The Effect of Meditation on Stroke-Survivor Resilience: A Secondary Analysis of Existing Data

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THE EFFECT OF MEDITATION ON STROKE-SURVIVOR RESILIENCE:
A SECONDARY ANALYSIS OF EXISTING DATA

A DISSERTATION
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN NURSING

THE UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER AT HOUSTON
CIZIK SCHOOL OF NURSING

BY
MARY F. LOVE, MSN, RN

MAY, 2019
Approval Form D3

Date:  March 14, 2019

To the Dean for the School of Nursing:

I am submitting a dissertation written by Mary F. Love and entitled “The Effect of Meditation on Stroke-Survivor Resilience: A Secondary Analysis of Existing Data”. I have examined the final copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Nursing.

[Signature]
Committee Chair

We have read this dissertation and recommend its acceptance

[Signature]

Accepted

[Signature, Dean, School of Nursing]
Acknowledgments

I want to express my gratitude to my family, friends, and neighbors for supporting and encouraging me throughout this journey. Caroline, my beautiful daughter and friend, from the very beginning you have inspired me to believe this was a challenge I could, and should, accept. To all of my questions, from “Should I apply for this program?”, “Can I write a paper, (re)learn statistics, make a PowerPoint presentation?”, “Should I switch to this new research focus?”, you always answered with a resounding “YES, MOM!!” Thank you for all of your study tips, for editing my papers, for your guidance on writing cover letters and applying for jobs. We will always remember spending Christmas Eve at the Palumbo’s dining room table in Danville, with you editing those pdf tables for publication. (A special thank you to Stroke for sending those proofs, with a 48-hour deadline, on December 24, 2018…). Sharing our commencement exercises in May 2019 is such a joy, and I am so fortunate and proud to have you, Caroline.

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Mary F. Love

The Effect of Meditation on Stroke-Survivor Resilience:  
A Secondary Analysis of Existing Data

May 16, 2019

Abstract

**Purpose:** To test the effect of meditation on resilience of community-dwelling stroke survivors, and to identify resilience predictor variables in these survivors.

**Methods:** Sub-study with secondary analysis of existing data from the parent study, MEDITATION for post stroke Depression (MEND). The effect of meditation on resilience of stroke-survivors (n=20) in the intervention group was evaluated with paired samples t-test. Demographic, clinical, and psychological predictor variables of baseline resilience for all stroke survivors (n=35) were evaluated with univariate analysis and general linear modeling (GLM).

**Results:** The increase in stroke-survivor resilience scores from baseline (mean 3.46, SD=.81) to intervention completion (mean 3.57, SD 1.02) was not statistically significant (t=.60, df 19, p=.56). One-way ANOVA with Tukey post hoc analysis revealed baseline resilience was significantly lower (p=.02) for NH Black participants than for NH White participants. GLM with resilience as the dependent variable, race as a fixed factor, and trait anxiety as a covariate was significant (F3,30, p = .002), and accounted for nearly 33% of the variance in baseline resilience.
**Conclusion:** Trait anxiety and NH Black race were associated with lower resilience in these stroke survivors. Meditation interventions to enhance resilience may support stroke-survivor recovery, but further research is needed.
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Summary of Study

This research project, a secondary analysis of existing data, focused on the effect of a meditation intervention on stroke-survivor resilience. The plan for the research project, including specific aims, significance, and research approach, is detailed in the research proposal. The specific aims for the project were to test the effect of meditation on resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery, and to identify potential predictor variables of baseline resilience in these stroke survivors. In preparation for this project, two systematic literature reviews were performed (Manuscript A and Manuscript B). The results for the research project are reported in Manuscript C.

The purpose of the initial systematic literature review (Manuscript A) was to synthesize the evidence regarding the effect of mind-body therapies on quality of life, psychological stressors, and biological outcomes for stroke survivors. Five randomized clinical trials and three qualitative studies were included in this review, which followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. Despite an absence of statistically significant between-group differences in outcomes for these clinical trials, there were trends for improvement in symptoms of depression, anxiety, and quality of life, which were also reflected in themes reported in the qualitative studies. None of the retrieved studies focused on biological outcomes. We concluded larger, randomized trials with a mixed-methods design were indicated to investigate the effect of mind-body therapies on stroke survivor outcomes. This manuscript, “Mind-Body Interventions, Psychological Stressors, and Quality of Life in Stroke
Survivors: A Systematic Review,” was published in the February 2019 issue of Stroke.

The next step in this research project (Manuscript B) was to synthesize the literature regarding factors influencing resilience of adults with cardiovascular disease (CVD). Most of the twenty-two studies in this review, which also followed PRISMA guidelines, were observational. The review explored the effects of psychological, social, behavioral, and biological factors on resilience among adults with CVD. Results indicated psychological factors of depression, anxiety, and perceived stress were inversely associated with resilience, while self-care behaviors were positively associated with resilience. We concluded further research is warranted regarding factors influencing resilience, including the effect of interventions on resilience in CVD patients. This manuscript, “Resilience Predictors in Cardiovascular Disease: A Systematic Review,” is in process of submission to Psychosomatic Medicine: Journal of Biobehavioral Medicine.

The final step of this research project was a sub-study of MEditatioN for post stroke Depression (MEND), a pilot randomized controlled trial regarding the effect of a four-week meditation intervention on outcomes for adult community-dwelling stroke survivors and their informal caregivers. The principal investigator for the sub-study actively participated in MEND through data collection, entry, management, and cleaning, and participant recruitment and enrollment. The sub-study, a secondary analysis of existing MEND data, focused on the effect of meditation on the resilience outcome for stroke survivors. While the slight increase in resilience from baseline to immediately post-intervention was not
statistically significant, potential resilience predictors of trait anxiety and NH Black race were identified in this sample of stroke survivors. Results of this sub-study, reported in Manuscript C (“The Effects of Meditation on Stroke-Survivor Resilience: A Secondary Analysis of Existing Data”) are in process of submission to the journal *Disability and Rehabilitation*.

Supplemental documents for this research projects are found in the appendixes. This supplemental information includes the protocol submitted to, and approved by, the university institutional review board. Data for univariate and multivariate analysis of the sub-study not reported in the original manuscript are also included.
Research Proposal:
The Effect of Meditation on Resilience Among Stroke Survivors in the First Year of Recovery

Submitted to

Jennifer E. Sanner Beauchamp, PhD, RN
Geri LoBiondo-Wood, PhD, RN, FAAN
Anjail Sharrief, MD, MPH

Submitted in Partial Fulfillment of the Requirements for Dissertation

The University of Texas Health Science Center at Houston
Cizik School of Nursing

By
Mary Love, MSN, RN
October 10, 2018
Abstract

Background

Stroke, the leading cause of disability in the United States, results in significant physical and psychological stress for stroke survivors. Poststroke care focuses on rehabilitation of the physical effects of stroke, resulting in gaps in knowledge and treatment of the psychological effects of stroke. Resilience has shown positive correlations to mindfulness and self-care, and negative correlations to anxiety and depression among various adult populations, including those with cardiovascular disease. Among stroke survivors, qualitative evidence regarding resilience points to engagement in self-care and reduced symptoms of psychological stress. Strategies to enhance resilience could improve the recovery trajectory for stroke survivors. Mind-body therapies such as meditation have the potential to enhance resilience through the cultivation of mindfulness.

Objectives

The primary aim of this proposed research project is to test the effect of a meditation intervention on resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. The secondary aim is to identify potential predictor variables of resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery.

