many trauma-exposed individuals (with and without PTSD) do not seek help, drop out of treatment, refuse these treatments, or do not experience any substantial reduction in symptoms (Schottenbauer et al., 2008). Seppälä et al. (2014) noted that conventional treatment, such as psychotherapy, may have limited success for the population who have high levels of PTSD. It has been found that many people who have PTSD or other stress-related disorders drop out of traditional treatments because the process of recounting traumatic events can be highly emotionally taxing (Seppälä et al., 2014).

Other interventions that target stress include Stress Inoculation training (SIT), a non-trauma-focused anxiety management program that teaches coping skills to manage stress and anxiety (Meichenbaum & Deffenbacher, 1988). Saunders et al. (1996) conducted a meta-analysis on the effectiveness of SIT and found that SIT is an effective means for reducing performance anxiety, reducing state anxiety, and enhancing performance under stress. SIT differs from CPT and PE due to the treatment emphasizing the use of coping strategies to help manage trauma-related anxiety and stress (i.e., relaxation training, thought stopping, cognitive restructuring, and positive self-statements) and individuals are not required to discuss in detail about the trauma they have experienced (Meichenbaum & Deffenbacher, 1988). Comparing PE, SIT, and a combination of PE-SIT for reducing PTSD symptoms, it was found that PE was superior to SIT and the variety of PE-SIT on posttreatment anxiety and social adjustment (Foa

et al., 1999).

Although conventional pharmacologic and psychotherapeutic interventions have shown some proven efficacy in treating PTSD and psychological stress, residual symptoms and therapeutic efficacy remain problematic (Cukor et al., 2009). As a result, various integrative mind-body intervention modalities have developed that are increasingly employed in the treatment of psychological stress and PTSD. This growing body of evidence has shown that mind-body interventions positively impact the quality of life, reduce stress, and improve health outcomes among individuals with psychological stress and PTSD (Descilo et al., 2010; Kearney et al., 2012).

Mind-Body Interventions in the Treatment of Stress and Trauma

Approaches to treating stress-related disorders involving the body and physical sensations may be helpful for improving physiological systems of stress and trauma and overall psychological well-being (van der Kolk, 1994). Recently, there has been growing inclusion of physical movement in the treatment of psychological disorders. The relationship between mental health and physical activity is supported by a growing amount of evidence linked to physical activity being beneficial to mental health and psychiatric rehabilitation (Probst et al., 2010). Furthermore, physical activity has also been shown to enhance the effectiveness of psychological therapies (Craft & Perna, 2004). In addition, the symptoms following psychological stress/trauma are associated with significant problems in the body and self-awareness (Lanius et al., 2011). This suggests that it would be valuable to identify therapeutic approaches that target stress's psychological and physical effects.

Interventions involving the connection between the mind and body may be a supplementary aid to cognitive behavioral therapies or could stand alone to improve and regulate

emotional reactivity and improve the physiological systems impacted by trauma (Vujanovic et al., 2011). Specifically, an intervention developed by Kabat-Zinn (1990), Mindfulness-based stress reduction (MBSR), incorporates mindfulness meditation, body awareness, and yoga, in addition to exploring patterns of behavior, thinking, and feeling. Evaluation of MBSR in various populations has found beneficial effects of the intervention on positive mental health outcomes (Goldberg et al., 2018; Khoury et al., 2015) and positive impacts on overall physical health (Creswell et al., 2019; Grossman et al., 2004). A study by Hunt et al. (2017) dismantled the active components of an MBSR intervention with college students experiencing stress. The study aimed to uncover to what extent movement, including gentle yoga, mindfulness training, or the synergy between the two, had an impact on emotional and physiological outcomes. The study dismantled the active components of MBSR by having five different conditions, including mindfulness training and meditation alone (with no movement), yoga alone (with no explicit mindfulness), and their combination, compared to a credible placebo control and a no-treatment control. The results found that yoga (whether it is presented as a part of a multi-component, mindfully focused intervention, or alone) had beneficial effects on cardiac vagal control and the stress response system, which suggests that something is compelling about incorporating yoga and movement into treatment. Furthermore, the combined movement and mindfulness treatment group had better physical and mental health outcomes on multiple outcome measures (Hunt et al., 2017). The results from this study reveal the benefits of incorporating movement into an intervention for positive mental and physical health outcomes.

As such, a growing body of evidence suggests that mind-body interventions incorporating movement have the potential to reduce symptoms of PTSD and improve overall well-being (Kim et al., 2013). Mind-body interventions involving meditation and exercise can be particularly

beneficial for stress-related disorders as they can potentially address many frequent symptoms, including autonomic dysfunction, negative affect, and difficulties with emotion regulation (American Psychiatric Association, 2013; Gard et al., 2014). Studies have found that using breathing-based meditation and movement improves emotion regulation in yoga practitioners (Gootjes et al., 2011) and improves immune function in cancer patients (Kochupillai et al., 2005), and increases rapid gene expression in a non-clinical population (Qu et al., 2013). Specifically, interventions that have a core focus on the use of movement and emphasis on bodily experiences have been found to reduce PTSD symptoms, and anxiety and regulate physiological responses, such as improved immune system and lower levels of inflammation (Bower & Irwin, 2016; Seppälä et al., 2014; van de Kolk et al., 2019). For example, it has been found that yoga downregulates the HPA axis, reduces cortisol levels, and influences several neurotransmitters, increasing neurotrophic factors and thus decreasing inflammation (Balasubramaniam et al., 2012). These combined physiological effects can be hypothesized to counteract the stress response and reduce associated PTSD symptoms. There is growing evidence that movement and an increase of body awareness benefit physical and mental health via down-regulation of the hypothalamic–pituitary–adrenal (HPA) axis and the sympathetic nervous system (SNS; Ross & Thomas, 2010).

Movement-Oriented Mind-Body Interventions

Half of the adults in the United States use complementary and alternative medicine, with mind–body interventions being the most commonly used (Wahbeh et al., 2008). Mind–body complementary health approaches (CHAs) are a group of healthcare practices emphasizing the relationships among the mind, body, brain, and behavior. The National Center for Complementary and Integrative Health lists the following as mind–body practices: acupuncture,

massage, meditation (including mindfulness meditation), movement therapies, relaxation (breathing exercises, guided imagery, and progressive muscle relaxation), spinal manipulation, tai chi or qigong, yoga, healing touch, and hypnotherapy (www.nccam.nih.gov).

One of the goals of stress-related disorder treatment is to improve body awareness and help individuals understand bodily sensations (American Psychiatric Association, 2013; West et al., 2017). This suggests the importance of focusing on those interventions where the body, particularly movement, is focused upon. Movement-oriented mind-body interventions have been defined as interventions in which physical activity or body awareness are the central themes and core focus of the intervention and are characterized by their use of movement activities and focus on bodily experiences (Probst et al., 2010). For the purpose of this review the definition above will be used but limited to the following empirically supported movement-oriented mind-body interventions and therapies: exercise, yoga, tai chi, qi gong, and dance movement therapy. Mind-body movement-oriented interventions have received increasing awareness and attention from the scientific community seeking to understand the safety and efficacy of these widely used practices (Langmuir et al., 2012; Röhricht, 2009; Weber et al., 2020).

Dance Movement Therapy

The American Dance Therapy Association (2019) defines dance/movement therapy as the psychotherapeutic use of movement to encourage emotional, social, cognitive, and physical integration of the individual working from the premise that body and mind are interconnected. By using movement as the mode of intervention, the DMT practice is inherently attuned to focusing on the present moment.

Yoga

Yoga can be defined as a set of practices based on Hindu philosophy aimed at bringing about a higher state of consciousness and selfhood by engaging in various body control exercises (Daruna, 2012). The poses or postures in yoga (asanas) are only one of eight limbs of a larger philosophy of complete health and balance outlined in the Yoga Sutras. The other seven limbs, or disciplines, of yoga are as follows: yamas (ethical disciplines), niyamas (individual observances), pranayama (breath control), pratyahara (withdrawal of senses), dharana (concentration), dhyana (meditation), and samadhi (self-realization, enlightenment). In addition, yoga is considered a moving meditation and has been observed to alter the stress response associated with thoughts and emotions, consequently reducing psychological distress (Gooties et al., 2011; van der Kolk, 2006). Most yoga currently practiced in the West can be considered Hatha yoga or a variation (e.g., Vinyasa, Ashtanga) and typically includes elements of poses and energetic breathing exercises, often combined with mindfulness/meditation and concentration (Bower, 2015). Breathwork, mindfulness, focus/attention to the pose, and alignment are all domains of yoga.

Tai Chi

Tai chi (also known as Tai Chi Chuan or Taiji) is a Chinese mind-body tradition practiced for at least 5000 years (Chen & Snyder, 1999). It is a moving meditation that comprises a series of movements, focused breathing, posturing movement, and consciousness directed at relaxation (Robins et al., 2012). All styles of Tai Chi include a series of gentle fluid movements, mental concentration, and controlled breathing. Tai chi is characterized by slowness of movement, total continuity without break or pause, and absolute focus of awareness on the present moment. The active concentration of the mind is instrumental in guiding the flow of the body's movements (Ospina et al., 2007; Stoney et al., 2009). Tai Chi is intended to increase a

person's mind-body connection through awareness of their body's energy and potential for self-healing.

Qigong

Qi gong, like tai chi, is a traditional Chinese practice that involves concentration and slow, controlled motions and is performed to enhance the circulation of qi in the body. Tai chi and qi gong are very similar in their core components, and they share what traditional Chinese medicine defines as the "three regulations": body focus (posture and movement), breath focus, and mind focus (Larkey et al., 2009). The main difference between them is that tai chi can be considered a martial art, and the movements can provide self-defense and are outwardly focused. Differently, qi gong is not a martial art and is internally focused (Wahbeh et al., 2008). The gentle movements and postures of the exercise are designed to achieve a harmonious flow of energy (*qi*) in the body and to improve physical fitness and overall well-being.

Exercise

Exercise is "planned, structured, and repetitive physical activity designed to improve or maintain one or more components of physical fitness" (Haskell et al., 2007, p. 142). The American College of Sports Medicine (ACSM) states that exercise is "a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness" (Garber et al., 2011, p. 1263). It has been found that exercise has several benefits for physical and mental health, including improved cardiovascular and respiratory function, increased muscle strength and endurance, and reduced risk of chronic diseases such as diabetes, obesity, and heart disease (Warburton et al., 2006).

Rationale

Research in psychoneuroimmunology has found that the experience of psychological stress and traumatic life events can lead to physical health conditions through the dysregulation of the hypothalamic-pituitary-adrenal axis and dysregulation of neuroendocrine and immune variables, which elevates inflammation. For those who have experienced psychological stress and traumatic events, alternative treatment options are needed to counteract the risk of physical health conditions and improve overall well-being. Psychoneuroimmunology research has demonstrated that what individuals experience, think, and feel has a measurable impact on physiological systems. Those treating individuals who have survived trauma or experienced prolonged psychological stress could benefit from information about actions that can be taken to downregulate stress response, decrease the chance of severe health problems, and improve psychological wellbeing. It is clear that psychological stress that is left untreated or monitored has an impact on one's physical and mental health (Kendall-Tackett, 2007, 2009; Segerstrom & Miller, 2004; Spitzer et al., 2009), and thus there needs to be prevention and information available to those who are treating individuals to reduce the cost of trauma on people's overall physical and emotional wellbeing. This proposed systematic review will focus on movement-oriented mind-body interventions (exercise, Yoga, Tai Chi, Qi Gong, and dance movement therapy) that target the physiological systems impacted by psychological stress.

Psychoneuroimmunology research has shown that the experiences people have in life and what people think and feel have a measurable effect on the stress response system and immune system, which shows that the connection between physical and mental health is not as distinct as previously believed. This review aims to provide information on movement-oriented mind-body interventions' impact on psychoneuroimmunological systems to provide information to those treating individuals who have experienced traumatic events or psychological stress, as well as

healthcare workers who are interested in prevention. Clinicians need to be aware and equipped with the knowledge and competence regarding the treatments available that can help counteract the physical health risks for those who have experienced stress that impacts one's overall quality of life and well-being. Movement-oriented mind-body interventions have been suggested to be an essential complement to medical, psychological, and pharmacological treatments. Lastly, individuals who have experienced potentially traumatic events or chronic psychological stress should have information on how they can regain control over part of their lives by utilizing interventions that improve not only their mental health but their physical health as well.

This systematic review will be a descriptive synthesis and summary of existing quantitative studies regarding movement-oriented mind-body interventions' impact on psychoneuroimmunological systems with populations who have experienced psychological stress or traumatic life events. This review aims to address three primary questions:

- 1) What are the types of mind-body movement-oriented interventions used to target the physiological PNI systems impacted by stress/trauma?
- 2) What are the different impacts that mind-body movement-oriented interventions have on physiological PNI-related variables?
- 3) What is the relationship between the physiological PNI-related outcome measures and any psychological outcome measure (e.g., stress, well-being, trauma symptoms, etc.)?

The larger goal of this review is to inform mental health and medical professionals about existing evidence for the effects of mind-body movement-oriented interventions on psychological and PNI-related physiological systems (markers of physical health) impacted by trauma. In addition, the author hopes that this review will provide valuable information and

resources for psychotherapists, medical professionals, and researchers who treat and provide services to individuals who have experienced psychological stress and traumatic life events.

Chapter 2: Methods

Systematic Review Approach

This systematic review is a descriptive synthesis and summary of existing quantitative studies on the impact of movement-oriented mind-body interventions on psychoneuroimmunological systems with populations who have experienced psychological stress and traumatic life events. The design and methods of the present protocol were used in accordance with the Preferred Reporting Items for Systematic Reviews (PRISMA; EPOC, 2013).

Inclusion Criteria

The studies selected for this systematic review met all the outlined criteria listed to be included.

Design

Included studies were quantitative only due to the types of physiological measures that were the focus of this review. Included studies were either randomized control trials (RCTs) or quasi-experimental studies.

Exclusion Criteria

Studies that included participants with substance use disorders, or participants who were given medication in combination with an intervention, were excluded from inclusion due to the potential impacts substance use and medication have on the critical psychoneuroimmunology systems being studied.

Intervention

The included studies in this systematic review involved a movement-oriented mind-body intervention. Movement-oriented mind-body interventions were defined as involving physical activity as the core emphasis of the intervention, characterized by their use of movement

activities with a focus on bodily experiences (Probst et al., 2010). The studies included for data extraction were yoga, trauma-sensitive yoga, qi gong, tai chi, and dance movement therapy.

Outcome

The included studies were all required to have an objective physiologic psychoneuroimmunological outcome measure, including instruments and strategies to measure neuroendocrine and immunological mechanisms. A physiologic measure was required in addition to a self or clinician-reported psychological or psychosocial symptom measure.

Population

The population of interest for the current review was adult human subjects (aged 18–90) from a clinical, non-clinical, or research population. Any male, female, transgender, or nonbinary individual were included. Due to the aims of the study targeting people with exposure to psychological stress, selected studies included individuals who met one of the following criteria for stress exposure: (a) diagnosed with PTSD, (b) experienced stress associated with a medical illness (i.e. cancer diagnosis or chronic illness), (c) indicated experiencing subjective distress or traumatic stress response symptoms on a self-report measure, or (d) observed or rated by a health professional to be experiencing stress or trauma.