Methods

This proposed research project is a sub-study consisting of a secondary analysis of existing data. The parent study, MEditatioN for post stroke...
Depression (MEND), is a pilot RCT of the effects of a meditation intervention on psychological and biological outcomes in stroke survivor/informal caregiver dyads. MEND is a repeated measures study, with data collection at baseline and at three time points post-intervention. The proposed sub-study will include data from the stroke survivors. Resilience was measured with the Brief Resilience Scale (BRS), and predictor variables will include demographic, psychological, and clinical variables collected at baseline. The data analysis to test the effect of meditation on resilience will focus on within-group measures of resilience in the intervention group at baseline and immediately upon completion of the intervention. The relationship between resilience and predictor variables at baseline will be assessed with univariate and multiple regression analysis.

**Expected Outcomes**

The hypothesis for the primary aim is that among adult community-dwelling patients diagnosed with stroke in the past 12 months, a 4-week, breath-based meditation intervention will result in improved resilience when measured at baseline and upon completion of the intervention. We hypothesize that among community-dwelling adult patients diagnosed with stroke in the past 12 months, female gender will be associated with lower baseline resilience, age will be positively correlated with resilience, while symptoms of anxiety and depression will be inversely correlated with resilience. This proposed study will be the first to address the effect of meditation on resilience in stroke survivors.
Specific Aims

Stroke exerts substantial physical and psychological stress on stroke survivors. The effects of stroke, which vary among individuals, include hemiparesis, aphasia, cognitive issues, and symptoms of anxiety and depression. Poststroke treatment focuses on physical effects of stroke (e.g. hemiparesis and aphasia), resulting in significant gaps in the identification and treatment of psychological effects of stroke (Winstein et al., 2016). Strategies to address the psychological effects of stroke have the potential to positively influence recovery for stroke survivors.

Early stroke recovery seems to follow a trajectory of either resilience or significant psychological stress (White et al., 2012). Stroke survivors who follow a resilient trajectory may be better equipped to engage in necessary treatments. Qualitative studies have identified resilience as a facilitator of occupational adaptation and also of engagement in multiple health behaviors among stroke survivors (Williams & Murray, 2013; Plow, Moore, Sajatovic, & Katzan, 2017). Resilience, viewed as a dynamic process of adaptation in the face of considerable stress, is amenable to change through intervention (Windle, 2011; Wagnild, 2009). To our knowledge, only one published study has focused on the effect of an intervention on poststroke resilience. In that feasibility study, ten of the eleven participants demonstrated slight increases in resilience after completion of the 6-week group peer-support intervention (Sadler et al., 2017).

Therapies with a mind-body component, such as meditation, have the potential to improve resilience. Hwang et al. (2017) compared the effect of an
intensive meditation intervention with relaxation in 51 healthy adults and found a significant interaction effect for the intervention and time on resilience and mindfulness at the three-month follow up. The few clinical trials of mind-body therapies in stroke survivors have focused on outcomes of falls, quality of life, and symptoms of anxiety or depression. Evidence regarding the effect of mind-body therapies on poststroke resilience is lacking. Effective strategies to promote poststroke resilience could positively impact the recovery of stroke survivors.

Our long-term goal is to ameliorate the negative impact of stress on poststroke recovery through targeted interventions which enhance resilience. The overall objective for this project is to obtain preliminary data regarding the effect of meditation on poststroke resilience. Our central hypothesis is that poststroke resilience, which may be moderated by demographic and clinical characteristics, will be improved by meditation practice. Our rationale is that meditation will enhance resilience in stroke survivors by fostering mindfulness. Preliminary efficacy data will provide essential information regarding the treatment effect of meditation on resilience for survivors of ischemic stroke, hemorrhagic stroke, or transient ischemic attack (TIA).

In order to meet our overall objective, we will pursue the following two aims.

**Aim 1.** To test the effect of meditation on resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. Our hypothesis is that among community-dwelling stroke survivors diagnosed with stroke in the past 12 months, a 4-week, breath-based meditation intervention will result in improved
resilience (operationalized with the Brief Resilience Scale) when measured at baseline and immediately upon completion of the 4-week intervention.

**Aim 2.** To identify potential predictor variables of baseline resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. *We hypothesize* that among community-dwelling stroke survivors diagnosed with stroke in the past 12 months, female gender will be associated with lower baseline resilience, age will be positively correlated with resilience, and symptoms of anxiety and depression will be inversely correlated with resilience. This hypothesis is based on observational studies of patients with cardiovascular disease (CVD) (Carvalho et al., 2017; Toukhsati et al., 2017; Smith et al, 2013). We will also explore the effect of demographic variables (race, ethnicity, education, marital status, income, religious beliefs), psychological variables (anxiety, depression), and clinical variables (time since stroke, type of stroke) on baseline resilience.

This new knowledge may facilitate the identification of stroke survivors in need of interventions (such as meditation) to enhance resilience. The survivors’ response to stroke-induced stress has a strong impact on recovery, including the ability to engage in essential poststroke self-care and self-management practices (Clark, Bennett, Ware & Jones, 2018). Fostering resilience supports recovery of stroke survivors, and offers a first step toward improved engagement in important treatment modalities.
Background and Significance

Stroke is the leading cause of disability in the United States; approximately 800,000 Americans currently live with stroke (Winstein et al., 2016). Poststroke treatment focuses on rehabilitating functional impairments and preventing future stroke. Stroke survivors are expected to adhere to treatments such as physical therapy, speech therapy, and occupational therapy. In addition, secondary prevention of stroke requires adherence to medications, dietary changes, exercise, and stress management. Stroke survivors may feel overwhelmed when faced with these challenges in early recovery (Boger, Demain, & Latter, 2015).

According to Williams and Murray (2013), initial response to stroke may be characterized by apprehension and fear, while responses later in stroke recovery may include feelings of hopelessness and lack of motivation. Changes in self-perception may result from the sudden changes in physical, cognitive, or communication abilities resulting from stroke (Sarre et al., 2014). These responses, when left unrecognized, can profoundly affect the stroke survivor’s recovery.

Engaging in meaningful activity, regaining physicality, and resuming past activities are important aspects of poststroke recovery (Sarre et al., 2014). White et al. (2012) have identified four trajectories in poststroke recovery: resilience, ongoing mood disturbance, emergent mood disturbance, and recovery from mood disturbance. The resilient trajectory is characterized by adaptability, an ability to embrace the future, previous experiences of mastery/resilience, being
optimistic rather than pessimistic, and feeling appreciative to be alive after the
stroke (White et al., 2012).

**Resilience**

Resilience in adults has been conceptualized in various ways, including as
a personality characteristic (Wagnild & Young, 1993), as “stress-coping ability”
(Connor & Davidson, 2003), and as a reflection of resilience-related resources
(Friborg et al., 2003). In contrast, other researchers have focused on resilience
as the ability to rebound or bounce back from stress (Sinclair & Wallston, 2004:
Smith et al., 2008). Mancini and Bonanno (2006) define resilience as “the ability
to maintain relatively stable, healthy levels of psychological and physical
functioning in the face of an extreme life event” (p. 978). The stressful or adverse
event challenges the individual physically and/or psychologically and poses a
significant threat for a negative outcome (Garcia-Dia et al., 2013; Windle, 2011).
Individuals with a resilient outcome may experience symptoms related to anxiety
or depression after a stressful event, but they are able to maintain functioning
despite these experiences (Mancini & Bonanno, 2006).

Among adult populations, positive psychological factors empirically related
to resilience include positive emotion, purpose and meaning in life, mindfulness,
and spirituality (Kemper, Mo, & Khayat, 2015; Kemper & Khirallah, 2015; Rutten
et al., 2013; Senders, Bourdette, Hanes, Yadav, & Shinto, 2014). In contrast,
psychological factors related to negative affect have been inversely related to
resilience in adults, including symptoms of anxiety, depression, and perceived
stress (Cal, de Sa, Glustak, & Santiago, 2015; (Leontjevas, de Beek, Lataster, &
Jacobs, 2014). Higher income and education, and social support are linked to higher levels of resilience in adults (Garcia-Dia, DiNapoli, Garcia-Ona, Jakubowski, & O'Flaherty, 2013; Sinclair & Wallston, 2004). Health-promoting behaviors have been positively associated with higher levels of resilience in patients with chronic kidney disease (Ma et al., 2013) and in older women (Wagnild, 2009). In addition, increased physical activity and increased consumption of fruits and vegetables were associated with higher levels of resilience among a sample of elderly adults (Perna et al., 2012).

Few studies have reported on the relationship between resilience and demographic, psychological, or behavioral factors in stroke survivors. Low stress resilience in young men has been associated with higher risk of stroke during middle age (unadjusted HR 1.54, 95% CI 1.40-1.70). and with increased length of hospital stay following ischemic stroke (unadjusted HR 1.46, 95% CI 1.12-1.98) (Bergh, Udumyan, Appelros, Fall, & Montgomery, 2016; Bergh et al., 2014). Among patients with diagnoses of other cardiovascular diseases, including heart failure and acute coronary syndrome (ACS), higher levels of depressive symptoms have been significantly correlated with lower resilience, with inverse correlation from \( r=0.51 \) to \( r=0.87 \) (Artinian et al., 2009; Barreto et al., 2017; Carvalho et al., 2016; Chang, Wu, Chiang, & Tsai, 2017; Liu et al., 2018; Meister et al., 2016; Toukhsati et al., 2017). Anxiety, perceived stress, and posttraumatic stress have also shown significant inverse relationships with resilience among various CVD populations (Artinian et al., 2009; Carvalho et al., 2016; Liu et al., 2018; Meister et al., 2016). Demographic factors positively associated with
resilience among CVD populations include higher income, higher economic status, and living with family (Liu et al., 2018; Shin, Kim, & Jung, 2015). Lastly, moderate to large positive correlations between resilience and self-care measures have been noted in CVD populations including patients with heart failure (Chang et al., 2017; Shin et al., 2015).

**Mind-Body Interventions**

Mind-body practices (such as tai chi, yoga, and meditation) focus on the interactions among the brain, mind, body, and behavior (National Center for Complementary and Integrative Health, 2017). Most meditation practices involve attentional focus which includes attention to the breath, thoughts, and/or feelings (Chaoul et al., 2014). Through meditation, the individual gains awareness of the bidirectional relationship between the mind and the body (Chaoul et al., 2014). This aspect of meditation is particularly relevant for stroke survivors due to the prevalence of both physical and psychological stroke effects. A key component of meditation practice is cultivating mindfulness, which is defined as the nonjudgmental acceptance of the present moment (Kabat-Zin, 2017).

Mind-body therapies have been associated with improvements in psychological outcomes in the elderly, patients with chronic disease, and patients with cardiovascular disease (Sorrell, 2015; Chan & Larson, 2015; Younge et al., 2015). A pilot study of the effects of an eight-week mindfulness based stress reduction (MBSR) program in women with CVD found significant improvements in the intervention group for measures of anxiety, emotional expression, and reactive coping (Tacón, McComb, Caldera, & Randolph, 2003). A recent
systematic review of mind-body interventions in heart failure retrieved only two studies with meditation as the intervention; both studies reported significant improvements for outcomes of depression and quality of life (Gok Metin et al., 2018). Relatively few studies have been conducted to evaluate the effect of mind-body interventions on outcomes for stroke survivors. These studies, which include either yoga or tai chi as the intervention, found positive trends in outcomes of anxiety, depression, and quality of life, but few significant between-group differences (Chan, W., Immink, M. A., & Hillier, S., 2012; Taylor-Piliae et al., 2014; Immink, Hillier, & Petkov, 2014; Schmid et al., 2012; Taylor-Piliae & Coull, 2012). Most of these studies were small pilot or feasibility studies, and none of the studies addressed resilience as an outcome.

**Resilience and Mindfulness**

Few studies have explored the relationship between resilience and mindfulness. A cross-sectional study of 134 middle-aged and older adults indicated the effect of stressors on mental health was “buffered” by mindfulness, which was referred to as a “resiliency factor” (de Frias & Whyne, 2015, p. 205). A prospective cohort study of 513 health professionals with moderate to high stress levels found significant acute improvements in mindfulness (p<.001) and resilience (p<.01) after completion of online mind-body skills training (Kemper & Khirallah, 2015).

**Conceptual Framework**

Our project will focus on resilience as the ability to rebound from stressful or adverse events. Smith et al. (2008) conceptualized resilience, which involves
a temporal dimension, as a three-stage process. The first stage involves being aware of and confronting a stressful event, the second stage includes orienting the self to a positive outcome, and the third stage results in engaging in efforts to cope with the stressor (Smith et al., 2013). The authors examined their hypotheses regarding resilience in a sample of 844 participants, which included cardiac rehabilitation patients (n=228), fibromyalgia patients (n=32), urban firefighters (n=123), first-generation college students (151), healthy adult women (n=51), and college students (n=259) (Smith et al., 2013). Multiple regression analysis resulted in a model with five variables: mindfulness, mood clarity, purpose in life, optimism, and active coping (Smith et al., 2013).

The authors hypothesized mindfulness and mood clarity would relate to the first stage of resilience, in which the person confronts the stressful event (Smith et al., 2013). Optimism and purpose in life would be related to the second stage, which focuses on orientating the self to a positive outcome. The last stage, engaging in efforts to cope with stress, would be related to active coping (Smith et al., 2013).

For this project, we hypothesize meditation will enhance resilience in stroke survivors through the cultivation of mindfulness. Through mindfulness, the stroke survivor gains greater acceptance and awareness of the present moment. This awareness facilitates the ability to confront the stressful event, which Smith et al. (2013) considered as the first stage in the resilience process. While mindfulness plays an essential role in the first stage of resilience, we believe
mindfulness will also influence the ability to orient the self to a positive outcome and to engage in efforts to cope with the stroke-related stressors.

Mindfulness facilitates clear thinking, which may result in the ability to take responsibility for making life choices (Ludwig & Kabat-Zinn, 2008). Through increased mindfulness, meditation may support the individuals’ ability to cope with stress and disability resulting from diseases such as stroke. Potential mechanisms for mindfulness meditation to improve poststroke recovery include the following: improved ability to tolerate discomfort and disability; reduced symptoms related to stress, depression, and anxiety; improved adherence to treatment; and increased motivation to engage in lifestyle changes needed for secondary prevention of disease (Ludwig & Kabat-Zinn, 2008).

**Innovation**

Traditionally, post-acute stroke care has focused on rehabilitation of the physical and cognitive effects of stroke through therapies such as physical therapy, occupational therapy, and speech therapy. While these therapies are vital components of stroke recovery, psychological and emotional responses to stroke also strongly impact recovery of stroke survivors. Our proposed study is innovative in that we focus on the psychological stress endured by stroke survivors. In addition, we are interested in resilience, a positive variable that has received little attention in stroke survivors. To our knowledge, our proposed study will be the first to address the effect of meditation on resilience in stroke survivors. We envision a new paradigm of poststroke stroke care in which the
stroke survivor’s psychological recovery trajectory is an essential component in the treatment plan.

**Research Approach**

The primary aim of this research project is to test the effect of meditation on resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. For this aim, the independent variable is the meditation intervention, and the dependent variable is the resilience level of the stroke survivors. The secondary aim is to identify potential predictor variables of baseline resilience in stroke survivors during the first 12 months of stroke recovery. Demographic, psychological, and clinical variables will be the independent variables, with resilience as the dependent variable. This project is a sub-study of an in-progress parent study. The parent study will be described first, followed by the proposed sub-study.