Source Eligibility

This review included only original studies, and all studies included in this review were published in peer-reviewed journals. The studies were conducted from 2005-2021. The current study did not restrict articles based on country of publication; however, only articles written in English were incorporated.

Search, Screening, and Selection Processes

Information Sources

A comprehensive electronic literature search was utilized using the same general search strategy with minor alterations as appropriate for each database: EBSCOHost (Psychinfo, Academic Search Complete), SCOPUS, Pubmed/Medline, and Psychiatry Online. The reference lists of each eligible study were reviewed to identify further studies for inclusion. Systematic review studies were identified as a source of relevant literature and examined to identify studies that may have been missed in searches.

Search Terms

A comprehensive list of search terms was identified for use in locating appropriate studies to use in this review. The primary search terms were psychoneuroimmunology-based outcome measure, psychological stress, physical exercise, and psychosocial outcome. After the initial search terms were utilized the term medical stressors were added to the primary search terms in each database due to the author and chair noticing the amount of research in the medical community. The author and chair decided to add medical stressors after the initial search was completed to ensure no articles were missed. For each search term, suitable synonyms were named and were used to strengthen the searching capacity for each database. A set of keywords identified through a preliminary literature search are documented in a spreadsheet called “search terms” (Appendix A).

The synonyms used with primary search term psychoneuroimmunology-based *outcome measure* were: PNI OR “immune system” OR “immune function” OR cytokines OR “natural killer t cell” OR interleukin OR cortisol OR “salivary alpha-amylase” OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers.

The synonyms used with primary search *psychological stress* were stress OR trauma OR "traumatic stress" OR distress OR "life stress" OR stressor OR violence OR abuse OR neglect OR "multiple trauma" OR burnout.

The synonyms used with primary search term *physical exercise* were: "physical activity" OR "high-intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR swimming OR yoga OR Hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "t'ai chi" OR "qi gong" OR qigong OR qi-gong OR "dance movement therapy" OR "dance movement psychotherapy" OR "dance therapy" OR "therapeutic movement" OR movement OR dance OR fitness OR "martial arts."

The synonyms used with primary search term *psychosocial outcome* were: "quality of life" OR "well-being" OR "mental health" OR "psychological health" OR "mental disorder" OR depression OR anxiety OR PTSD OR "post-traumatic stress disorder" OR "stress disorder" OR "sleep disorder" OR "psychosocial factors" OR "psychiatric diagnosis" OR mood). For each database, medical stressors were added and completed for an additional search. The medical stressors that were utilized included HIV or "human immunodeficiency virus" "chronic illness" "cancer" or "oncology," or "medical stressor." The search terms on each electronic database applied to titles, keywords, abstracts, and references of all articles.

Once the list of search terms and synonyms were identified, the words were grouped by similarity. For each database, the search groupings named in the tables of Appendix B were searched using predetermined combinations of the key search terms and every search was documented in Appendix C. The search documentation record (Appendix C) included the different variations of the search syntax used to identify publications in the databases. The information for each variation of search had the search date, a full search ID number,

the type of search, the database source, the search term identification numbers used, the search syntax (guidelines for search), the fields searched, the included years, the type of publication, the number of records, and notes for the examination.

Selection of Studies

After documenting each search, all articles were organized into a customized Microsoft Excel Screening and Selection spreadsheet that included author(s), title, and abstracts. Duplicates were noted and then removed via the Microsoft Excel duplicate removal function. The first phase included screening each title, keywords, and abstract (Appendix D). Studies that clearly did not meet the criteria were excluded and the reason for exclusion was documented. The second phase involved a full-text review to assess eligibility, including a set of criteria that must have been met for a study to be fit for data extraction. The requirements included analysis of year of the article, title and author of the article, database/sources, inclusionary criteria, and exclusionary criteria. Studies that did not meet standards were identified and the reason for exclusion documented. The third phase was the final decision phase on if the study was selected for analysis in this systematic review; a secondary confirmatory decision, final decision, final decision date, and additional notes about the decision were all documented (Appendix E). The articles that had conflicting eligibility criteria at this stage were included, and later the author and Chair met to discuss and determine the study's appropriateness for final inclusion in the review. Each step of the screening and selection process was recorded and documented, which included the information for why unselected studies were not included in the review.

A PRISMA-based flow chart was utilized to summarize each step involved in the study selection process. The PRISMA-based flow chart outlined the number of records

identified through electronic database searches and the records of articles found in the focused hand searches of selected journals. The diagram contains information about the number of duplicate records that were removed from the database, the total number of records evaluated, the total number of excluded articles based on the initial screening, the number of full-text articles reviewed for eligibility, the number excluded based on application of all inclusion and exclusion criteria, and lastly the final number of selected documents. The electronic copies of all selected published articles were maintained in two places: (a) the hard drive of the primary author's computer and (b) a google drive folder that belonged to the primary author.

Data Collection Extraction and Coding

To facilitate the extraction of relevant data from each selected article while minimizing bias, a Data Extraction Form (Appendix F) was utilized. This form was developed from modifying a data collection document (by this author's doctoral program) based on the Cochrane model for systematic reviews (EPOC, 2017) and individualized for the current study. The extraction form was customized by the author to include the key data points to be collected by this systematic review. The variables identified for extraction and coding were informed by results of preliminary literature searches and the research questions being asked. These variables were then organized into the following categories: (a) study/document identification, (b) general information, (c) design characteristics and methodological features, (d) intervention information, (e) assessment of research variables, (f) study participant characteristics and recruitment, (g) setting characteristics, (h) analyses conducted, (i) results, (j) and conclusions and follow-up. The author had selected these broad categories and the specific variables within each domain to

capture the majority of the studies, however, not every type or variable applied to every included study.

Study Documentation and Identification

The first section of the Data Extraction Form, *Study Identification*, included the outlined variables: (a) document ID# (b) authors and year (c) full document title and (d) notes. For each document used on the data extraction form, the document was given a specific name that utilized the document's first author and publication date.

General Information

The author included the following variables in the second section, General Information: (a) date form completed (b) source/publication type, (c) source name, (d) publication status, and (e) country study took place in.

Design Characteristics and Methodological Features

The third section, Design Characteristics, and Methodological Features, included the following variables: (a) aim of the study, (b) general method (c) specific design of the study, (d) duration of participation in intervention, (e) method of collecting physiological measure (saliva, hair, blood, urine) (f) type of psychological variable intervention measured, and (g) sample size.

Intervention Information

The author used the next section of the Data Extraction form, Intervention Information, to record the specifics of the intervention utilized in each study. The first variable was (a) type of intervention (exercise, yoga, tai chi/qi gong, and dance movement therapy. This section described what mind-body intervention was used and how the study defined the intervention. The following variable in this section (b), duration of intervention, described the length of the intervention, number of sessions, and how much time the participants spent partaking in the

outlined intervention versus the control group. The last variable of this section, (c) specific details of intervention (concurrent interventions, etc.), cited a general description of the intervention being used as defined by the author(s) of the study.

Assessment of Research Variables

The Assessment of Research Variables section of the Data Extraction Form captured the research variables of each study as well as the type of measures that were utilized. The author included an extraction category for the (a) immunological variable measure, (b) neuroendocrine variable measure, and (c) psychological variable measure. For each research variable, it was recorded how the variable was measured for the physiological and psychological variables. There was also a section to record what biomarker was researched (i.e., cortisol, IL-6, inflammation). If a study did not include one of the variables, then the author wrote, “Not applicable for this study.” The reliability, validity, and utility were also recorded in this section if it was applicable for the study. There was space to record any other measures not captured by an immunological, neuroendocrine, or psychological research variable; (d) other measure.

Participant Information

The author aimed to understand how mind-body interventions impact physical and mental health in a population who has experienced psychological stress or trauma. This section, Participant Information, focused on the characteristics of the study sample. The following variables were included in this section: (a) population of interest, (b) type of trauma/stress (i.e., medical stressor, environmental stress, or potentially traumatic event), (c) mental health diagnosis (e.g., PTSD) or n/a, (d) physical health diagnosis (e) recruitment methods, (f) sample size, (g) age, (h) gender, and (i) race/ethnicity. The population of interest outlined if the population is clinical or non-clinical and if the study included a certain type of population that

has experienced trauma (i.e., veteran population). The type of psychological stress described if the study focused on a specific type of stress such as a cancer diagnosis or trauma from a natural disaster. The author documented the inclusion and exclusion criteria used to identify the participants in each study.

Setting Characteristics

The next section of the Data Extraction Form, Setting Characteristics, included the following variables: (a) study location and (b) data collection setting(s). The variables in this section were utilized to document the location of each study's location and capture the types of settings where data was collected (hospitals, outpatient, community centers, etc.).

Analyses Conducted

The following variables were included in the Analyses Conducted section: (a) descriptive statistics used, (b) inferential statistics used, (c) qualitative analysis conducted, and (d) other. The category “other” was used to describe analyses that did not fit precisely into any of the other variable sections.

Key Results From Study

The Key Results from Study section was used to describe and document all of the key findings from each study. There were eight rows available for the author to write and describe each key finding, and the author added additional rows if there are more than eight key findings.

Conclusions and Follow-Up

The final section of the Data Extraction Form, Conclusions and Follow up, included the outlined variables: (a) critical conclusions of study authors, (b) study author's recommendation for future research, (c) research question addressed (d) the researcher's takeaways: general, (e) the researcher's take-aways: implications for practice (f) salient study limitations (to inform

quality appraisal), (g) references to other relevant studies, (h) other publications from this dataset, (i) further study information needed, (j) correspondence needed, and (k) additional notes on conclusion of the study. The variable “does the study directly address your research question?” included three rows to allow there to be a row for each research question. If one of the research questions is not answered, the author wrote, “not applicable.”

Quality Appraisal

For evaluation of the quality of the studies and to examine the risk of bias within the studies included, the quality was appraised by using either the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Randomized Control Trials (Appendix G) or the Joanna Briggs Institute Critical Appraisal Checklist for Quasi-Experimental Studies (Appendix H; Joanna Briggs Institute, 2017).

The JBI Critical Appraisal Checklist for Randomized Controlled Trials (Joanna Briggs Institute, 2017) is a tool specifically designed to evaluate the quality of RCTs included in systematic reviews. The tool is available online and utilizes a checklist of thirteen questions. For each question, the appraiser answered, “yes,” “no,” “unclear,” or “not applicable.” The checklist included a space for the author, year, record number, reviewer, and date to be recorded. The questions examine randomization, allocation, blinding of participants, outcome assessors, follow-up, treatment delivery, attrition, measurement, and analysis of each study. After the thirteen questions were answered, the author recorded if a study should be included, excluded, or if further information needed to be based on the quality of the study.

The JBI Critical Appraisal Checklist for Quasi-Experimental Studies is similarly a tool that is specifically designed to evaluate the quality of quasi-experimental studies included in systematic reviews (Joanna Briggs Institute, 2017). The online tool consists of nine questions

that examine the case and effect, participants, selection bias, attribution bias, measurement, and analysis of each study. Like the JBI checklist for RCTs, for each question the appraiser was able to answer, “yes,” “no,” “unclear,” or “not applicable,” as well as the checklist included a space for the author, year, record number, reviewer, and date to be recorded.

The author completed the quality appraisal checklists for each study considered for inclusion. The author had a research assistant that was a secondary rater. If there were differences, then the articles were highlighted to be reviewed for a third time by the author. For example, there was one article that had differences, and after the author examined the article for a third time, the article was removed from inclusion due to receiving a low-quality score.

Data Management, Synthesis, and Analysis Plan

Database Development

The first step in data analysis and synthesis involved creating a central database utilizing an Excel spreadsheet. The database included all variables from the Quality Assessment Forms and the Data Extraction form. The spreadsheet was used to allow the author to view all of the data points across studies easily.

Data Analysis and Synthesis

After all the included studies were reviewed and the data was entered into the central database, the author created separate spreadsheets for each research question to have the studies and variables answering the same research question grouped together. The author analyzed each variable to inform a narrative overview of the research questions answers and identify key findings.

In addition to creating a “Table of Included Studies” to document general characteristics of selected studies, an evidence table was created for each research question. The author also developed a series of relevant charts to present additional findings.

Reporting of the Results

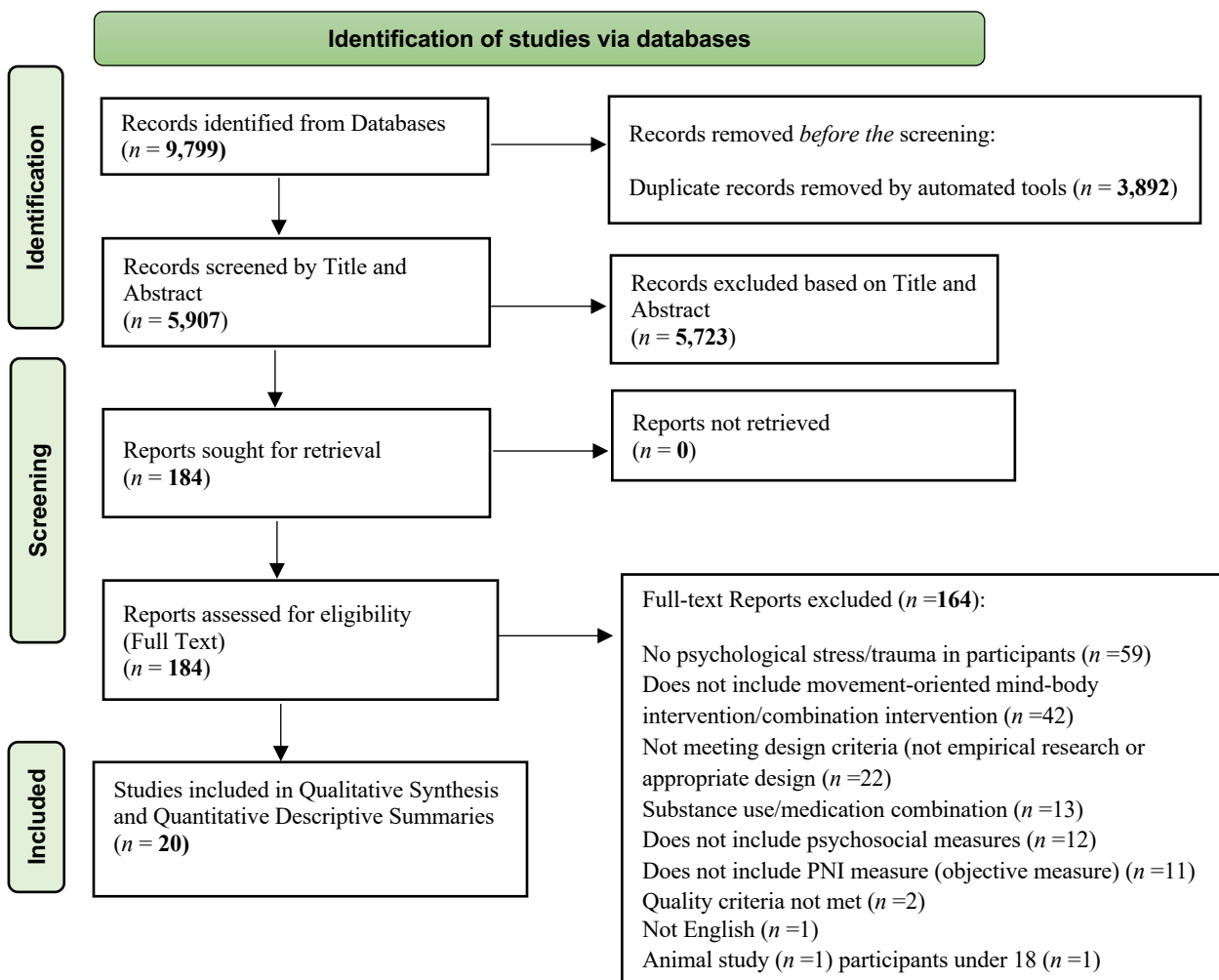
The “Table of Included Studies” was intended to serve as an overview of all the studies selected for this systematic review. The table reported the high-level details and significant findings from each document reviewed. The table reported the following pieces of information from each study reviewed: (a) author(s), (b) publication year, (c) title, (d) type of movement-based mind-body intervention, (e) population description, (f) objective PNI measure, (g) psychological measure (h) results/main findings. The table of included studies, in addition to the charts and graphs created, was the author’s primary mode of reporting the significant findings and results of this systematic review. The author also included three evidence tables for each research question.