**Methods, Parent Study:** MEditatioN for post stroke Depression (MEND);
Jennifer E. Sanner Beauchamp, PhD, RN, Principal Investigator

**Design.** The parent study is a pilot randomized controlled trial (RCT) regarding the effect of a four-week meditation intervention on psychological and biological outcomes for stroke survivors and their informal caregivers. The parent study has a repeated measures design, with data collection at baseline (T0), immediately after completion of the intervention (T1), at one-month (T2) and two months (T3) post intervention.

**Human subjects protection:** The MEND study has received approval from the UTHSC Houston Committee for the Protection of Human Subjects
Written informed consent is obtained from all participants before they were enrolled in the study. As part of the consent process, risks and benefits are reviewed with potential participants. Potential risks include psychological discomfort with self-report survey questions, fatigue from completing the surveys, or discomfort or bruising from venipuncture. The total time required to complete study surveys at each data collection time point varies from 10 to 20 minutes. Participants are informed that while the intervention may result in relaxation, no such benefit can be expected for any individual participant. In addition, the demarcation between the treatment in the clinic and the research study is specifically described to participants, who are also informed they may withdraw from the study at any time without any negative repercussions. There are no exclusions to study participation for women or minorities.

All data is de-identified and stored as directed by the policies of UTHSC Houston. All research personnel were trained regarding human subject protection in research, including the procedures for handling of data and protected health information.

**Sample and setting.** The target population for the study is community-dwelling adult patients in Houston, Texas who are in the first year of stroke recovery. The accessible population consists of the stroke patients seen in the Stroke, Transitions, Education and Prevention (STEP) Clinic at The University of Texas Health Science Center Houston (UTHSC Houston). Adult patients (≥ 18 years of age) who have been diagnosed with ischemic stroke, hemorrhagic stroke, or transient-ischemic attack (TIA) in the past 12 months are eligible for
study participation. Community-dwelling stroke survivors who can read and write English are eligible for inclusion. Stroke survivors with any of the following characteristics are excluded: suicidal ideation, active substance abuse, active psychosis, or current participation in psychotherapy or meditation. In addition, stroke survivors with severe cognitive impairment which might interfere with the ability to provide written informed consent will also be excluded unless a legally authorized representative (LAR) provides written informed consent for the stroke survivor.

In addition to the stroke survivors, adults over the age of 18 who self-identify as the patient’s informal caregiver are also eligible to participate in the study. Inclusion and exclusion criteria for the caregivers are the same as for the stroke survivor, with the exception of the stroke history. The target sample size is 24 stroke survivor-caregiver dyads in the intervention group and 12 stroke survivor-caregiver dyads in the control group.

The setting for patient recruitment is the STEP Clinic at UTHSC Houston. Stroke survivors and their informal caregivers are recruited for study participation during stroke clinic visits. The meditation intervention is conducted in a quiet room in the University of Texas Health Science Center Houston Cizik School of Nursing.

Measures. Demographic variables collected via self-report at baseline include: age, gender, race (five categories), ethnicity (two categories), education (seven categories), marital status (four categories), income (six categories), and religious beliefs (six categories). Clinical variables collected at baseline through
electronic record review include Brief MOCA score, type of stroke (ischemic, hemorrhagic, or transient ischemic attack) and date of stroke. A diagnostic psychological tool is also administered at baseline. Psychological variables collected via self-report include resilience and symptoms of anxiety and depression. Resilience is measured with the self-report Brief Resilience Scale (BRS), symptoms of anxiety are measured with the self-report State-Trait Anxiety Inventory (STAI-Y), and symptoms of depression are measured with the self-report Center for Epidemiologic Studies Depression Scale (CES-D). These psychological variables collected via self-report are collected at baseline (T0) and at each post-intervention data collection time point (T1, T2, T3).

**Data collection.** Baseline (T0) data collection occurs in the STEP clinic, immediately after written informed consent has been obtained. Post-intervention data collection (T1, T2, and T3) occurs at the Cizik School of Nursing and includes the same outcome variables as the baseline collection. Data collection and data management occur via REDCap, a secure web application for building and managing online surveys and databases (REDCap, 2018). Patients or caregivers who are unwilling or unable to perform web-based data collection complete data collection via paper and pencil surveys. Strategies to enhance retention include reminder phone calls and emails for each study session and data collection time point.

**Data management and quality control.** The principal investigator has included several strategies to enhance data quality. Prior to study initiation, instruments were entered and tested in the REDCap software. Checklists were
prepared to guide study personnel in all procedures for recruitment and data entry, as well as for data collection and data management.

**Intervention.** Consented patients are randomized into two groups: meditation (intervention) or written education on relaxation (control). Randomization is computer generated in blocks of 6 with a 2:1 allocation. The two members of each dyad are randomized into the same group. If only the stroke survivor or caregiver enroll, they are randomized individually. The meditation intervention is administered face-to-face by an expert, doctoral-prepared meditation practitioner with extensive experience in the field. The intervention sessions are conducted weekly for four weeks and include instruction for home practice between sessions. Each session lasts approximately one hour and focuses on guided, breath-based meditation. Intervention fidelity data is gathered through audio recording of each meditation intervention session. The participants in the control arm receive the written education via email or postal mail to coincide with the timing of each meditation intervention.

**Methods, Proposed Study**

**Design.** This study is a sub-study of the MEND study, consisting of a secondary analysis of existing data.

**Human subjects protection.** The data analysis and data management plan will be submitted to the UTHSC Houston CPHS for approval (see Table 1). The data received by the researcher will be deidentified, so there will be no link to participant protected health information. At the discretion of the MEND
principal investigator and statistician, data transfer to the proposed study researcher will occur in one of two methods. Either the data will be stored on a password-protected computer in the Cizik SON, located in a locked room accessible to MEND personnel, or the data will be stored on an encrypted flash drive to be utilized with the researcher's password-protected laptop. If utilized, the flash drive will be stored in a locked cabinet in the researcher's home, and the data will not be stored directly on the laptop.

**Sample and setting.** Inclusion criterion is the stroke survivors enrolled in the MEND study with BRS data available at baseline and T1. Exclusion criterion is the informal caregivers enrolled in the MEND study. Because stroke survivors can be enrolled as either individuals or as members of a dyad, the total sample of stroke survivors could vary from a minimum of 36 (with 24 in the intervention group and 12 in the control group) to a maximum of 72 (with 48 in the intervention group and 24 in the control group). This sample will be a nonprobability, convenience sample.

**Measures.** The independent variable is the breath-based meditation intervention, and the dependent or outcome variable is resilience as operationalized by the score on the BRS (Smith et al., 2008). The BRS has been included in the MEND study for data collection at baseline and at the three post-intervention data collection points.

**Demographic, clinical and psychological variables.** Demographic variables collected via self-report at baseline include: age, gender, race (five categories), education (seven categories), marital status (four categories),
income (six categories), and religious beliefs (six categories). Clinical variables collected at baseline through electronic record review include type of stroke (ischemic, hemorrhagic, or transient ischemic attack) and date of stroke. Psychological variables include symptoms of anxiety (STAI-Y) and symptoms of depression (CED-D).

**Brief Resilience Scale.** The BRS is a self-report instrument with six items on a 5-point Likert type scale, with choices ranging from “strongly disagree” to “strongly agree”. Three of the items are reverse scored. The resilience level is based on the average of the responses on the six questions, after reverse coding of items 2, 4, and 6 (Smith et al., 2013). Higher scores on the BRS correspond to higher levels of resilience.

The BRS was developed to assess resilience as the ability to bounce back from stress. Smith et al. (2008) hypothesized the BRS scale would be unidimensional and would be related to resilience resources as well as to health outcomes. Initial scale development testing resulted in adequate evidence for internal consistency reliability (Cronbach’s alpha of 0.8 to 0.9) and for test-retest reliability (r=0.7, one-month interval) (Smith et al., 2008). Adequate evidence for construct validity was also reported. Factor analysis (n = 354) resulted in a one-factor solution, with item loadings ranging from 0.6 to 0.9. Convergent validity was demonstrated by correlations with the Connor-Davidson Resilience Scale (CD-RISC, r =0.6) and the Ego Resilience Scale (r =0.5) (Smith et al., 2008).

**Data collection.** The data collection occurs in the context of the MEND study.
Data management and quality control. The MEND study statistician will export the data from the REDCap software into SPSS version 24 for the proposed study researcher. Frequency data will be inspected for normality, skewness, and outliers. The data will also be inspected for missing values, which will be imputed with multiple imputation through the SPSS missing value feature. The parent study statistician has coded the BRS data to meet the scale requirements for reverse scoring and averaging of item responses. The BRS data will also be inspected for floor or ceiling effects.

Data analysis plan. The data analysis for the sub-study will be a secondary data analysis of the existing parent-study data. Descriptive statistics will be computed for the demographic, clinical, and BRS variables. Internal consistency reliability of the BRS scale will be analyzed with Cronbach’s alpha, with an a priori criteria of $\alpha \geq 0.80$ (Nunnally & Bernstein, 1994).

Aim 1. The first aim of the sub-study is to test the effect of meditation on resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. Our hypothesis is that among adult community-dwelling patients diagnosed with stroke in the past 12 months, a 4-week, breath-based meditation intervention will result in improved resilience (operationalized with the Brief Resilience Scale) when measured at baseline and immediately upon completion of the 4-week intervention.

The available sample size is not expected to provide adequate power to assess between-group differences in resilience. The data analysis for this aim will focus on within-group measures of resilience in the intervention group. The
statistical approach to test the hypothesis will be a paired t-test. The G*Power 3.1.9.2 software was utilized to compute a sensitivity analysis for a two-tailed test with $\alpha \leq .05$, $\beta .80$, and a sample size of 16, 24 or 48 (Faul, Erdfelder, Lang, & Buchner, 2007). The effect size (Cohen’s $d$) needed to detect a statistically significant increase in resilience from baseline (T0) to post-intervention (T1) varies from .74 (sample size 16), .59 (sample size 24), or .41 (sample size of 48). These effect sizes fall within the range of a Cohen’s $d$ medium effect (Watson, 2017). The analysis of this aim will provide preliminary estimates of the effect of meditation on resilience of stroke survivors in early stroke recovery.

**Aim 2.** The second aim of the sub-study is to identify potential predictor variables of baseline resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. We hypothesize that among community-dwelling stroke survivors diagnosed with stroke in the past 12 months, female gender will be associated with lower baseline resilience, age will be positively correlated with resilience, and symptoms of anxiety and depression will be inversely correlated with resilience. Predictors of resilience will be evaluated from the baseline data of the entire sub-study sample. The predictors of resilience will include seven demographic variables: age, gender, race, education, marital status, income, and religious beliefs. Clinical variables assessed as predictor variables will include type of stroke and time since stroke. Psychological variables will include symptoms of anxiety (score on the STAI-Y) and symptoms of depression (score on the CES-D). Univariate analysis will be utilized to evaluate the relationship between resilience and each predictor variable. The
relationship between gender and resilience will be analyzed with an independent t test, with \( \alpha \leq 0.10 \) required for inclusion in the multivariate model. The bivariate correlation between the remaining predictor variables and resilience will be determined with the Pearson product-moment correlation (for continuous data) or the Spearman rank-order correlation coefficient (for categorical data) (Hawkins, 2014). Multiple linear regression analysis will then be utilized to develop the model which best predicts resilience based on the variables with the highest correlations to resilience. The analysis of this aim will provide initial evidence regarding predictor variables of resilience in stroke survivors.

**Timeline.** The timeline for this study is depicted in Table 1.

**Limitations and alternative strategies.** A sub-study can be associated with certain limitations. First, study completion is contingent upon the recruitment and retention of stroke survivors in the parent study. The MEND study is currently on schedule regarding the recruitment and data collection for stroke survivors. In case of a delay in MEND study completion, the dissertation defense will be changed to accommodate graduation in August 2019 rather than May 2019. Recruitment and retention may be impacted by the need for participants to return to the medical center for study sessions and data collection. A nonprobability convenience sample may result in selection bias. In addition, sampling in a single stroke clinic limits generalizability of study findings.

The main potential problem is that the hypothesis for Aim 1 will test invalid. The data analysis for the effect of meditation on resilience focuses on within group measures, which can result in history and maturation threats to
internal validity. The final sample size could also impact the validity of findings, particularly in consideration of the anticipated small to medium effect size. In addition, valid findings depend on the BRS ability to accurately measure and detect changes in resilience. If the hypothesis were to test invalid, we would consider these mentioned factors in the design of future research. We expect the findings from this pilot study to provide preliminary evidence regarding the effect of meditation on poststroke resilience. Our plan would be to design a larger study powered to detect between-group differences in resilience of stroke survivors.
References


training (Templestay program) on resilience to stress: A randomized controlled trial. Psychology, Health & Medicine, 1-8.

doi:10.1310/tsr2103-256

doi:10.1007/s12671-017-0758-2

doi:10.1177/2156587215575816 [doi]

doi:10.1089/acm.2014.0281


doi:10.1161/STROKEAHA.112.658211


Table 1:

*Timeline*

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February 15, 2018

*Stroke: A Journal of Cerebral Circulation*

RE: Manuscript “Mind-Body Interventions and Psychological Stress in Stroke Survivors: A Systematic Review”

On behalf of all authors, please find the required documents submitted for publication consideration. All authors have read and approved the submitted manuscript, the manuscript has not been submitted elsewhere nor published elsewhere in whole or in part, except as an abstract. The authors have no conflicts of interest to report and have adhered to all authorship and ethical adherence best practices.

Contact information for the corresponding author is as follows:

Mary F. Love: Mary.F.Love@uth.tmc.edu at The University of Texas Health Science Center at Houston, Cizik School of Nursing, 6901 Bertner Avenue, Suite 540, Houston, TX 77030. 281-242-0336

Thank you for your time and consideration.

Sincerely,

Mary F. Love

Mary F. Love, MSN, RN
The University of Texas Health Science Center at Houston
Cizik School of Nursing
6901 Bertner Avenue, Suite 540
Houston, TX 77030
July 5, 2018

*Stroke: A Journal of Cerebral Circulation*


On behalf of all authors, please find the required documents resubmitted for publication consideration. All authors have read and approved the resubmitted manuscript, the manuscript has not been submitted elsewhere nor published elsewhere in whole or in part, except as an abstract. The authors have no conflicts of interest to report and have adhered to all authorship and ethical adherence best practices.

Contact information for the corresponding author is as follows:

Mary F. Love: [Mary.F.Love@uth.tmc.edu](mailto:Mary.F.Love@uth.tmc.edu) at The University of Texas Health Science Center at Houston, Cizik School of Nursing, 6901 Bertner Avenue, Suite 540, Houston, TX 77030. 281-242-0336

Thank you for your time and consideration.

Sincerely,

Mary F. Love, MSN, RN
The University of Texas Health Science Center at Houston
Cizik School of Nursing
6901 Bertner Avenue, Suite 540
Houston, TX 77030
October 4, 2018

*Stroke: A Journal of Cerebral Circulation*


Please note the above is a title change from the originally submitted manuscript which was titled “Mind-Body Interventions and Psychological Stress in Stroke Survivors: A Systematic Review.”

On behalf of all authors, please find the required documents resubmitted for publication consideration. All authors have read and approved the resubmitted manuscript, the manuscript has not been submitted elsewhere nor published elsewhere in whole or in part, except as an abstract. The authors have no conflicts of interest to report and have adhered to all authorship and ethical adherence best practices.