Chapter 3: Results

A total of 9,799 records were identified using electronic databases. Duplicate records were removed using automated features of Microsoft Excel, resulting in 3,892 duplicates for removal before the screening. After reviewing titles and abstracts in the context of identifiable inclusion criteria, 5,723 records were excluded, resulting in 184 full-text articles assessed comprehensively for eligibility. Of the full-text studies assessed, 163 were excluded, primarily due to not participants not having psychological stress/trauma ($n = 59$), not having a movement-oriented mind-body intervention ($n = 42$), not meeting design criteria (not empirical research or appropriate design; $n = 22$), participants with substance use/medication ($n = 13$), no psychosocial outcome measure ($n = 12$), no PNI objective measure ($n = 11$), quality criteria not met ($n = 2$), not in English ($n = 1$), animal study ($n = 1$) and participants under 18 ($n = 1$). In total, 20 studies were selected for the descriptive synthesis and summary of existing quantitative studies.

Figure 1

PRISMA Flow Diagram



General Characteristics of Included Studies

The general characteristics of each of the included studies are reported in Appendix I. In addition, the table includes information on the author, publication year, title, type of research design, population description, objective immune/neuroendocrine measure, psychological measures, and results/main findings.

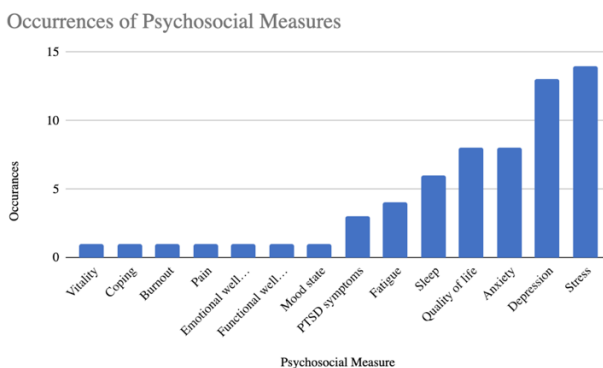
The studies were conducted between 2005 and 2021. The studies were primarily randomized control studies ($n = 16$) followed by quasi-experimental designs ($n = 4$).

Characteristics of the study participants varied across the 20 studies reviewed. Eight studies had individuals diagnosed with cancer. Out of the eight studies, six included participants with a breast cancer diagnosis ($n = 6$). Three studies involved healthcare professionals. Three studies had participants who self-reported clinically relevant perceived stress scores ($n = 3$). Two studies included veterans that were diagnosed with PTSD ($n = 2$). There were two included studies of caregivers (family caregivers for Alzheimer's ($n = 1$), and parent caregivers for children with cancer ($n = 1$)). There was one study with participants that had maternal anxiety and depression ($n = 1$) and one study that had participants of women who reported intimate abuse from a partner ($n = 1$). The studies were conducted in five countries. 65% of the included studies were done in the United States ($n = 13$), followed by 20% of the studies from England ($n = 4$). The remainder of the studies were conducted in India ($n = 1$), China ($n = 1$), and Australia ($n = 1$).

In the 20 included studies, 14 different psychosocial measures were used across all studies (see Figure 2). The most common psychosocial measure was perceived stress in 70% of the included studies ($n = 14$). Depression measures were in 65% of the included studies ($n = 13$) followed by quality of life ($n = 8$) and anxiety ($n = 8$) in 40% of the studies. Sleep ($n = 6$) was measured in 30% of the studies, fatigue ($n = 4$) in 20% of the studies, and PTSD symptoms ($n = 3$) in 15% of the studies. The remainder of the measures (mood state $n = 1$, functional wellbeing $n = 1$, emotional wellbeing $n = 1$, pain $n = 1$, burnout $n = 1$, coping $n = 1$, vitality $n = 1$) were assessed in only 0.05% of the studies.

Figure 2

Occurrences of Psychosocial Measures Across Included Studies



The selected studies included 29 different neuroendocrine/immunological variables that were assessed. Cortisol was the most frequently assessed biomarker ($n = 13$), with 65% of studies utilizing cortisol as a physiological measure of stress (see Figure 3). The following objective PNI biomarkers were assessed in included studies: TNF-alpha and Il-6 were the second most frequent biomarkers assessed, with each used in 6 studies. C-reactive protein was used in 3 studies. IgA, IL-1 β , and DHEAS were each used in two studies. The following biomarkers were each used in only one study: IL-5, IL-4, IL-2, BDNF, Sirtuin1, CD4%, CD8%, Natural Killer cell, IgM, telomerase activity, IL-7, IL-8, IL-10, IL-12, IL-13, IL-17, G-CSF, GN, CSF, IFN- γ , MCP-1, MIP-1 β .

Figure 3

Physiological Variables Utilized

Type of physiological Measure	Occurrence
Cortisol	13 studies
TNF-alpha	6 studies
Il-6	6 studies
C-reactive protein	3 studies
IgA	2 studies
IL-1 β	2 studies
DHEAS	2 studies
IL-5, IL-4, IL-2, BDNF, Sirtuin1, CD4%, CD8%, Natural Killer cell, IgM, telomerase	1 study

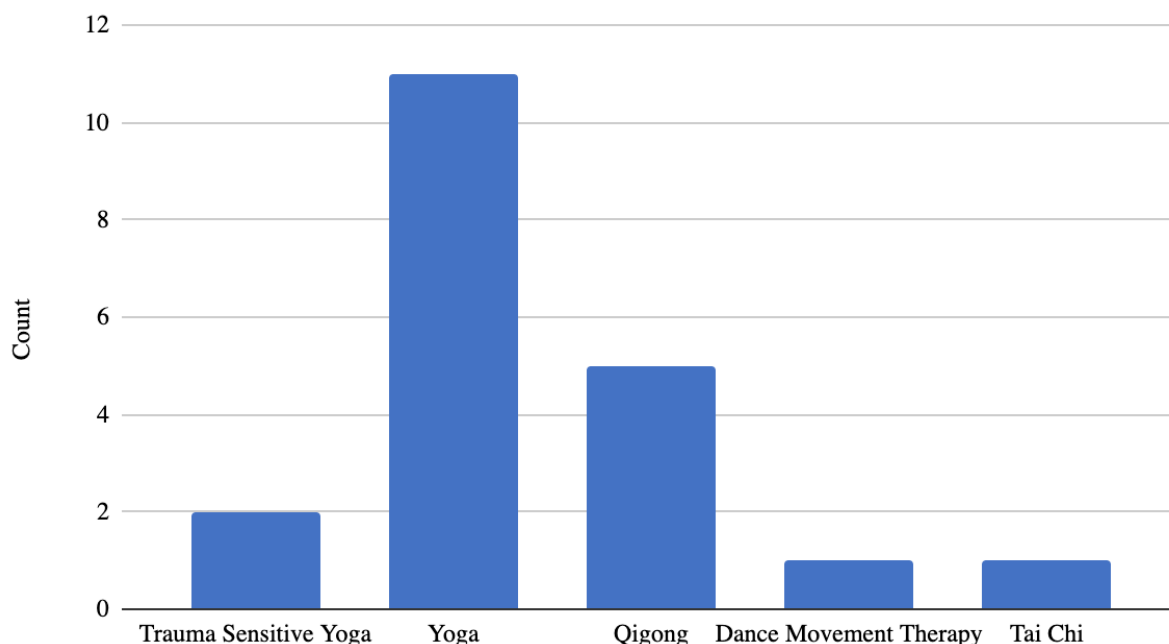
activity, IL-7, IL-8, IL-10, IL-12, IL-13, IL-17, G-CSF, GN, CSF, IFN- γ , MCP-1, MIP-1 β	
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The following sections will provide results related to the types of mind-body movement-oriented interventions utilized, the impact mind-body movement-oriented interventions have on PNI systems measured, and the impact of the interventions had on psychosocial and physiological systems studied.

Research Question 1: What are the types of mind-body movement-oriented interventions used to target the physiological PNI systems impacted by stress/trauma? The first question focused on the types of mind-body movement-oriented interventions used to target physiological PNI symptoms (see Figure 4). The results found that 55% of the included studies included yoga ($n = 11$) as the mind-body movement-oriented intervention. The next most frequently studied intervention involved qigong ($n = 5$), which was 25% of the included studies. Trauma-sensitive yoga ($n = 2$) was 10% of the included studies, followed by 5% of the included studies for both dance movement therapy ($n = 1$) and tai chi ($n = 1$). The details of the types of mind-body movement-oriented interventions targeting PNI systems are presented in Appendix J.

Figure 4

Type of Mind-Body Movement Oriented Interventions



Research Question 2: What are the different impacts that mind-body movement-oriented interventions have on physiological PNI related measures? Research question 2 focused on the descriptive synthesis of quantitative data for the impact of mind-body movement-oriented interventions on physiological PNI-related variables. The results found that 14 of the studies (70%) reported significant results in objective physiological PNI measures after the interventions. The remaining six studies (30%) did not have any significant findings for objective physiological PNI-related measures after the intervention. The descriptive results of physiological PNI measures for each study are presented in Table 1.

Table 1

Effects of Mind-Body Movement-Oriented Interventions on Physiological PNI-Related Measures

Author and Year	Movement Oriented Mind Body Intervention	Impact of Intervention on PNI Outcome Measure	Significant Result?
Sohl et al. (2022)	Yoga	The ratio of values at week 10 with adjustment for baseline showed that	Yes (for IL-6 and sTNF-R1)

Author and Year	Movement Oriented Mind Body Intervention	Impact of Intervention on PNI Outcome Measure	Significant Result?
		inflammatory cytokines IL-6 and sTNF-R1 were lower in the YST than AC group. TNF-a did not differ between groups	No (for TNF-a)
Danucalov et al. (2013)	Yoga	Decreased cortisol levels for caregivers of relatives with Alzheimer's disease after the intervention	Yes (for cortisol)
McCarthy et al. (2017)	Trauma Sensitive Yoga	There was an increase in the mean serum concentration of DHEA, the values for other biomarkers assessed did not change significantly relative to baseline	Yes (for DHEA) No (for Cortisol, C-reactive protein, and TNF)
Suen Chan et al. (2013)	Qigong	Salivary cortisol was reduced in response to Qigong sessions and improvements in mucosal immunity as indicated by changes in salivary flow rates of IgA after the intervention	Yes (for cortisol and Iga)
Tiwari et al. (2014)	Qigong	Telomerase activity had statistically significant results (increased in intervention group). TNF, and IL-6 was not statistically significant in intervention group from wait-list control group participants	Yes (for telomerase activity) No (for TNF-alpha and IL-6)
Mandal et al. (2021)	Yoga	The mean change of serum cortisol in the intervention group didn't differ than the mean change of the waitlist control group. The biochemical parameters didn't differ significantly between the 2 groups.	No (for cortisol and high-sensitive C-reactive protein)
Hwang et al. (2013)	Qigong	There were no significant differences between groups in salivary cortisol level at baseline and at the end of the BQSRP intervention.	No (for cortisol)
Vadiraja et al. (2009)	Yoga	Significant decreases in 6 a.m. salivary cortisol and pooled mean cortisol in the yoga group compared with controls	Yes (for cortisol)
Newham et al. (2014)	Yoga	Participation in a yoga class resulted in a significant decrease in cortisol in first and final yoga class	Yes (for cortisol)
Ratcliff et al. (2016)	Yoga	There were no significant differences in change in cortisol level in yoga group.	No (for cortisol)
Hilcove et al. (2021)	Yoga	Intervention did not have statistically significant impact on cortisol	No (for cortisol)

Author and Year	Movement Oriented Mind Body Intervention	Impact of Intervention on PNI Outcome Measure	Significant Result?
Oh et al. (2010)	Qigong	Participants in the qigong group had significant differences in reduction of the level of the inflammation biomarker (CRP) than the control group at week 10	Yes (for C-Reactive Protein)
Bisht et al. (2019)	Yoga	Significant increase in BDNF (cardinal biomarker of neuroplasticity) at the end of the intervention versus baseline. Mind- body communicative biomarkers, DHEAS and sirtuin-1 were found to be significantly increased following the intervention. Cortisol and IL-6 significantly declined at the end of the intervention versus baseline.	Yes (for cortisol, BDNF, DHEAS, sirtuin1 and IL-6)
Rao et al. (2008)	Yoga	A significantly lower decrease in CD56 % in the yoga group as compared to the controls and lower levels of serum IgA in the yoga group as compared to controls postoperatively suggesting prevention of immune suppression following surgery after yoga intervention	Yes (for CD56% and IgA) No (for CD4%, CD8%, natural killer cell, IgG, and IgM)
Ho et al. (2018)	Dance Movement Therapy	Participants in both groups displayed significantly steeper diurnal cortisol slopes over the 3-week interval. Controlling for the baseline cortisol slope and other covariates, the DMT group displayed a slightly steeper diurnal cortisol curve at Time 2 than the control group, but there were no significant findings on DMT and diurnal cortisol slope.	Yes (for cortisol)
Robins et al. (2013)	Tai chi	No significant differences in enkephalin levels. There were significant elevations in urinary beta-endorphin levels and IFN- γ were noted for the Tai-chi group at follow up suggesting better recovery of proinflammatory cytokine production.	Yes (for IFN- γ and TNF- α Endorphins) No (for IL-1 β , IL-2, IL-4, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12, IL-13, IL-17, G-CSF,

Author and Year	Movement Oriented Mind Body Intervention	Impact of Intervention on PNI Outcome Measure	Significant Result?
			CSF, IFN- γ , MCP-1, MIP-1 β , and TNF- α)
Michalsen et al. (2005)	Yoga	Analysis showed a decrease of mean cortisol levels in 9 of 11 participants immediately following yoga intervention	Yes (for cortisol)
Chow et al. (2012)	Qigong	The qigong group had a lower mean cortisol level than the wait-list control group after the intervention	Yes (for cortisol)
Zaccari et al. (2020)	Trauma Sensitive Yoga	Trauma sensitive yoga was not accompanied with statically significant changes in cortisol. There was a statistically significant correlation between cortisol and life satisfaction after TSY intervention	Yes (for Cortisol and life satisfaction)
Kiecolt-Glaser et al. (2014)	Yoga	For all three cytokines, there were no significant group differences immediately posttreatment, but by 3 months posttreatment, the yoga group had significantly reduced cytokine levels compared with the control group. At 3 months posttreatment, the mean ln TNF-a, ln IL-6, ln IL-1 was lower for the yoga group compared with controls.	Yes (for IL-6 and TNF- α at 3-month posttreatment) No (for IL-6 and TNF- α immediately after treatment and no for IL-1 β)

Research Question 3: What is the relationship between the physiological PNI-related outcome measures and any psychosocial outcome measure (e.g., stress, well-being, trauma symptoms, etc.)? Research question three focused on the results of physiological PNI-related outcome measures and psychosocial outcome measures (See Appendix K). Fourteen of the 20 selected studies indicated at least one significant finding for a physiological PNI-related outcome measure and psychosocial outcome measure (70%). Six studies had at least one significant finding for a psychosocial outcome measure with no significant findings for PNI related-outcome measure (30%). Notably, no studies had significant results for only physiological PNI-related

outcome measures; when there were physiological outcomes, there were also significant psychosocial outcomes.