Contact information for the corresponding author is as follows:

Mary F. Love: Mary.F.Love@uth.tmc.edu at The University of Texas Health Science Center at Houston, Cizik School of Nursing, 6901 Bertner Avenue, Suite 540, Houston, TX 77030. 281-242-0336

Thank you for your time and consideration.

Sincerely,

Mary F. Love

Mary F. Love, PhD(c), MSN, RN
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Cizik School of Nursing
6901 Bertner Avenue, Suite 540
November 29, 2018

*Stroke: A Journal of Cerebral Circulation*


On behalf of all authors, please find the required documents resubmitted for publication consideration in *Stroke*. Please let us know if we have overlooked any of the requested formatting edits.

All authors have read and approved the resubmitted manuscript, the manuscript has not been submitted elsewhere nor published elsewhere in whole or in part, except as an abstract.

The authors have no conflicts of interest to report and have adhered to all authorship and ethical adherence best practices.

Contact information for the corresponding author is as follows:

Mary F. Love: [Mary.F.Love@uth.tmc.edu](mailto:Mary.F.Love@uth.tmc.edu) at The University of Texas Health Science Center at Houston, Cizik School of Nursing, 6901 Bertner Avenue, Suite 540, Houston, TX 77030. 281-242-0336

Thank you for your time and consideration.

Sincerely,

Mary F. Love, PhD(c), MSN, RN
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Houston, TX 77030
December 7, 2018

Ms. Mary F Love
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6901 Bertner Ave.
Houston, Texas 77030

MS ID#: STROKE/2018/021150R3
MS TITLE: Mind-Body Interventions, Psychological Stressors, and Quality of Life in Stroke Survivors: A Systematic Review

Dear Ms. Love:

We are pleased to inform you that your manuscript has been accepted for publication in Stroke.

Prior to sending the manuscript to the publisher, we ask that all material required for publication is submitted. Timely publication depends upon your compliance with these requirements. We cannot process your manuscript until all final documents have been received. Please review your submission for the following:

1. Please complete reference 34. It is missing the year.

2. Jennifer Sanner Beauchamp indicated an institutional conflict of interest on her disclosure form, but did not specify what it is. Her form will be reset so this may be corrected. Please consult her to ensure that all disclosures on her form are listed in the manuscript.

3. Final files for the text and figure are required. The acceptable format for your
manuscript text and tables is Microsoft Word. Please provide a higher-resolution file for Figure 1. Acceptable figure formats are TIFF or EPS. The figure should be at least 1200 dpi; it is currently 96 dpi. Please note that most figures will be sized at 1 column wide. Dimensions for figures are: 1 column: 3.25 inches wide (8 cm or 19.5 picas); 2 columns: 6.80 inches wide (17.272 cm or 40.8 picas).

To defray costs of publication, authors are charged $70 per printed page. No estimate of the total publication fees is provided, but authors may estimate the total cost upon receipt of page proofs. For all costs to authors, please refer to the Instructions for Authors.

During the copyediting phase, there may be some changes in phraseology, but there will be no alteration to scientific content. When you receive your galley proofs, please read, correct, and return them immediately so that publication will not be delayed.

Thank you for your valued submission to Stroke.

With kind regards,

Tatjana Rundek
Handling Editor
Stroke
Over 33% of stroke survivors develop clinically significant psychological stressors. Poststroke depression occurs in nearly one-third of stroke survivors, is the most common psychiatric sequela of stroke, and is independently associated with increased morbidity, mortality, and disability. Less is known about posttraumatic stress disorder and poststroke anxiety; however, evidence suggests that an estimated 25% of stroke survivors develop persistent symptoms of anxiety.

Whether chronic, relapsing, or remitting, psychological stressors induce harm in stroke survivors owing to associated stroke recurrence, mortality, disability, reductions in quality of life (QOL), and cognitive impairment. Neuro-immune interactions related to the activation of brain microglia and imbalances among inflammatory cytokines likely mediate critical disease-promoting behavioral risks (eg, immune responses to psychological stressors) in stroke survivors with the aforementioned psychological stressors.

Despite the high prevalence of psychological stressors and the adverse impact, many stroke survivors are ineffectively treated for psychological stressors with pharmacological agents (eg, antidepressants), and there is no consensus on the optimal agent, dosage, or timing. While the American Heart Association/American Stroke Association guidelines for stroke recovery recommend the treatment of mood and anxiety disorders, gaps exist in the treatment of psychological stressors.

Studies of mind-body interventions suggest a possible benefit on psychological stressors and quality of life; however, rigorously designed, sufficiently powered randomized controlled trials with mixed-methods design are warranted to delineate specific treatment effects of these interventions. Studies with both biological and psychological stressors as outcomes would provide evidence about interaction effects of these factors on stroke-survivor responses to mind-body interventions.

**Background and Purpose**—Psychological stressors, including poststroke depression, poststroke anxiety, and posttraumatic stress disorder, are highly prevalent in stroke survivors. Clinical and research efforts in stroke recovery focus on motor disability, speech and language deficits, and cognitive dysfunction while largely neglecting psychological stressors. Evidence suggests mind-body interventions in other chronic illness populations decrease symptoms of depression, regulate immune responses, and promote resilience, yet similar studies are lacking in stroke populations. This review aims to synthesize evidence of the effects of mind-body interventions on psychological stressors, quality of life, and biological outcomes for stroke survivors.

**Methods**—A systematic search of PubMed, PsycINFO, and CINAHL was conducted from database inception to November 2017.

**Results**—Eight studies were included in the review, with a total of 292 participants. Mind-body interventions included yoga or tai chi. Of the 5 included randomized controlled trials, most were pilot or feasibility studies with small sample sizes. Psychological stressors, including poststroke depression and anxiety, along with the quality of life, improved over time, but statistically significant between-group differences were largely absent. The 3 included studies with a qualitative design reported themes reflecting improvement in psychological stressors and quality of life. No included studies reported biological outcomes.

**Conclusions**—Studies of mind-body interventions suggest a possible benefit on psychological stressors and quality of life; however, rigorously designed, sufficiently powered randomized controlled trials with mixed-methods design are warranted to delineate specific treatment effects of these interventions. Studies with both biological and psychological stressors as outcomes would provide evidence about interaction effects of these factors on stroke-survivor responses to mind-body interventions. (Stroke. 2019;50:434-440. DOI: 10.1161/STROKEAHA.118.021150.)

**Key Words**: biological factors ■ mind-body therapies ■ quality of life ■ stress, psychological ■ stroke ■ systematic review
populations with other chronic illnesses decrease symptoms of depression, regulate immune responses, and promote resilience.

Mind-body practices, a varied group of techniques used to enhance health and well-being, are typically administered by trained practitioners. Mind-body practices, including meditation, yoga, and tai chi, which derive from ancient traditions, have been found to enhance awareness of the bidirectional connection between the mind and the body. According to the National Center for Complementary and Integrative Health, the mind’s capacity to affect bodily function and symptoms through behavior is an essential component of mind-body interventions.

The burden of stroke poses staggering costs to society. By 2030, 3.88% of the US adult population is projected to have had a stroke, and stroke-related costs are expected to reach $183 billion. Greater emphasis on recovery interventions will have both clinical and societal benefits. Therefore, we performed a systematic review of published literature to synthesize the evidence about the effects of nonpharmacological, mind-body interventions on (1) psychological stressors, (2) QOL, and (3) biological outcomes in stroke survivors.

Methods

Eligibility Criteria
We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. The authors declare that all supporting data are publicly available and appropriately cited within the article. Studies published in English were considered for inclusion if the (1) sample comprised adults 18 years or older with a history of stroke, (2) authors reported an intervention with a mind-body component implemented for the prior stroke, and (3) authors evaluated at least one psychological stressor or biological outcome. Primary studies, secondary analyses, and observational studies, including quantitative, qualitative, and mixed-methods designs, were eligible for inclusion. Studies with interventions involving pharmacological preparations or medical devices were excluded, as were unpublished studies and systematic reviews without meta-analyses.