The results from research question three are presented in Appendix K. The appendix table for research question three outlines the specific results for each study included. The included studies had a variety of psychosocial measures, different interventions utilized, and different physiological outcome measures utilized. This makes it challenging to synthesize and interpret the results due to the unique differences in each study. The descriptive results for research question three are organized by intervention below.

Yoga: Of the 13 included studies with a yoga-based intervention, eight studies had at least one significant result for a psychosocial and physiological variable. For example, in one study yoga program reduced cortisol levels and stress, depressive, and anxiety symptoms among familial caregivers of Alzheimer's disease patients (Danucalov et al., 2013), similar to another study that decreased anxiety, depression, cortisol, and perceived stress after a yoga intervention in early breast cancer patients undergoing adjuvant radiotherapy (Vadiraja et al., 2009).

There were two studies conducted on a yoga intervention for veterans with PTSD, and the results were very similar (McCarthy et al., 2017; Zaccari et al., 2020). The results in both studies found that there were improvements in all psychosocial measures after the yoga intervention. Specifically, both studies found a reduction in anxiety, stress, and PTSD symptoms and improved sleep quality and quality of life. In addition, it was found that yoga was not accompanied by statically significant changes in cortisol in both studies after the intervention. Similarly, a survey of yoga to manage burnout and stress for nurses (Hilcove et al., 2021) found that all psychosocial variables were significant, and cortisol was not statistically significant. Another study on yoga for women with breast cancer found that there were statistically

significant results for psychosocial variables of disturbed sleep, depression, improved quality of life, PTSD, with no significant effects for changes in cortisol after the intervention (Ratcliff et al., 2016). Lastly, a study conducted among nursing staff in a tertiary care hospital in Delhi found that after yoga, there was reduced perceived stress and improved quality of life with no changes in cortisol or high-sensitive C-reaction protein (Mandal et al., 2021).

In summary, the studies suggest that yoga interventions can positively affect psychological outcomes, and most of the studies show significant results for both PNI and psychological effects. However, the results for both physical and mental outcomes are not consistent across all studies for yoga.

Qigong: For the five studies that included a Qigong intervention, there were statistically significant results for at least one psychosocial variable and physiological variable in four of the five studies. It was found that first-year nursing students, after the Qigong intervention, had improvements in depression, anxiety, and stress scores, in addition to a reduction in cortisol and improvements in mucosal immunity (significant changes in IgA; Chan et al., 2013). Similarly, a study with cancer patients and Qigong found that the Qigong group had a reduction of the inflammation biomarker C-reaction protein levels compared with the wait-list control group in addition to significant improvements in quality of life, fatigue, and reduction in mood disturbance compared to the control group (Oh et al., 2010). Another study found that adults with mood disturbance (stress, anxiety, depression) had a lower mean cortisol level after the Qigong intervention than the wait-list control group. Additionally, the participants in the Qigong group experienced significant improvements in emotional relief, including reduced stress, anxiety, and depressive mood, and improved quality of life (Chow et al., 2012).

The included study on the effect of Qigong on telomerase activity, TNF-alpha, IL-6, perceived stress, depressive symptoms, and coping in Chinese women survivors of intimate partner violence found mixed results (Cheung et al., 2019). The results showed that telomerase activity increased significantly in the intervention group. There was no statistically significant difference in TNF-alpha and IL-6 levels between the intervention and wait-list control groups. Perceived stress was significantly lower in the intervention group compared to the wait-list control group after six weeks, and depressive symptoms were also significantly lower in the intervention group after six weeks but not after 22 weeks. The study suggests that Qigong may effectively improve mental health outcomes such as perceived stress and depressive symptoms, and telomerase activity.

Lastly, the included study that investigated the effects of a brief Qigong-based stress reduction program (BQSRP) on cortisol levels, stress, anxiety, anger, and quality of life in a distressed Korean population (Hwang et al., 2013) found no significant differences between the groups' salivary cortisol levels at baseline and the end of the BQSRP intervention. However, the BQSRP group showed statistically significant changes in reducing stress perception, anxiety, and anger and improving quality of life. This study suggests that BQSRP may effectively reduce mental health outcomes but not affect cortisol levels.

Tai chi: One study investigated tai chi as a movement-oriented mind-body intervention (Robins et al., 2012). The study looked at the effects of tai chi on immune function and psychosocial outcomes in early breast cancer patients undergoing chemotherapy. The study measured the levels of various cytokines, endorphins, and enkephalins and their relationship with depressive symptoms, perceived stress, and quality of life. The results showed significant elevations in IFN- γ for both intervention groups at the 6-month follow-up, possibly reflecting

better recovery of proinflammatory cytokine production. Participants in all groups experienced decreased levels of stress and depressive symptoms over time, and quality of life scores increased by the first follow-up time point.

Dance-movement therapy: One study investigated dance-movement therapy and the relationship between physiological and psychological outcome measures in breast cancer patients (Ho et al., 2018). The results showed that dance movement therapy (DMT) had a significant effect on diurnal cortisol slopes among patients with elevated baseline levels of perceived stress. However, the direct impact of DMT on diurnal cortisol slopes was not significant among patients with low or average levels of perceived stress. The results also showed that there were positive effects on sleep after the DMT intervention.

Results of Individual Study Quality Appraisal

Appendix L and Appendix M show the results from the JBI quality appraisals and Appendix N shows the IRB approval form. According to Munn et al. (2020), the guidance for the JBI quality appraisal tool is not to utilize a cut-off score because not all the questions are equal for scoring. Instead, it is recommended that the systematic review author determines the quality based on the presentation of results for each question via a table. The author found that the results indicated that eight studies were high-quality, 12 were mid-quality, and two were low-quality. The two studies that were of low quality were removed from inclusion in the systematic review. The low-quality studies did not include a baseline or control group, had errors in collecting objective biological samples, or had many participants dropping out of the study/not completing the intervention.

Of the 20 included studies, the most common classification rating given based on the Joanna Briggs Institute (see Appendices L and M) to the studies was "mid-quality" ($n = 12$),

followed by "high-quality" ($n = 8$), and lastly, "low quality" ($n = 2$). The high-quality studies had a combination of the following for RCT studies: (a) true randomization used for the assignment of participants to treatment groups, (b) allocation to groups concealed, (c) treatment groups similar at the baseline, (d) participants blinded to treatment assignment, (e) individuals delivering the treatment blinded to treatment assignment, (f) treatment groups treated identically other than the intervention of interest, (g) outcome assessors blinded to treatment assignment, (h) outcomes measured in the same way for treatment groups, (i) outcomes measured reliably, (j) follow up completed and if not, differences between groups adequately described and analyzed, (k) participants analyzed in the groups to which they were randomized, (l) appropriate statistical analysis used, and (m) trial designed appropriate and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial. For quasi-experimental studies high quality, studies included a combination of the following: (a) clear in the study what is the "cause" and what is the "effect" (i.e., no confusion about which variable comes first), (b) participants included in any comparisons was similar, (c) the participants included in any comparisons received similar treatment/care, (d) included a control group, (e) multiple measurements of the outcome both pre and post the intervention/exposure, (f) follow up completed and differences between groups in terms of their follow up were adequately described and analyzed, (g) outcomes of participants included in any comparisons were measured in the same way, (h) outcomes measured reliably, and (i) appropriate statistical analysis used. Quality appraisal data indicated that eight studies were high-quality, 12 were mid-quality, and two were low-quality.

Chapter 4: Discussion

In recent years, mind-body movement-oriented interventions have become increasingly popular in promoting physical and mental health. The findings of this systematic review suggest that movement-oriented mind-body interventions may be a promising approach for promoting mental and physical health in individuals with psychological stress and trauma.

The present systematic review aimed to summarize and synthesize the research literature on existing quantitative studies regarding movement-oriented mind-body interventions' impact on psychoneuroimmunological systems with populations who have experienced psychological stress or trauma. The research questions intended to provide information on the types of mind-body movement-oriented interventions used to target the physiological PNI systems impacted by stress/trauma, the different impacts that mind-body movement-oriented interventions have on physiological PNI-related outcome measures, and the relationship between the physiological PNI-related outcome measures and any psychological outcome measure (e.g., stress, well-being, trauma symptoms). Finally, the discussion will review the summary of the main findings, implications of the results, future direction for research, methodology quality, and limitations and contributions of the review.

Addressing the Research Questions

The first research question concerned the specific interventions researched in psychoneuroimmunological outcomes for stress and trauma. The results found that yoga was the most researched intervention, followed by qigong, trauma-sensitive yoga, dance movement therapy, and tai chi. No studies met the inclusion criteria for the movement-oriented mind-body intervention of exercise. This finding is relevant for integrating movement-oriented mind-body interventions into clinical practice because there is significantly more research on yoga than on

other movement-oriented mind-body interventions. The utilization of yoga for those experiencing ongoing stress or trauma is promising due to the low physical/emotional risk, the low cost, and the ability for individuals to have a choice to integrate the practice into their daily lives (Wahbeh et al., 2008). Future research would benefit from comparing mind-body movement-oriented interventions such as yoga, tai chi, qigong, dance-movement therapy, and exercise to explore the differences in outcomes when utilizing each intervention.

The second research question focused on the impact of movement-oriented mind-body interventions on objective physiological PNI measures. Results found that 14 of the 20 included studies reported significant results in objective physiological PNI measures after the interventions, which is congruent with the growing body of evidence indicating that mind-body movement-oriented interventions such as yoga, tai chi, dance-movement therapy, and qigong can have positive effects on physiological systems (Gothe & McAuley, 2015; Li et al., 2021; Moraes et al., 2018). In addition, current research supports that reducing inflammation (i.e., Il-6, CRP, TNF-alpha), stress hormones (i.e., cortisol), and improving immune function (i.e., natural killer cells) lead to improvements in overall physical health and mental health, and reduction of infectious disease (Bower, 2015; Moraes et al., 2018).

Reviewed studies found that mind-body interventions reduced inflammation in participants after the interventions of yoga (Bisht., 2019; Kiecolt-Glaser et al., 2014; Sohl et al., 2022), qigong (Oh et al., 2010), and tai chi (Robin et al., 2012). The included study of dance movement therapy did not assess inflammation biomarkers. The reduction in levels of pro-inflammatory cytokines and markers of inflammation in the included studies in the present systematic review aligns with the current research supporting the anti-inflammatory effects of mind-body movement-oriented interventions by reducing levels of pro-inflammatory cytokines,

such as interleukin-6 (IL-6), C-reactive protein (CRP), and tumor necrosis factor-alpha (TNF-alpha; Bower, 2015). This reduction in inflammation has been associated with improvements in the immune system and a range of health conditions, including arthritis, cardiovascular disease, depression, and stress-related mental health conditions (Bower & Irwin, 2016; Seppälä et al., 2014; van de Kolk et al., 2019).

A descriptive review by Bower and Irwin (2016) examined mind-body practices and inflammatory biology and found that mind-body practices such as yoga, tai chi, and qigong were effective at reducing inflammation in a variety of populations, including healthy adults, individuals with chronic pain, and people with various medical conditions. In addition, increased inflammation has been found to lead to higher disease prevalence (Cohen et al., 2007). Thus, the results from this systematic review finding that movement-oriented mind-body interventions can reduce inflammation are congruent with other literature and essential for individuals who have experienced stress and trauma.

As previously mentioned, cortisol is a steroid hormone released by the adrenal gland in response to stress and is commonly measured as an indicator of stress in the body. Cortisol was utilized more than any other physiological measure. Cortisol is often utilized in research focused on stress due to cortisol being involved in the stress response system. It has been found that prolonged exposure to stress produces measurable changes in the body, such as an activation of the HPA, which causes increased cortisol secretion (Dziurkowska & Wesolowski, 2021). Since cortisol is used to measure the body's response to stress, it can provide insight into the effectiveness of movement-oriented mind-body interventions' impact on physiological stress. Reducing physiological stress via cortisol has been associated with improved health conditions,

including anxiety, depression, sleep disturbance (insomnia), heart disease, and chronic pain (Adam et al., 2017; Dziurkowska & Wesolowski, 2021; Hannibal & Bishop, 2014).

The included studies found that there were significant results for cortisol in caregivers of relatives with Alzheimer's disease after yoga (Danucalov et al., 2013), first-year nursing and midwifery students after Qigong (Chan et al., 2013), individuals with breast cancer after yoga (Vadiraja et al., 2009), women with maternal anxiety and depression after yoga (Newham et al., 2014), parents of children with retinoblastoma after yoga (Bisht et al., 2019), women who identified as distressed after yoga (Michalsen et al., 2005), and individuals with a mild degree of stress/anxiety/depression after qigong (Chow et al., 2012).

There were no significant findings for cortisol for nursing staff in tertiary care hospital in Delhi after structured yoga (Mandal et al., 2021), brief qigong-based stress reduction in a distressed Korean population (Hwang et al., 2013), yoga for combat-related PTSD (McCarthy et al., 2017), and for women undergoing radiotherapy after yoga (Ratcliff et al., 2009). It was found that for veterans with PTSD, trauma-sensitive yoga was not accompanied by significant changes in cortisol; however, there was a statistically significant correlation between cortisol and life satisfaction after trauma-sensitive yoga (Zaccari et al., 2020). Two included studies looked at yoga for veterans with PTSD, and the results found that there were mental health benefits with no significant findings for cortisol after yoga (McCarthy et al., 2017; Zaccari et al., 2020). The significant impact on mental health outcome measures and not cortisol could be due to it being found that veterans have different diurnal cycles patterns than non-veterans (Wahbeh & Oken, 2013), as well as individuals with PTSD, tending to have lower salivary cortisol levels than controls (Pan et al., 2018). For other studies, the absence of significant findings in cortisol could also be due to there being ongoing stress exposure, such as continued treatment for cancer

(surgery, radiotherapy, chemotherapy) and continued stress related to working in a hospital, and ongoing crisis management impacting cortisol.