Search Strategy
A systematic search of 3 electronic databases was conducted from the time of inception to November 2017. The search terms, which included both natural language and controlled vocabulary, were separated with boolean operator OR within each concept (mind-body intervention, psychological OR biological outcomes, and stroke population) and with boolean operator AND between the concepts. Mind-body intervention terms included mind-body therapies, yoga, tai chi, mindfulness-based stress reduction, meditation, nonpharmacological intervention, nonpharmacological treatment, mindfulness, and MBSR (Mindfulness-Based Stress Reduction). Psychological stress terms included depression, posttraumatic stress disorder, anxiety, QOL, resilience, posttraumatic stress disorder, health-related QOL, social support, loneliness, social isolation, psychosocial outcome, psychosocial factor, and optimism. Biological outcomes included biomarkers, biological factors, immune markers, inflammatory markers, immunologic markers, and inflammatory biomarkers. Population terms included stroke survivors, stroke, and poststroke. No further restrictions were placed on the searches. The search began in PubMed with combinations of Medical Subject Headings and text words, which were then converted for searches in CINAHL Plus and PsycINFO. The reference lists of eligible articles were reviewed to identify additional articles.

Study Selection and Quality Assessment
Articles retrieved were initially screened for eligibility by title by one independent author (Ms Love) to identify those appropriate for abstract review. Abstracts were independently reviewed by 2 authors (Ms Love and Dr Beauchamp), with consensus from both authors required for full-text review. The full text of articles was independently screened by both authors. Disagreements were solved by consensus between both authors.

Studies with a qualitative design were assessed with the National Institutes of Health Quality Assessment of Controlled Intervention tool. Quality review for qualitative studies was performed using the Mixed Methods Appraisal Tool.

Data Extraction and Synthesis of Results
Data extracted from each study included study setting, design, sample and sampling method, and data sources. Tools to operationalize the outcomes, statistical methods, and findings were also extracted. Data from quantitative and qualitative studies were first analyzed and synthesized separately. The results were then integrated and discussed through complementarity and divergence stances. For the quantitative randomized controlled trial (RCT) studies, we examined intervention effects by evaluating the interaction of time and group, which compares the change in outcome over time between the intervention and control groups. Results for the qualitative studies were reported as themes.

Results
As seen in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses flowchart (Figure), the search resulted in 261 articles. Initial screening of article titles resulted in exclusion of 215 articles. Of the 46 article abstracts reviewed, 18 were excluded, resulting in full-text review of 28 articles. Ten articles were excluded and ranked as poor quality based on insufficient information provided to determine the quality assessment criteria and identified risks of potential for
In all 3 qualitative studies, the data sources and analysis were included studies are detailed in Tables 2 and 3. The sample sizes ranged from 9 to 145, for a total of 292 study participants across all studies. Participants’ ages were between 24 and 91 years. Characteristics and findings of community-dwelling adult stroke survivors, most of whom had a stroke ≈ 3 to 4 years before study participation (range, 9 months to 18 years). The sample sizes ranged from 9 to 145, for a total of 292 study participants across all studies. Participants’ ages were between 24 and 91 years. Characteristics and findings of included studies are detailed in Tables 2 and 3.

Table 1. Quality: Quantitative Studies (National Institutes of Health Quality Assessment of Controlled Intervention Studies)

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</tr>
</tbody>
</table>

Quantitative Study Characteristics

The 5 RCTs reviewed in this synthesis included group mind-body interventions with either yoga, tai chi, or a combination of the two. The duration of the interventions ranged from 6 to 12 weeks, with sessions 1 to 3 times per week. Outcomes for depressive symptoms, anxiety symptoms, or QOL were measured at baseline and postintervention using self-report surveys, with baseline measures available for all studies. None of the included studies examined biological outcomes.

Quantitative Study Findings

Depressive Symptoms

None of the 4 studies that assessed the effect of mind-body interventions on depressive symptoms reported statistically significant differences in change in outcomes over time between groups. Chan et al³⁰ compared the effects of yoga plus exercise to the effects of exercise only in stroke survivors (n=17) and found significant (P<0.05) reductions in depressive symptoms over time within both groups; however, no significant differences in change in outcome over time were found between groups.

Anxiety Symptoms

Neither of the 2 studies examining anxiety symptoms reported statistically significant differences in change in outcomes over time between groups. Immink et al³⁰ studied stroke survivors with hemiparesis (n=25) and found significant reductions (P<0.045) in trait anxiety symptoms within both yoga and control groups over a 10-week period; however, no significant differences in change in outcome over time were found between groups.

Quality of Life

Four trials measured the effect of mind-body interventions on QOL; however, only Immink et al³⁰ and Schmid et al³² administered instruments developed to specifically investigate QOL in stroke survivors. Immink et al³⁰ reported significant improvements in the yoga group (n=11) over time in the physical domain (P<0.002) of the Stroke Impact Scale, but this change was not significantly different from the change in outcome over time in the control group (P=0.052).³⁰,³⁶ A significant difference in change in outcome over time for the yoga group compared with the control group was seen in the memory domain (P<0.048) of the Stroke Impact Scale.

In a sample of 145 stroke survivors, Taylor-Piliae et al²⁸ compared the effects of a tai chi intervention, a strength and range of motion exercise intervention, and usual care on QOL and found significant improvements within all groups over time in both the physical component score (P=0.04) and the mental component score (P<0.01) of the MOS SF-36 (Medical Outcome Study Short Form 36).³⁷ However, no significant differences were found in change in outcome over time between groups.²⁸,³¹

Qualitative Study Characteristics

Garrett et al³³ used an interpretative phenomenological design to study the experiences and perceived outcomes of 9 stroke survivors. The sample was recruited from stroke survivors who participated in a 10-week mind-body yoga trial.³⁰ After et al³⁴ used a descriptive approach to explore perceived changes in abilities and activities in stroke survivors after an 8-week mind-body yoga intervention.³⁶ The third qualitative study explored the experiences of stroke survivors (n=14) 6 to 18 months after participation in an RCT comparing an exercise group to a mind-body relaxation control group.³⁵ In all 3 studies, data were collected via semistructured, individual interviews.³³–³⁵ One study used focus groups for additional data collection.³⁵

Qualitative Study Findings

Three themes among yoga participants emerged from the study by Garrett et al.³³ The theme greater sensation, included reports of feeling stronger, more flexible, having better balance, and improved walking ability. The theme feeling calmer included
Table 2. Characteristics and Findings: Randomized Controlled Trials