Cortisol is a valuable biomarker to assess the body's stress response and the effectiveness of movement-oriented mind-body intervention in the context of stress exposure. However, calculating cortisol can also be challenging to measure and interpret due to the high number of confounding factors that can impact cortisol measurements, such as differences in circadian regulation, time of day measuring, the impact of medical treatment (i.e., radiotherapy, chemotherapy), comorbid mental and physical health conditions, and other factors (Clow et al., 2004; Stalder et al., 2016). In addition, it has also been found that variability can occur in individual differences in cortisol secretion and response to stress, resulting in multiple measurements needed to accurately assess cortisol levels and the body's stress response (Stalder et al., 2016). These reasons could explain the differences in significant cortisol findings among similar populations and interventions in the current systematic review.

Overall, the results from research question two are promising in that there are physiological benefits after a movement-oriented mind-body intervention, leading to a potential range of health conditions. It is recommended that for systematic reviews, an analysis of the effect sizes from each physiological measure would benefit from understanding the power of each intervention on physiological systems.

Interpretation of the result for research question 3 is hard because of the variation of psychosocial measures, intervention differences, and physiological outcome measures utilized. However, the majority of the included studies found there to be significant results for at least one psychosocial measure and physiological measure. There were no studies that did not have a significant result for either a physiological measure or a psychosocial measure after a movement-

oriented mind-body intervention. Across the included studies, there were significant results for reductions in depression, stress, fatigue, burnout, distress, anxiety, PTSD, and improvements in quality of life and sleep after movement-oriented mind-body interventions. There were also significant changes in neuroendocrine and/or immunological variables, such as changes in cortisol, Il-6, and TNF- α decreasing, a decrease in CD56 %, and improvements in inflammatory cytokines after the interventions. The results are promising in that there were improvements in both mental health and measures of physical health across various movement-oriented mind-body interventions. The results are like previous studies finding evidence for bidirectional interactions between psychological, neuroendocrine, and immunological variables (ThyagaRajan & Priyanka, 2012).

While examining results from research question three, a similar interpretation of results was found for two separate studies with individuals diagnosed with breast cancer. Ho et al. (2018) study on dance movement therapy for breast cancer patients found that individuals with elevated cortisol at baseline had more improvements in cortisol after the intervention. This result was similar to the results in the included study by Ratcliff et al. (2016) study on yoga for women with breast cancer undergoing radiotherapy, which found that the most significant mental-health-related quality of life (QOL) benefits were for those experiencing higher levels of stress, sleep disturbance, and depressive symptoms at baseline prior to the intervention. These results suggest that improvements are more significant when there is increased distress. The findings from both included studies from the review show the importance of utilizing movement-oriented mind-body interventions for individuals who have increased perceived stress or are experiencing distress due to traumatic life events.

Future Research

The research on movement-oriented mind-body interventions and psychoneuroimmunological outcomes for psychological stress and trauma is an emerging field, and several areas could benefit from future research. Firstly, future research could include longitudinal studies that track participants over extended periods. With movement-oriented mind-body interventions, individuals frequently continue the practice as it becomes part of their daily lives (Payne & Crane-Godreau, 2013; Ratcliff et al., 2016). Therefore, examining participants for extended periods could provide insights into the long-term effects of each intervention. Only one study from the current systematic review included follow-up measures after the intervention ended at three months posttreatment. The study looked at the impact of yoga on inflammation, mood, and fatigue in breast cancer survivors (Kiecolt-Glaser et al., 2014). The results for the yoga treatment group found that there were no significant group differences immediately after the treatment for all three cytokines and fatigue. However, by three months posttreatment, the yoga group had significantly reduced cytokine levels, decreased fatigue, higher vitality, and lower IL-6, TNF-, and IL-1 for yoga participants compared with controls (Kiecolt-Glaser et al., 2014). The results from this included study show the importance of more longitudinal studies in this area of research. It is possible that some of the included studies that did not have significant results immediately after the treatment could have had significant results at three- or six months posttreatment if physiological and psychological measures were continued to be collected.

Secondly, having standardized interventions for each movement-oriented mind-body intervention would increase the ability to replicate the interventions and help determine which interventions are most effective. It would also be helpful to identify characteristics of interventions that might be responsible for the effects (e.g., duration of the intervention, home

practice, etc.). Descriptions of the protocols for yoga, tai-chi, qigong, and dance-movement therapy interventions were different across studies. Future research that examines the critical components of each intervention that are most responsible for their effects would be valuable in developing more standardized descriptions of movement-oriented mind-body interventions. Additionally, it would be beneficial to research the dose-response relationship between movement-oriented mind-body interventions and psychoneuroimmunological outcomes, which could help to determine the optimal frequency, duration, and intensity of these interventions. This information can help to develop more effective and efficient interventions that maximize the benefits of these practices. Moreover, future studies could compare the effectiveness of different movement-oriented mind-body interventions (e.g., yoga, tai chi, qigong, and dance movement therapy) to help determine which interventions are most effective.

Finally, future systematic reviews in this area of research could focus on limiting study populations to the same type to improve homogeneity in data extraction for comparison. The nature of the current systematic review was to provide a descriptive synthesis of the current research on movement-oriented mind-body interventions and psychoneuroimmunological outcomes for populations that have experienced stress or trauma. As more studies in this field are conducted, stricter inclusion criteria could provide more opportunities to compare, and contrast included studies. For example, only looking at studies from the same population (i.e., veteran populations with PTSD, women with breast cancer, and individuals with anxiety disorders) would allow for statistical comparison of the results versus descriptive. Additionally, due to many of the studies being in institutions (hospitals, VA, schools), there was not enough attention on recruiting or including individuals from diverse backgrounds. It was found that some of the included studies did not include specific demographics of participants. Future research needs to

focus more on having diverse study participants and reporting demographics. Future research should also include study power calculations to avoid type I or II errors. Additionally, looking at and reporting the effect sizes for each outcome measure would be recommended to help readers understand the magnitude of differences found in the studies. Lastly, it is recommended that future systematic reviews should include only high-quality studies for inclusion to have higher confidence in the review results.

Limitations and Contributions

The current systematic review is not without limitations. Due to the research in movement-oriented mind-body interventions being relatively new, many of the included studies that were included had small sample sizes, limited racial and ethnic diversity, and a larger number of female subjects compared to male or nonbinary participants, which could limit the generalizability of the present findings. Additionally, there are challenges in the current research literature on defining stress and trauma. Stress and trauma are subjective experiences that can differ for each person and are multifaceted experiences that can vary significantly between individuals. Furthermore, many types of stress and trauma range from acute, one-time events to chronic, ongoing, and medical stressors.

The included studies in this research specifically focused on populations exposed to psychological stress or trauma. They included individuals who met at least one of the following criteria for stress exposure: diagnosed with PTSD, experienced stress related to a medical illness (such as a cancer diagnosis or chronic illness), reported subjective distress, or exhibited symptoms of traumatic stress as measured by self-report or assessed by a healthcare professional. However, it should be noted that the definition of stress or trauma varied among the studies, as there was no consistent definition in the existing literature. For example, one study defined stress

for participants as “subjects confirmed experiencing emotional distress on more than 50% of days during the last 3 months” (Michalsen et al., 2005, p. 556), whereas another study defined stress for inclusion as “at least a mild degree of mood disturbance as defined by the range of scores according to the DASS manual in one or more domain of DASS (i.e., stress, anxiety, or depression) in the preliminary screening test” (Chow et al., 2012, p. 53). There were differences in how studies defined stress. One study (Michalsen et al., 2005) asked a single question about “emotional distress” for inclusion, versus another study (Chow et al., 2012) that utilized a more extensive measure that included questions about stress, anxiety, and depression.

Moreover, the most common population included in the study was individuals with a cancer diagnosis, as cancer is often accompanied by stress and potential medical trauma. However, the inclusion of a diagnosis alone may not account for individual differences in response to that diagnosis. For example, while a cancer diagnosis may be traumatic for some individuals, it may not have the same impact on others. The studies that included participants with a cancer diagnosis often did not exclude participants based on their scores on psychosocial measures related to stress due to the inclusion criteria emphasizing a cancer diagnosis alone. Overall, stress and trauma can be subjective experiences due to personal history, environmental factors, coping mechanisms, biological factors, and resilience. These challenges highlight the complexity of studying stress and trauma and the need for careful consideration and consistent definitions when defining and measuring these experiences.

Additionally, during the search/screening phase, there may have been biasing from the author in selecting articles since it is challenging to define what constitutes inclusion criteria for participant groups operationally. For example, the author had discussions with the chair on the inclusion of studies based on a medical illness (i.e., cancer diagnosis or chronic illness) and

which studies to include versus exclude. Determining which illnesses would qualify as exposure to psychological stress or trauma was challenging. As such, there were studies that were reviewed during the search and screening phase that included obesity, heart disease, diabetes, arthritis, HIV, cancer, etc. Furthermore, due to the large volume of articles initially identified using electronic databases, one primary researcher (author), and one research assistant searching and screening titles/abstracts, relevant articles may have been missed due to these procedural factors.

Although there are limitations, there remain potential contributions of this systematic review. To the author's knowledge, this is the first systematic review examining the effects of movement-oriented mind-body interventions on psychoneuroimmunological outcomes for those who have experienced psychological stress or trauma. The information provided from this review provides information on the impact that movement-oriented mind-body interventions have on psychoneuroimmunological systems, which can be used by clinicians, patients, and other medical professionals to use as additional complementary treatment options. Psychological stress and trauma that are left unmanaged have the potential to cause harm to one's physical and mental health, and the information provided on interventions that downregulate the stress response system can enable individuals to regain control in their lives and possibly reverse the effects that trauma and stress can have on one's physical and mental health. Current treatment options for stress-related disorders have been found to have high financial costs and can be labor-intensive. Drug treatments are associated with significant adverse effects and modest efficacy (Garakani et al., 2020). Thus, the information about movement-oriented mind-body interventions that are low cost and require minimal supplies can be an essential complement to medical and pharmacological treatments. Finally, providing additional evidence to support

interventions that enhance mental and physical health and understanding the mind-body connection can be valuable for both the academic literature and the public.

Concluding Remarks

The primary goal of this systematic review was to provide a descriptive synthesis and summary of existing quantitative studies regarding the impact that movement-oriented mind-body interventions have on psychoneuroimmunological systems with populations who have experienced psychological stress or traumatic life events. The findings of this research highlighted implications for future research to include longitudinal studies, standardizing the movement-oriented mind-body interventions in research, operationally defining stress and trauma, increasing inclusion of diversity in participants, and increasing sample sizes. In conclusion, despite the limitations, most of the included studies found mental health improvements alongside positive impacts on inflammatory and immune processes after yoga, tai-chi, qigong, or dance-movement therapy.

This systematic review provides compelling evidence supporting the integration of movement-oriented mind-body interventions into trauma and psychological stress treatments. With consistent significant findings across all included studies, the potential effectiveness of yoga, tai chi, qi gong, and dance movement therapy in promoting mental and physical well-being is highlighted. These results instill hope, encouraging individuals, researchers, and practitioners to proactively address and alleviate the adverse effects of trauma and stress.

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APPENDIX A

Search Terms

LIST OF SEARCH TERMS			
Search Term ID#	Primary Term	Synonyms/ Alternate Forms	Notes
01	Psychoneuroimmunology (PNI) based outcome measure	Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer t cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers	
02	Psychological Stress	stress OR Trauma OR "Traumatic stress" OR distress OR "life stress" OR stressor OR violence OR abuse OR neglect OR "multiple trauma" OR burnout	oncology, chronic illness, cancer, HIV-> removed into separate search term
03	Physical Exercise	"physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR swimming OR yoga OR Hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "t'ai chi" OR "qi gong" OR qigong OR qi-gong OR "dance movement therapy" OR "dance movement psychotherapy" OR "dance therapy" OR "therapeutic movement" OR movement OR dance OR fitness OR "martial arts"	
04	Psychosocial outcome	"quality of life" OR "well being" OR "mental health" OR "psychological health" OR "mental disorder" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "stress disorder" OR "sleep disorder" OR "psychosocial factors" OR "psychiatric diagnosis" OR mood	
05	Medical Stressor	HIV or "human immunodeficiency virus" or "chronic illness" or "cancer" or "oncology" or "medical stressor"	

APPENDIX B

Comprehensive Search Plan

COMPREHENSIVE SEARCH PLAN					
*Includes Electronic databases, registries, journal TOCs, Reference lists from articles/books, resource lists from organizations, etc. etc.					
Search Type	Databases or Sources	Search Term ID(s)	Search Syntax or Instructions	Fields to Search	Specifiers
Electronic Database	EBSCOHost (PsychINFO, Academic Search Complete)	01, 02, 03, 04, 05, 06, 07	[Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer t cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers] AND ("psychological stress" OR stress OR Trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR "posttraumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout) AND ("physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "ta chi" OR "qi gong" OR qigong OR "dance movement therapy" OR "dance movement psychotherapy" OR "dance therapy" OR "therapeutic movement dance" OR dance) AND ("psychosocial outcome" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood)	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only
Electronic Database	EBSCOHost, PsychINFO, Academic Search Complete	01, 02, 03, 04, 05, 06, 07, 08	[Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer t cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers] AND ("psychological stress" OR stress OR Trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR "posttraumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout) AND ("physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "ta chi" OR "qi gong" OR qigong OR "dance movement therapy" OR "dance movement psychotherapy" OR "dance therapy" OR "therapeutic movement dance" OR dance) AND ("psychosocial outcome" OR "quality of life" OR "well being" OR "mental health" OR "neurobehavioral health" OR "depression" OR anxiety)	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only
Electronic Database	SCOPUS	01, 02, 03, 04, 05, 06, 07	[Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer t cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers] AND ("psychological stress" OR stress OR Trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR "posttraumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout) AND ("physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "ta chi" OR "qi gong" OR qigong OR "dance movement therapy" OR "dance movement psychotherapy" OR "dance therapy" OR "therapeutic movement dance" OR dance) AND ("psychosocial outcome" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood)	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only
Electronic Database	SCOPUS	01, 02, 03, 04, 05, 06, 07, 08	[Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer t cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers] AND ("psychological stress" OR stress OR Trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR "posttraumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout) AND ("physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "ta chi" OR "qi gong" OR qigong OR "dance movement therapy" OR "dance movement psychotherapy" OR "dance therapy" OR "therapeutic movement dance" OR dance) AND ("psychosocial outcome" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood) AND (hiv or "human immunodeficiency virus" or "chronic illness" or cancer or oncology or "medical research")	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only

Electronic Database	PubMed		<p>[Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer t cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers] AND ["psychological stress" OR stress OR Trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout] AND ["physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR Hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "tai chi" OR "qi gong" OR qigong OR qi-gong OR "dance movement therapy" OR "dance movement psychotherapy" OR "dance therapy" OR "therapeutic movement dance" OR dance] AND ["psychosocial outcome" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood] AND [hiv or "human immunodeficiency virus" or "chronic illness" or cancer or oncology or "medical stressor"]</p>	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only	
Electronic Database	Psychiatry Online	01, 02, 03, 04, 05, 06, 07,	<p>[Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer t cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers] AND ["psychological stress" OR stress OR Trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout] AND ["physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR Hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "tai chi" OR "qi gong" OR qigong OR qi-gong OR "dance movement therapy" OR "dance movement psychotherapy" OR "dance therapy" OR "therapeutic movement dance" OR dance] AND ["psychosocial outcome" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood]</p>	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only	Add Medical Conditions as a stressor terms
Individual Search of Systematic Reviews and references of articles on topic		01, 02, 03, 04, 05, 06, 07				

APPENDIX C

Search Documentation Record

SEARCH DOCUMENTATION RECORD											
Search Date	FULL SEARCH ID#	TYPE OF SEARCH	DATABASE/SOURCE	SEARCH TERM ID#	SEARCH SYNTAX OR OTHER GUIDELINES FOR THE SEARCH	FIELDS SEARCHED	SEARCH SPECIFIER, Year	SEARCH SPECIFIER, Publication Type	Columns for Other Specifiers as Needed	# of Records	NOTES
6/4/2021	001	Electronic Database	EBSCOhost; PsychINFO; Academic Search Complete	01, 02, 03, 04, 05, 06, 07	(Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers) AND ("psychological stress" OR stress OR trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR "posttraumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout) AND ("physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "tai chi" OR "qi gong" OR qi gong OR "dance movement therapy" OR "therapeutic movement dance" OR "dance" AND ("psychosocial outcomes" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood)	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only			4,342	
08/04/2021	002	Electronic Database	EBSCOhost; PsychINFO; Academic Search Complete	01, 02, 03, 04, 05, 06, 07, 08	(Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers) AND ("psychological stress" OR stress OR trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR "posttraumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout) AND ("physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "tai chi" OR "qi gong" OR qi gong OR "dance movement therapy" OR "therapeutic movement dance" OR "dance" AND ("psychosocial outcomes" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood) AND (hiv OR "human immunodeficiency virus" OR "chronic illness" OR cancer OR oncology OR "medical stressor")	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only			419	added medical stressors to search (hiv or "human immunodeficiency virus" or "chronic illness or cancer or oncology or "medical stressor")
6/4/2021	003	Electronic Database	SCOPUS	01, 02, 03, 04, 05, 06, 07	(Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers) AND ("psychological stress" OR stress OR trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR "posttraumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout) AND ("physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "tai chi" OR "qi gong" OR qi gong OR "dance movement therapy" OR "therapeutic movement dance" OR "dance" AND ("psychosocial outcomes" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood)	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only			5,255	
08/03/2021	004	Electronic Database	SCOPUS	01, 02, 03, 04, 05, 06, 07, 08	(Psychoneuroimmunology OR PNI OR "immune system" OR "immune function" OR cytokines OR "natural killer cell" OR interleukin OR cortisol OR "salivary alpha-amylase" OR neuroendocrine OR endocrine OR neuroimmune OR epinephrine OR norepinephrine OR inflammation OR biomarkers) AND ("psychological stress" OR stress OR trauma OR "traumatic stress" OR "stress disorder" OR distress OR stressor OR "post-traumatic stress disorder" OR "posttraumatic stress disorder" OR PTSD OR violence OR abuse OR neglect OR "multiple trauma" OR distress OR burnout) AND ("physical exercise" OR "physical activity" OR "high intensity interval training" OR "aerobic fitness" OR "cardiorespiratory fitness" OR cycling OR "strength training" OR running OR yoga OR hatha OR vinyasa OR "meditative exercise" OR "tai chi" OR "tai chi" OR "qi gong" OR qi gong OR "dance movement therapy" OR "therapeutic movement dance" OR "dance" AND ("psychosocial outcomes" OR "quality of life" OR "well being" OR "mental health" OR "psychological health" OR depression OR anxiety OR PTSD OR "post traumatic stress disorder" OR "spiritual" OR sleep OR stress OR "psychosocial factors" OR mood) AND (hiv OR "human immunodeficiency virus" OR "chronic illness" OR cancer OR oncology OR "medical stressor")	Titles, Keywords, Abstract	*Years 2005-2021 *Type: Peer-reviewed articles only			628	added medical stressors to search (hiv or "human immunodeficiency virus" or "chronic illness or cancer or oncology or "medical stressor")

APPENDIX D

Title, Keyword, Abstract Screening Phase 1

A	B	C	D
Title	Year	Authors	Reason Code 1: Does not include PNI measure (objective measure) 2: Does not include psychological measure 3: Does not include movement-oriented mind body intervention 4: Not human subject 5: Not in English 6: Review not study 7: Duplicate 8: Other

APPENDIX F

Data Collection and Data Extraction Form

Extractors Initials: _____

Date of Extraction: _____

Document ID#

Authors and Year (<i>last names of authors and year of publication, e.g., Johnson, Jones, and Jackson 2011</i>)

Full Document Title

General Information

1. Date form completed (<i>dd/mm/yyyy</i>)	
2. Source/Publication Type (<i>journal, book, conference, report, dissertation, abstract, etc.</i>)	
3. Source Name (<i>Title of Journal, Book, Organization, etc.</i>)	
4. Publication Status (<i>Published, Unpublished</i>)	
5. Country of Study:	
6. Notes:	

Design Characteristics and Methodological Features

	Descriptions as stated in report/paper	Location in text (<i>pg & ¶/fig/table</i>)
7. Aim of study		
8. General Method (<i>RCT, quasi-experimental studies</i>)		
9. Design or Specific Research Approach		
10. Duration of participation in intervention		
11. Type of physiological measure (<i>salvia, hair, blood, urine</i>)		

12.	Type of psychological Variable (stress, well-being, trauma)		
13.	Sample size		
14.	Notes		

Intervention information

	Descriptions as stated in report/paper	Location in text (pg & ¶/fig/table)	
15.	Type of intervention (Exercise, yoga, tai chi/qi gong, dance movement therapy)		
16.	Duration of Intervention		
17.	Specific details of intervention		
<i>Notes:</i>			
18.	Notes		

Assessment of Research Variables

RESEARCH VARIABLES	How Assessed (Measure, Observation,	Biomarker Measured (cortisol, IL-6, IL-10, inflammation etc) or psychological measure	Location in text (pg & ¶/fig/table)

	<i>Interview Question, Archival, etc.)</i>	(include type of psychological measure)	
19. Immunological Variable			
20. Immunological Variable			
21. Immunological Variable			
22. Neuroendocrine Variable			
23. Neuroendocrine Variable			
24. Neuroendocrine Variable			
25. Psychological Measure			
26. Psychological Measure			
27. Psychological Measure			
28. Other Measure:			
29. Other Measure:			
30. Notes:			

Study Participant Characteristics and Recruitment

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
31. Population of Interest (clinical or non-clinical)		
32. Type of Psychological Stress (disease diagnosis, traumatic event, natural disaster, chronic stress etc)		
33. Mental Health Diagnosis (PTSD)		
34. Physical Health Diagnosis (Cancer, HIV, etc)		
35. Recruitment Methods		
36. Sample Size		
37. Age		

38.	Gender		
39.	Race/Ethnicity		
40.	Other:		
41.	Other:		
42.	Other:		
43.	Notes:		

Setting Characteristics

	Descriptions as stated in report/paper	Location in text <i>(pg & ¶/fig/table)</i>	
44.	Study Location		
45.	Data Collection Setting(s)		
46.	Other		
47.	Other		
48.	Notes:		

Analyses Conducted

	Description as stated in report/paper	Location in text <i>(pg & ¶/fig/table)</i>
49.	Descriptive Statistics used	

50.	Inferential Statistics used		
51.	Quantitative Analyses conducted		
52.	Qualitative Analyses conducted		
53.	Notes:		

Analyses Conducted

	Description as stated in report/paper	Location in text (pg & ¶/fig/table)
54.	Effect Size	
55.	Notes:	

Results for each research variable:

RESEARCH VARIABLES	Each measure results reported in study (add more rows for each measure used)	Results	Location in text (pg & ¶/fig/table)
56. Immunological Variable			
57. Immunological Variable			
58. Immunological Variable			
59. Neuroendocrine Variable			
60. Neuroendocrine Variable			
61. Neuroendocrine Variable			
62. Psychological Measure			
63. Psychological Measure			
64. Psychological Measure			
65. Other Measure:			
66. Other Measure:			

Results Table (if included put screenshot of results table here)

	Description as stated in report/paper	Location in text <i>(pg & ¶/fig/table)</i>
67. Key Result #1		
68. Key Result #2		
69. Key Result #3		
70. Key Result #4		
71. Key Result #5		
72. Key Result #6		
73. Key Result #7		
74. Key Result #8		
75. Notes:		

Conclusions and Follow-up

	Description as stated in report/paper	Location in text <i>(pg & ¶/fig/table)</i>
76. Key conclusions of study authors		
77. Study Author's Recommendations for Future Research		

78. Does the study directly address your review question? (any issues of partial or indirect applicability)		
79. Your Take-Aways: General		
80. Your Take-Aways: Implications for Practice		
81. Salient Study Limitations (to inform Quality Appraisal)		

APPENDIX G

JBI Critical Appraisal Checklist for Randomized Controlled Trials

JBI CRITICAL APPRAISAL CHECKLIST FOR RANDOMIZED CONTROLLED TRIALS

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	NA
1. Was true randomization used for assignment of participants to treatment groups?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Was allocation to treatment groups concealed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were treatment groups similar at the baseline?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Were participants blind to treatment assignment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were those delivering treatment blind to treatment assignment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Were outcomes assessors blind to treatment assignment?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were treatment groups treated identically other than the intervention of interest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Were participants analyzed in the groups to which they were randomized?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Were outcomes measured in the same way for treatment groups?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Were outcomes measured in a reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

APPENDIX H

JBI Critical Appraisal Checklist for Quasi-Experimental Studies

**JBI CRITICAL APPRAISAL CHECKLIST FOR
QUASI-EXPERIMENTAL STUDIES**

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

	Yes	No	Unclear	Not applicable
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Were the participants included in any comparisons similar?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was there a control group?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Were the outcomes of participants included in any comparisons measured in the same way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Were outcomes measured in a reliable way?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Was appropriate statistical analysis used?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

APPENDIX I

Table of Included Studies

INCLUDED STUDIES							
AUTHOR(S)	PUBLICATION YEAR	TITLE	TYPE OF STUDY	POPULATION DESCRIPTION (STUDY SAMPLE)	PNI MEASURE	PSYCHOLOGICAL MEASURE	RESULTS/MAIN FINDINGS
Sohl, Tooze, Johnson, Ridner, Rothman, Lima, Ansley, Wheeler, Nicklas, Avis, Wagner	2021	A Randomized Controlled Pilot Study of Yoga Skills Training Versus an Attention Control Delivered During Chemotherapy Administration	Randomized control trial	Adults diagnosed with Gastrointestinal cancer.	IL-6, sTNF-R1, and TNF-a	Fatigue, depressive symptoms, sleep disturbances, and psychological stress	Results indicate YST influenced depressive symptoms and sleep disturbances in those diagnosed with gastrointestinal cancer. Greater reductions were evident for inflammatory biomarkers IL-6 and sTNF-R1 in the YST as compared to AC group, no differences were seen for TNF-a
Danucalov, Kozasa, Ribas, Galduróz, Garcia, Verreschi, Oliveira, de Oliveira, Leite	2013	A Yoga and Compassion Meditation Program Reduces Stress in Familial Caregivers of Alzheimer's Disease Patients	Randomized control trial	Familial caregivers of patients dx with Alzheimer's disease	Cortisol	Perceived stress, anxiety, and depression symptoms	The results of this study demonstrate that the practice of yoga and the suggested meditation techniques may represent an effective intervention for caregivers of relatives with Alzheimer's disease to reduce their stress, anxiety, and depression symptoms and to decrease their cortisol levels.

INCLUDED STUDIES							
McCarthy, Fuller, Davidson, Crump, Positano, Alderman	2017	Assessment of yoga as an adjuvant treatment of combat-related posttraumatic stress disorder	Quasi-experimental study	Individuals with combat-related posttraumatic stress disorder	Cortisol, C-reactive protein, DHEA, TNF	Perceived stress, depression symptoms, quality of life, PTSD	There was significant improvement across the board in the results of psychometric assessments, with decreases in total scores and all subscales of the PCL and DASS results. In contrast, for the most part, values for various biomarkers did not change significantly relative to baseline, except for an increase in the mean serum concentration of DHEA, the clinical significance of which is uncertain. Interestingly, at the end of the study, most subjects reported having a positive view about the benefits of the yoga approach, but a positive pre-intervention attitude towards yoga during pre-intervention assessment was not associated with a significant treatment response ($p > 0.5$).
Chan et al.	2013	Biochemical and Psychometric Evaluation of Self-Healing Qigong as a stress reduction tool among	Randomized control trial	First year nursing and midwifery students	Cortisol, IgA	Depression symptoms, anxiety, perceived stress	Findings show that 10 weeks of Qigong intervention reduces depression, anxiety and stress among newly enrolled nursing and midwifery students; based upon evidence from psychometric

INCLUDED STUDIES							
		first year nursing and midwifery students					evaluations. It was shown that salivary cortisol, a biomarker of stress, was reduced in response to Qigong sessions.
Cheung, Deng, Tsao, Tin Hung Ho, Lai Wan Chan, Yee Tak Fong, Hing Chau, Wai Lin Hong, Yin King Yuk Fung, Lai Chong Ma, Tiwari	2019	Effect of a Qigong Intervention on Telomerase Activity and Mental Health in Chinese Women Survivors of Intimate Partner Violence: A Randomized Clinical Trial	Randomized control trial	Women to have been abused by an intimate partner within the past three years	Telomerase activity, TNF-alpha and IL-6	Perceived stress, depression symptoms, coping	Perceived stress and depressive symptoms were significantly lower in intervention group versus the wait-list control group. No significant benefit of qigong on telomerase activity in intervention group.
Mandal, Misra, Sharma, Sagar, Kant, Dwivedi, Lakshmy and Goswami	2021	Effect of Structured Yoga Program on Stress and Professional Quality of Life Among Nursing Staff in a Tertiary Care Hospital of Delhi- A Small Scale Phase-II Trial	Randomized control trial	Nurses	Cortisol, high-sensitive C-reactive protein	Perceived stress	Yoga reduced the perceived stress from baseline to post-intervention Mean change of serum cortisol in the intervention group didn't differ than the mean change of the waitlist control group. High-sensitive C-reactive protein reduced but not statistically significant
Eun-Young Hwang, Sun-Yong Chung,	2013	Effects of a Brief Qigong-based Stress Reduction Program	Randomized control trial	Individuals with self-reported stress that felt they did not have	Cortisol	Perceived stress, anxiety, anger, quality of life	Improvements in subjective stress, anxiety, anger, and quality of life after Qigong intervention. and

INCLUDED STUDIES							
Jae-Heung Cho, Mi-Yeon Song, Sehyun Kim and Jong-Woo Kim		(BQSRP) in a distressed Korean population: a randomized trial		control over their everyday lives because of that stress			psychological well-being in a general sample of distressed adults. Salivary cortisol levels not changed.
Vadiraja, Raghavendra, Nagarathna, Nagendra, Rekha, Vanitha, Gopinath, Srinath, Vishweswara, Madhavi, Ajaikumar, Ramesh, Nalini, Kumar	2009	Effects of a Yoga Program on Cortisol Rhythm and Mood States in Early Breast Cancer Patients Undergoing Adjuvant Radiotherapy: A Randomized Controlled Trial	Randomized control trial	Breast cancer outpatients undergoing adjuvant radiotherapy at a cancer center	Cortisol	Anxiety, depression symptoms, perceived stress	The results suggest significant decreases in self-reported anxiety, depression, perceived stress, and in 6 a.m. and pooled mean cortisol levels in the yoga group compared with controls.
Newham, Wittkowski, Hurley, Aplin, Westwood	2014	Effects of Antenatal yoga on maternal anxiety and depression: a randomized controlled trial	Randomized control trial	Maternal Anxiety and depressed individuals	Cortisol	Anxiety, depression symptoms	This study shows that a single session of yoga can reduce both subjective and physiological correlates of anxiety and that these effects remain after repeated sessions. Antenatal yoga lowered state anxiety and cortisol levels after a single session and this effect was consistent over time. Antenatal yoga was associated with significant reductions in fear of childbirth and is

INCLUDED STUDIES							
							potentially preventative against an increase in depressive symptoms.
Ratcliff, C. G., Milbury, K., Chandwani, K. D., Chaoul, A., Perkins, G., Nagarathna, R., Haddad, R., Nagendra, H. R., Raghuram, N. V., Spelman, A., Arun, B., Wei, Q., & Cohen, L.	2016	Examining Mediators and Moderators of Yoga for Women with Breast Cancer Undergoing Radiotherapy	Randomized control trial	Women with breast cancer undergoing radiotherapy	Cortisol	Depression symptoms, sleep, posttraumatic stress symptoms, quality of life	Results suggest that yoga is helpful for those women with disturbed sleep and depressive symptoms at the start of radiotherapy. Quality of life benefits were found for those experiencing pre-radiotherapy sleep disturbance and depressive symptoms. Posttraumatic stress symptoms and cortisol slope did not mediate treatment effect on quality of life.
Hilcove, Marceau, Thekdi, Larkey, Brewer and Jones	2021	Holistic Nursing in Practice: Mindfulness-Based Yoga as an Intervention to Manage Stress and Burnout	Randomized control trial	Health care professional (Nurses)	Cortisol	Perceived stress, burnout, vitality, sleep quality, and mindfulness	MB yoga intervention had statistically significant results for improved perceived stress, burnout, vitality, sleep quality, serenity, and mindfulness in comparison with the control group. Cortisol not statistically significant
Oh, B., Butow, P., Mullan, B., Clarke, S., Beale,	2010	Impact of Medical Qigong on quality of life, fatigue, mood, and inflammation	Randomized control trial	Individuals diagnosed with cancer	C-Reactive Protein	Quality of life, Fatigue, mood state	Qigong group significantly improved overall quality of life, fatigue, mood disturbance, and inflammation

INCLUDED STUDIES							
P., Pavlakis, N., Kothe, E., Lam, L., & Rosenthal, D.		n in cancer patients: a randomized controlled trial					compared with usual care after controlling for baseline variables
Bisht, Chawla, Tolahunase, Mishra, and Dada	2019	Impact of yoga-based lifestyle intervention on psychological stress and quality of life in the parents of children with retinoblastoma	Quasi-experimental study	Parents of children with cancer (caregivers)	Cortisol, BDNF, DHEAS, sirtuin1, IL-6	Depression symptoms, quality of life	The results showed significant improvement in the overall rating of QOL and overall perception of health at the end of the intervention verses baseline (day 0) in these participants. A significant improvement has been noted in all the domains (physical, psychological, social, and environmental) of WHOQOL-BREF. The improvement in QOL was also found to be collateral with the improvement in the biomarkers of neuronal plasticity.
Rao, R. M., Nagendra, H. R., Raghuram, N., Vinay, C., Chandrasekara, S., Gopinath, K. S., & Srinath, B. S.	2008	Influence of yoga on mood states, distress, quality of life and immune outcomes in early-stage breast cancer patients undergoing surgery	Randomized control trial	Breast Cancer Patients (stage II or stage III)	CD4%, CD8%, natural killer cell, IgG, IgA, IgM	Anxiety, depression symptoms, stress, quality of life	Results suggest a significant decrease in the state and trait anxiety, depression symptom severity distress, and improvement in quality of life in the yoga group as compared to the controls. There was significantly lesser decrease in CD 56% and lower levels of serum IgA in the yoga group as compared to controls following

INCLUDED STUDIES							
							surgery suggesting prevention of immune suppression following surgery.
Ho, Fong, and Yip	2017	Perceived stress moderates the effects of a randomized trial of dance movement therapy on diurnal cortisol slopes in breast cancer patients	Randomized control trial	Breast Cancer Patients	Cortisol	Perceived stress, fatigue, pain, sleep disturbance	DMT showed a significant reduction effect on perceived stress. Participants in both groups displayed significantly steeper diurnal cortisol slopes over the 3-week interval. DMT exerted a significant and moderate effect on diurnal cortisol slopes among patients with elevated baseline levels of perceived stress (not significant for individuals with low perceived stress at baseline)
Robins, McCain, Elswick, Walter, Gray, Tuck	2013	Psychoneuroimmunology-Based Stress Management during Adjuvant Chemotherapy for Early Breast Cancer	Randomized control trial	Women with early-stage breast cancer	IL-1 β , IL-2, IL-4, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12, IL-13, IL-17, granulocyte colony stimulating factor (G-CSF), granulocyte macrophage-(GM-)CSF, IFN- γ , MCP-1, MIP-1 β ,	Perceived stress, depression, emotional wellbeing, functional wellbeing	Significant elevations in IFN- γ were noted for both intervention groups possibly reflecting better recovery of proinflammatory cytokine production

INCLUDED STUDIES							
					and TNF- α Endorphins and enkephalins		
Michalsen, Grossman, Acil, Langhans, Lütke, Esch, Stefano, and Dobos	2005	Rapid stress reduction and anxiolysis among distressed women because of a three-month intensive yoga program	Quasi-experimental study	Self-referred females who scored clinically relevant levels for emotional distress	IL-6, TNF- α , and interleukin-1 β	Perceived stress, anxiety, well-being, fatigue, depression symptoms	Compared to waiting-list women who participated had significant improvements in perceived stress, anxiety, well-being, fatigue, and depression. Salivary cortisol decreased significantly after participation in a yoga class
Chow et al.	2012	The Effects of Qigong on Reducing Stress and Anxiety and Enhancing Body-Mind Well-Being	Randomized control trial	Adults with mild degree of mood disturbance (stress, anxiety, or depression)	Cortisol	Depression symptoms, anxiety, perceived stress, quality of life	Qigong group had a positive effect on reduced depression, anxiety, and stress. Qigong group had increased scores on quality of life. The qigong group reported a lower mean cortisol level than control group.
Zaccari, B., Callahan, M. L., Storzbach, D., McFarlane, N., Hudson, R., & Loftis	2020	Yoga for veterans with PTSD: Cognitive functioning, mental health, and salivary cortisol	Quasi-experimental study	Veterans dx with PTSD	Cortisol	PTSD symptoms, depression symptoms, quality of life, sleep	Statistically significant improvements were observed between baseline and postintervention scores on measures of response inhibition, PTSD, depression, sleep, quality of life, and subjective neurocognitive complaints. Positive correlations were found between baseline and postintervention changes in sleep

INCLUDED STUDIES							
							and depression, and between change in cortisol output and a measure of life satisfaction.
Kiecolt-Glaser, Bennett, Andridge, Peng, Shapiro, Malarkey, Emery, Layman, Mrozek, and Glaser	2014	Yoga's Impact on Inflammation, Mood, and Fatigue in Breast Cancer Survivors: A Randomized Controlled Trial.	Randomized control trial	Breast cancer survivors	IL-6, TNF- α , IL-1 β	Depression symptoms, sleep quality	Results suggest that yoga practice substantially reduced fatigue and inflammation. Immediately post-treatment, vitality was higher in the yoga group compared with the control group. At 3 months post-treatment, the yoga group's fatigue was lower, vitality was higher, and IL-6, TNF-, and IL-1 were lower for yoga participants compared with controls.

APPENDIX J

Research Question 1 Evidence Table

Research Question 1) What are the types of mind-body movement-oriented interventions used to target the physiological PNI systems impacted by trauma?		
Author and Year	Type of Mind Body Movement Oriented Intervention	PNI Objective measure
Sohl et al. (2022)	Trauma Sensitive Yoga	IL-6, sTNF-R1, and TNF-a
Danucalov et al. (2013)	Yoga	Cortisol
McCarthy et al. (2017)	Yoga	Cortisol, C-reactive protein, DHEA, TNF
Suen Chan et al. (2013)	Yoga	Cortisol, IgA
Tiwari et al. (2014)	Qigong	Telomerase activity, TNF-alpha and IL-6
Mandal et al. (2021)	Yoga	Cortisol, high-sensitive C-reactive protein
Hwang et al. (2013)	Qigong	Cortisol
Vadiraja et al. (2009)	Trauma Sensitive Yoga	Cortisol
Newham et al. (2014)	Yoga	Cortisol
Ratcliff et al. (2016)	Yoga	Cortisol
Hilcove et al. (2021)	Qigong	Cortisol
Oh et al. (2010)	Yoga	C-Reactive Protein
Bisht et al. (2019)	Dance Movement Therapy	Cortisol, BDNF, DHEAS, sirtuin1, IL-6
Rao et al. (2008)	Yoga	CD4%, CD56%, CD8%, natural killer cell, IgG, IgA, IgM
Ho et al. (2018)	Yoga	Cortisol
Robins et al. (2013)	Tai Chi	IL-1 β , IL-2, IL-4, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12, IL-13, IL-17, granulocyte colony stimulating factor (G-CSF), granulocytemacrophage-(GM-) CSF, IFN- γ , MCP-1, MIP-1 β , and TNF- α Endorphins and enkephalins

Michalsen et al. (2005)	Yoga	Cortisol
Chow et al. (2012)	Qigong	Cortisol
Zaccari et al. (2020)	Qigong	Cortisol
Kiecolt-Glaser et al. (2014)	Yoga	IL-6, TNF- α , IL-1 β

APPENDIX K

Research Question 3 Evidence Table

Research Question 3) What is the relationship between the physiological PNI-related outcome measures and any psychological outcome measure (e.g., stress, well-being, trauma symptoms, etc.)?					
Author and Year	PNI Outcome	Psychosocial Measure	PNI Results	Psychosocial Results	Significant results for both PNI and Psychosocial Results?
Sohl et al. (2022)	IL-6, sTNF-R1, and TNF-a	Fatigue, depressive symptoms, sleep disturbances	The ratio of values at week 10 with adjustment for baseline showed that inflammatory cytokines IL-6 and sTNF-R1 were lower in the YST than AC group. TNF-a did not differ between groups.	This study in patients with a GI cancer found that the YST group had a larger decline from baseline to Week 10 in the primary outcome of fatigue as compared to an attention control group. There was also a larger decline in the secondary outcome of depressive symptoms in the YST group at Week 10. Results for sleep disturbances and psychological distress were inconsistent with expected results at some time points and showed that the AC group	Yes- YST improved fatigue, depressive symptoms, sleep disturbances, and inflammation.

				improved more than YST.	
Danucalov et al. (2013)	Cortisol	Stress, anxiety, depression	Decreased cortisol levels for caregivers of relatives with Alzheimer's disease after the intervention	Statistically significant reduction in stress, depressive and anxiety symptoms among the participants in the YCMP group.	Yes-A reduction in stress, anxiety, and depression symptoms and decrease in participants cortisol levels compared to control group after intervention
McCarthy et al. (2017)	Cortisol, C-reactive protein, DHEA, TNF	Depressive symptoms, perceived stress, anxiety, PTSD	Values for various biomarkers did not change significantly relative to baseline, with the exception of an increase in the mean serum concentration of DHEA	Reduction in stress/anxiety symptoms, PTSD symptoms. Sleep quality and quality of life improved significantly in comparison to those measured immediately prior to the commencement of the yoga intervention There was significant improvement across the board in the results of psychosocial assessments, with decreases in total scores and all sub-scales of the PTSD and stress/anxiety results	No-There was significant improvement across the board in the results of psychometric assessments, with decreases in total scores and all sub-scales of the PCL and DASS results Values for various biomarkers did not change significantly relative to baseline, apart from an increase in the mean serum concentration of DHEA

Suen Chan et al. (2013)	Cortisol, IgA	Depressive symptoms, anxiety, stress	Salivary cortisol was reduced in response to Qigong sessions and improvements in mucosal immunity as indicated by changes in salivary flow rates of IgA after intervention	After 10 weeks, only the Qigong group showed a statistically significant improvement in their depression, anxiety, and stress scores.	Yes-Qigong improved both psychological states (depression, anxiety, stress) and PNI biomarkers of stress from results of mucosal immunity (IgA), and salivary cortisol
Tiwari et al. (2014)	Telomerase activity, TNF-alpha and IL-6	Perceived stress, depressive symptoms, coping	Telomerase activity had statistically significant results (increased in intervention group). TNF, and IL-6 was not statistically significant in intervention group from wait-list control group participants	Perceived stresses were significantly lower in the intervention group than that in the wait-list control group after 6 weeks. Depressive symptoms (BDI-II scores) were significantly lower in the intervention group than that in the wait-list control group after 6 weeks but not after 22 weeks. For perceived coping, there was no significant between-group difference after 6 weeks	Yes-telomerase increased in intervention group as well as perceived stress and depressive symptoms.
Mandal et al. (2021)	Cortisol, high-sensitive C-reactive protein	Perceived stress, professional quality of life	The mean change of serum cortisol in the intervention group didn't	The intervention group showed a lower score on perceived stress	No- Changes in perceived stress and no change in PNI

			differ than the mean change of the waitlist control group. The biochemical parameters didn't differ significantly between the 2 groups.	after 12 weeks of the yoga program	outcome measures
Hwang et al. (2013)	Cortisol	Stress, anxiety, anger, quality of life	There were no significant differences between groups in salivary cortisol level at baseline and at the end of the BQSRP intervention.	Statistically significant changes after BQSRP intervention for reducing stress perception, reducing anxiety and anger, and improving quality of life	No - The BQSRP group demonstrated highly significant decreases in all mental health outcomes (stress, anxiety, anger, quality of life) but no significant differences between groups in cortisol
Vadiraja et al. (2009)	Cortisol	Anxiety, depression, perceived stress	Significant decreases in 6 a.m. salivary cortisol and pooled mean cortisol in the yoga group compared with controls	Significant decreases in anxiety, depression, and perceived stress after yoga intervention group compared with controls	Yes-The results suggest significant decreases in self-reported anxiety, depression, and perceived stress and in 6 a.m. and pooled mean cortisol levels in the yoga group compared with controls.
Newham et al. (2014)	Cortisol	Anxiety, depression	Participation in a yoga class resulted in a	The intervention reduced state	Yes-This study shows that a single session

			significant decrease in cortisol in first and final yoga class	anxiety and depression scores compared to control group.	of yoga can reduce both subjective and physiological correlates of anxiety and that these effects remain after repeated sessions. Antenatal yoga lowered state anxiety and cortisol levels after a single session and this effect was consistent over time. Antenatal yoga was associated with significant reductions in fear of childbirth and is potentially preventative against an increase in depressive symptoms.
Ratcliff et al. (2016)	Cortisol	Quality of life, depression, sleep, PTSD	There were no significant differences in change in cortisol level in yoga group.	Yoga is especially helpful for those women with disturbed sleep and depressive symptoms at the start of radiotherapy. Yoga indirectly affected physical health related QOL 6 months after radiotherapy via increased benefit finding	No- No significant change in cortisol slope between groups. Significant change in quality of sleep and depressive symptoms within the yoga group.

				reported 3 months after radiotherapy. Authors suggested that yoga may not reduce posttraumatic stress symptoms in the acute phase, but in turn may facilitate improved long-term adjustment.	
Hilcove et al. (2021)	Cortisol	Perceived stress, burnout, vitality, sleep quality, serenity, and mindfulness	Intervention did not have statistically significant impact on cortisol	All psychosocial variables were statistically significantly: perceived stress, burnout, vitality, sleep quality, serenity, and mindfulness in comparison with the control group after yoga intervention	No- all psychosocial variable were statistically significant. Cortisol was not statistically significant
Oh et al. (2010)	C-Reactive Protein	Quality of life, fatigue, mood	Participants in the qigong group had significant differences in reduction of the level of the inflammation biomarker (CRP) than the control group at week 10	Participants in the qigong group reported larger improvements in quality of life, fatigue, and had greater reduction in mood disturbance compared to control group	Yes- participants in qigong group had improved mood, quality of life, fatigue, and reduced inflammation compared to control group
Bisht et al. (2019)	Cortisol, BDNF, DHEAS, sirtuin1, Il-6	Depression, quality of life	Significant increase in BDNF (cardinal biomarker of	There was a significant decline in depression	Yes-The findings implies significant

			neuroplasticity) at the end of the intervention versus baseline Mind- body communicative biomarkers, DHEAS and sirtuin 1 were found to be significantly increased following the intervention. Cortisol and IL-6 significantly declined at the end of the intervention versus baseline.	scores and significant improvement in the overall rating of quality of life (across all domains) and overall satisfaction with health from baseline to 12-weeks of YBLI	improvement in biomarkers of neuronal plasticity {cardinal biomarker of neuroplasticity (BDNF)} and mind-body communicative biomarkers (DHEAS, sirtuin1, cortisol and IL-6) in association with the positive clinical outcomes of reduction in depressive symptoms and overall improvement in quality of life
Rao et al. (2008)	CD4%, CD8%, natural killer cell, IgG, IgA, IgM	Anxiety, depression, stress, quality of life	A significantly lower decrease in CD56 % in the yoga group as compared to the controls and lower levels of serum IgA in the yoga group as compared to controls postoperatively suggesting prevention of immune suppression following surgery after yoga intervention	A significant decrease in psychological morbidity such as anxiety state and trait, depression, treatment-related stress symptoms and improvement in the quality of life in the yoga group as compared to the controls following surgery.	Yes- the results suggest possible benefits for yoga in reducing postoperative distress (anxiety, stress, depression) and preventing immune suppression following surgery (decrease CD56%, lower levels serum IgA)

Ho et al. (2018)	Cortisol	Perceived stress, fatigue, pain, sleep	Participants in both groups displayed significantly steeper diurnal cortisol slopes over the 3-week interval. Results appears to suggest a temporal association between PSS and diurnal cortisol slopes. Baseline PSS levels significantly moderated the effects of DMT on Time 2 diurnal cortisol slopes. DMT exerted a significant and moderate effect on diurnal cortisol slopes among patients with elevated baseline levels of perceived stress.	Results appears to suggest a temporal association between PSS and diurnal cortisol slopes. Baseline PSS levels significantly moderated the effects of DMT on Time 2 diurnal cortisol slopes. DMT exerted a significant and moderate effect on diurnal cortisol slopes among patients with elevated baseline levels of perceived stress.	Yes- Though the direct effect of DMT on diurnal cortisol slopes were not significant among patients with low or average levels of PSS1, DMT exerted a significant and moderate effect on diurnal cortisol slopes among patients with elevated baseline levels of perceived stress. The present findings suggest that DMT might have a beneficial effect on diurnal cortisol slopes in breast cancer patients with high levels of distress.
Robins et al. (2013)	IL-1 β , IL-2, IL-4, IL-5, IL-6, IL-7, IL-8, IL-10, IL-12, IL-13, IL-17, granulocyte colony stimulating factor (G-CSF), granulocytemacrophage -(GM-) CSF, IFN- γ , MCP-1, MIP-1 β ,	Depressive symptoms, perceived stress, quality of life	Significant elevations in IFN- γ were noted for both intervention groups at the 6-month follow-up possibly reflecting better recovery of proinflammatory cytokine production	For all participants, levels of stress were highest at baseline, decreased over the period of chemotherapy, and then plateaued over the recovery period. Similarly, QOL	Yes- Significant elevations in IFN- γ were noted for both intervention groups at the 6-month follow-up and decreased depressive symptoms, decreased levels of stress,

	and TNF- α Endorphins and enkephalins			scores decreased during chemotherapy but increased by the first follow-up time point. Depressive symptoms declined for all groups of participants over time.	and increased QOL
Michalsen et al. (2005)	IL-6, TNF- α , and interleukin-1 β	Perceived stress, anxiety, well-being, fatigue, depression symptoms	Analysis showed a decrease of mean cortisol levels in 9 of 11 participants immediately following yoga intervention	Compared to waiting-list, women who participated in the yoga-training had significant improvements in perceived stress, anxiety, well-being, fatigue, and depression	Yes-significant changes in all psychosocial variables as well as an immediate decrease in salivary cortisol concentrations after intervention
Chow et al. (2012)	Cortisol	Psychological well-being, quality of life	The qigong group had a lower mean cortisol level than the wait-list control group	Qigong training participants experienced significant results for emotional relief (reduced stress, anxiety, and depressive mood) and improved quality of life	Yes- Significant lower cortisol levels and lower stress, anxiety, depression symptoms of qigong subjects when compared with the waiting subjects
Zaccari et al. (2020)	Cortisol	PTSD symptoms, depression, quality of life, sleep	There was a statistically significant correlation between cortisol and life satisfaction after TSY intervention.	Statistically significant improvements between baseline and postintervention scores on measures of PTSD,	No-Trauma sensitive yoga was not accompanied with statically significant changes in cortisol. Improvements

			Trauma sensitive yoga was not accompanied with statically significant changes in cortisol.	depression, sleep, quality of life, and subjective neurocognitive complaints after intervention.	across all psychosocial variables after intervention (PTSD symptoms, depression, quality of life, sleep).
Kiecolt-Glaser et al. (2014)	IL-6, TNF- α , IL-1 β	Depressive symptoms, sleep quality	At 3 months post-treatment, the mean ln TNF- α , ln IL-6, ln IL-1 was lower for the yoga group compared with controls. In secondary analyses, the pattern was similar, with significant effects of the frequency of yoga practice on cytokine levels 3 months post-treatment but not immediately post-treatment. At 3 months post-treatment, a 10-minute per-day increase in yoga practice was associated with a decrease in the IL-6 and the IL-1 geometric mean.	Yoga group participants reported significantly improved sleep and reduced fatigue compared with the control group. Depressive symptoms were not significantly different between groups.	Yes- Yoga practice substantially reduced fatigue and inflammation. Immediately post-treatment, vitality was higher in the yoga group compared with the control group. At 3 months post-treatment, the yoga group's fatigue was lower, vitality was higher, and IL-6, TNF- α , and IL-1 β were lower for yoga participants compared with controls

APPENDIX L

RCT JBI Quality Appraisal Results

Reviewer	Article Title	Was true randomization used for assignment of participants to treatment groups?	Was allocation to treatment groups concealed?	Were treatment groups similar at baseline?	Were participants blind to treatment assignment?	Were those delivering treatment blind to treatment assignment?	Were outcome assessors blind to treatment assignment?	Were treatment groups treated identically other than the intervention of interest?	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Were participants analyzed in the groups to which they were randomized?	Were outcomes measured in the same way for treatment groups?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?	Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Overall Appraisal	Comments
EW/DG	A Randomized Controlled Pilot Study of Yoga Skills Training Versus an Attention Control Delivered During Chemotherapy Administration	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	Include	high quality
EW/DG	A Yoga and Compassion Meditation Program Reduces Stress in Familial Caregivers of Alzheimer's Disease Patients	YES	U/C	YES	NO	NO	NO	YES	NO	YES	YES	YES	YES	YES	Include	mid quality
EW/DG	Biochemical and Psychometric Evaluation of Self-Healing Qigong as a stress reduction tool among first year nursing and midwifery students	YES	YES	YES	YES	NO	U/C	YES	YES	YES	YES	U/C	YES	YES	Include	high quality
EW/DG	Effect of a Qigong Intervention on Telomerase Activity and Mental Health in Chinese Women Survivors of Intimate Partner Violence: A Randomized Clinical Trial	YES	YES	YES	YES	U/C	YES	YES	YES	YES	YES	YES	YES	YES	Include	high quality
EW/DG	Effect of Structured Yoga Program on Stress and Professional Quality of Life Among Nursing Staff in a Tertiary Care Hospital of Delhi- A Small Scale Phase-II Trial	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	Include	mid quality
EW/DG	Effects of a Brief Qigong-based Stress Reduction Program (BQSRP) in a distressed Korean population: a randomized trial	YES	YES	YES	NO	U/C	U/C	YES	YES	YES	YES	YES	YES	YES	Include	mid quality
EW/DG	Effects of a Yoga Program on Cortisol Rhythm	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	Include	high quality

	and Mood States in Early Breast Cancer Patients Undergoing Adjuvant Radiotherapy: A Randomized Controlled Trial															
EW/DG	Effects of Antenatal yoga on maternal anxiety and depression: a randomized controlled trial	YES	YES	YES	NO	YES	U/C	YES	YES	YES	YES	YES	YES	YES	Include	high quality
EW/DG	Examining Mediators and Moderators of Yoga for Women with Breast Cancer Undergoing Radiotherapy	YES	YES	YES	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	Include	mid quality
EW/DG	Feasibility and Effect of a Tai Chi Self-Help Education Program for Korean Gastric Cancer Survivors	NO	NO	N/A	N/A	N/A	N/A	NO	NO	NO	YES	NO	YES	NO	Exclude	low-quality. High dropout. No control groups. Not everyone completed intervention (less than 50%)
EW/DG	Holistic Nursing in Practice: Mindfulness-Based Yoga as an Intervention to Manage Stress and Burnout	YES	YES	YES	U/C	YES	YES	YES	NO	YES	YES	YES	YES	YES	include	high quality
EW/DG	Impact of Medical Qigong on Quality of Life, Fatigue, Mood, and Inflammation in Cancer Patients: A Randomized Controlled Trial	YES	NO	YES	U/C	NO	NO	YES	YES	YES	YES	YES	YES	YES	include	mid quality
EW/DG	Influence of yoga on mood states, distress, quality of life and immune outcomes in early-stage breast cancer patients undergoing surgery	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	YES	YES	YES	include	high quality
EW/DG	Perceived stress moderates the effects of a randomized trial of dance movement therapy on diurnal cortisol slopes in breast cancer patients	YES	YES	YES	U/C	NO	U/C	YES	YES	YES	YES	YES	YES	YES	Include	mid quality
EW/DG	Preliminary indications of the effect of a brief yoga intervention on markers of inflammation and DNA methylation in chronically stressed women	YES	NO	NO	NO	NO	NO	NO	YES	NO	YES	YES	YES	NO	Exclude	low quality-Participants were from larger randomized control trial (subsample). Study did not meet the sample size assumption required to conduct a regression, nor exploration of mediation/moderation. No baseline measures of objective PNI variables. No active control groups.
EW/DG	Psychoneuroimmunology-Based	YES	YES	YES	U/C	YES	YES	YES	YES	YES	YES	YES	YES	YES	Include	mid quality

	Stress Management during Adjuvant Chemotherapy for Early Breast Cancer															
EW/DG	The Effects of Qigong on Reducing Stress and Anxiety and Enhancing Body-Mind Well-Being	YES	NO	YES	YES	U/C	NO	YES	YES	YES	YES	YES	YES	YES	include	mid quality
EW/DG	Yoga's Impact on Inflammation, Mood, and Fatigue in Breast Cancer Survivors: A Randomized Controlled Trial.	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	include	high quality

APPENDIX M

Quasi-experimental JBI Quality Appraisal Results

Reviewer	Title	Is it clear in the study what is the cause and what is the 'effect' (i.e., there is no confusion about which variable comes first)?	Were the participants included in any comparisons similar?	Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Was there a control group?	Were there multiple measurements of the outcome both pre and post the intervention/exposure?	Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Were the outcomes of participants included in any comparisons measured in the same way?	Were outcomes measured in a reliable way?	Was appropriate statistical analysis used?	Overall Appraisal	Comments
EW/DG	Assessment of yoga as an adjuvant treatment of combat-related posttraumatic stress disorder	YES	YES	NO	NO	YES	YES	YES	YES	YES	Include	mid quality
EW/DG	Impact of yoga-based lifestyle intervention on psychological stress and quality of life in the parents of children with retinoblastoma	YES	YES	NO	NO	YES	YES	YES	YES	YES	Include	mid quality
EW/DG	Yoga for veterans with PTSD: Cognitive functioning, mental health, and salivary cortisol	YES	YES	NO	NO	YES	YES	N/A	YES	YES	Include	mid quality
EW/DG	Rapid stress reduction and anxiolysis among distressed women because of a three-month intensive yoga program	YES	YES	NO	YES	YES	NO	U/C	YES	YES	Include	mid quality

APPENDIX N

IRB Approval

PEPPERDINE UNIVERSITY

Graduate & Professional Schools Institutional Review Board

July 28, 2021

Protocol #: **72821**

Project Title: Movement-Oriented Mind-Body Interventions and Psychoneuroimmunological Outcomes for Psychological Stress and Trauma.

Dear Emma:

Thank you for submitting a "GPS IRB Non-Human Subjects Notification Form" for *Movement-Oriented Mind-Body Interventions and Psychoneuroimmunological Outcomes for Psychological Stress and Trauma* project to Pepperdine University's Institutional Review Board (IRB) for review. The IRB has reviewed your submitted form and all ancillary materials. Upon review, the IRB has determined that the above titled project meets the requirements for *non-human subject research* under the federal regulations 45 CFR 46.101 that govern the protection of human subjects.

Your research must be conducted according to the form that was submitted to the IRB. If changes to the approved project occur, you will be required to submit *either* a new "GPS IRB Non-Human Subjects Notification Form" or an IRB application via the eProtocol system (<http://irb.pepperdine.edu>) to the Institutional Review Board.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite our best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the IRB as soon as possible. We will ask for a complete explanation of the event and your response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the IRB and documenting the adverse event can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* at <https://community.pepperdine.edu/irb/policies/>.

Please refer to the protocol number denoted above in all further communication or correspondence related to this approval.

On behalf of the IRB, we wish you success in this scholarly pursuit.

Sincerely,

Institutional Review Board (IRB)
Pepperdine University

cc: Mrs. Katy Carr, Assistant Provost for Research
Dr. Judy Ho, Graduate School of Education and Psychology IRB Chair