<table>
<thead>
<tr>
<th>Citation</th>
<th>Purpose</th>
<th>Design and Sample</th>
<th>Intervention</th>
<th>Findings: Interaction of Time and Group**†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schmid et al32</td>
<td>Assess the impact of yoga on balance, balance self-efficacy, fear of falling, and QOL after stroke</td>
<td>Pilot study Yoga (n=19) Yoga Plus (n=18) Usual Care/Control (n=10)</td>
<td>Yoga: biweekly group sessions Yoga plus: yoga and home relaxation recording Usual care: waitlist</td>
<td>Duration: 8 wk Stroke-specific QOL Scale‡</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y: 33.7 (9.2); 35.8 (8.1) C: 32.7 (5.2); 33.0 (6.2) P=0.266</td>
</tr>
<tr>
<td>Chan et al29</td>
<td>Investigate the effect of supplementing exercise with yoga on poststroke symptoms of depression and anxiety</td>
<td>Pilot study Yoga/exercise (n=9) Exercise only/control (n=8)</td>
<td>Yoga: weekly group exercise plus group yoga sessions with home practice Exercise only: weekly group classes</td>
<td>Duration: 6 wk GDS-15§</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y: 4.0 (1.7); 2.0 (1.0, 5.5) C: 3.5 (2.0, 5.0); 3.0 (2.0, 3.0) STA-Y1††</td>
</tr>
<tr>
<td></td>
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<td>Y: 31.5 (29.0, 45.4); 30.5 (23.5, 35.5) C: 36.0 (33.0, 38.0); 35.5 (32.0; 38.0) STA-Y2§</td>
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<td>Y: 35.3 (27.5, 47.5); 33.5 (26.5; 45.0) C: 41.5 (40.0, 43.0) NR</td>
</tr>
<tr>
<td>Immink et al30</td>
<td>Assess the efficacy of yoga for motor function, mental health, and QOL in stroke survivors with hemiparesis</td>
<td>Mixed-methods study Yoga (n=12) Control (n=13)</td>
<td>Yoga: weekly group classes with home practice Control: waitlist</td>
<td>Duration: 10 wk GDS‡</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>Y: 3.9 (3.3); 2.7 (2.9) C: 5.8 (2.9); 4.8 (3.3) NR</td>
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<td></td>
<td>Y: 40.7 (13.4); 33.4 (7.1) C: 40.4 (11.5); 41.8 (12.2) STA-Y1††</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y: 67.3 (17.0); 74.3 (15.0) C: 67.2 (17.8); 67.5 (21.2) NR</td>
</tr>
<tr>
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<td>Y: 76.0 (22.3); 87.5 (11.0) C: 74.7 (19.8); 72.22 (0.0) NR</td>
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<td></td>
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<td>Y: 60.5 (19.1); 54.5 (15.0) C: 58.4 (18.1); 54.5 (30.0) NR</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Y: 60.5 (22.3); 79.6 (24.5) C: 58.4 (18.1); 54.5 (30.0) NR</td>
</tr>
<tr>
<td>Taylor-Piliae and Coull31</td>
<td>Assess the safety/feasibility of tai chi; describe within-group changes in physical function and QOL</td>
<td>Pilot study Tai Chi (n=16) Usual Care/Control (n=12)</td>
<td>Tai Chi: group classes 3 times weekly Usual care: Weekly telephone calls, written material about physical activity.</td>
<td>Duration: 12 wk CES-D‡</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TC: 13.9 (10.8); 11.8 (6.5) C: 12.3 (9.2); 12.9 (8.4) †</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Physical‡ TC: 36.8 (8.3); 40.5 (9.1) C: 40.2 (8.7); 38.0 (10.4) †</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Mental‡ TC: 49.6 (11.5); 55.2 (5.4) C: 51.9 (13.1); 52.7 (8.3) †</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>SF-36: Physical‡ TC: 37.4 (8.4); 38.2 (9.9) C: 37.1 (8.9); 38.6 (10.5) †</td>
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<td></td>
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<td></td>
<td>SF-36: Mental‡ TC: 49.7 (10.9); 52.8 (10.3) SS: 51.0 (7.9); 54.0 (8.9)</td>
</tr>
<tr>
<td></td>
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<td>C: 46.8 (10.7); 51.6 (9.4)</td>
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</table>

C indicates control; CES-D, Center for Epidemiological Studies Depression Scale; GDS-15, Geriatric Depression Scale-Short Form; NR, results not reported; QOL, Quality of Life; SF-36, Medical Outcomes Study Short Form-36; SIS, Stroke Impact Scale; SS, Silver Sneakers; STA-Y, State-Trait Anxiety Inventory Form-Y; TC, Tai Chi; and Y, yoga.

*CIs not reported in individual studies.
†Intervention effects by evaluating the interaction of time and group, which compares the change in outcome over time between the intervention and control groups.
‡Baseline mean (interquartile range); postintervention mediation (interquartile range).
§P≤0.05=significance.
stroke survivors. Poststroke depression has been associated with ongoing treatment of symptoms of depression, and anxiety in the realm of mind-body practices. Additionally, the focus on mind-body interventions initiated during the early stroke recovery period may strengthen future quantitative and qualitative studies.

Most of the RCTs in this review were considered pilot or feasibility studies with inadequate power to detect between-group differences, suggesting the need for larger trials in the future. Additionally, at baseline, symptoms of depression, and anxiety did not reach diagnostic thresholds for major depressive or anxiety disorders. The inability to detect significant changes in symptoms of depression or anxiety after the mind-body intervention may be related to low baseline levels of psychological stressors. In all 5 RCTs, the final data collection point occurred immediately after the completion of the mind-body intervention. Evaluation of the psychological stressors and adherence to the mind-body intervention over extended periods of time were not addressed.

One of the included qualitative studies interviewed stroke survivors 6 to 18 months after the mind-body intervention, potentially introducing recall bias. Repeated measures designs may strengthen future quantitative and qualitative studies. Overall, the authors reported the mind-body interventions were feasible, safe, and well-tolerated by the study participants. High rates of adherence (77%–99%) and retention (78%–90%) for enrolled participants were reported in all 5 of the included RCTs. While issues recruiting study participants, including low response rate to recruitment efforts, lack of interest, and time constraints existed, between 21% and 60% of eligible subjects chose to participate.

We included studies with both quantitative and qualitative designs to provide a comprehensive view of mind-body interventions. Our focus on nonpharmacological interventions that explicitly reported a mind-body component may have excluded other therapies, such as art and music that might be considered in the realm of mind-body practices. Additionally, the focus of our review was on the stroke survivor. Notably, the majority of stroke survivors receive long-term care in the home by an informal caregiver. The psychological well-being of stroke survivors consistently self-reported improvements in psychological stressors in response to the mind-body intervention. These quantitative results support significant differences in depression, anxiety, or QOL between stroke survivors in the intervention and control groups. However, there were findings approaching statistical significance, along with participants’ comments indicative of a trend toward improvements in psychological stressors in response to the mind-body intervention. These quantitative results complement the findings of the 3 qualitative studies, in which stroke survivors consistently self-reported improvements in psychological stressors and QOL. Increased feelings of calmness and relaxation, improvements in confidence and self-reliance, and overall perceptions of improved QOL were themes that emerged from these studies.

This systematic review had limitations related to the included studies. The study samples consisted of community-dwelling stroke survivors with mild to moderate disability and mild, if any, cognitive impairment. In general, participants were white (60%–78%) men (60%) between the ages of 60 and 80. These clinical and demographic characteristics limit the generalizability of study findings and support the need for future studies of more diverse populations. In addition, recent rehabilitation guidelines from the American Heart Association/American Stroke Association recommend early, ongoing treatment of symptoms of depression, and anxiety in stroke survivors. Poststroke depression has been associated with lower levels of engagement in rehabilitation treatments, while stroke survivors with poststroke anxiety may have impairments in both social functioning and in recovery of activities of daily living. However, the mean time for study intervention initiation postacute stroke for the included studies ranged from 37 to 52.5 months. A focus on mind-body interventions initiated during the early stroke recovery period in future studies is warranted.

### Discussion

The quantitative studies included in this synthesis did not report significant differences in depression, anxiety, or QOL between stroke survivors in the intervention and control groups. However, there were findings approaching statistical significance, along with participants’ comments indicative of a trend toward improvements in psychological stressors in response to the mind-body intervention. These quantitative results complement the findings of the 3 qualitative studies, in which stroke survivors consistently self-reported improvements in psychological stressors and QOL. Enhanced feelings of calmness and relaxation, improvements in confidence and self-reliance, and overall perceptions of improved QOL were themes that emerged from these studies.

This systematic review had limitations related to the included studies. The study samples consisted of community-dwelling stroke survivors with mild to moderate disability and mild, if any, cognitive impairment. In general, participants were white (60%–78%) men (60%) between the ages of 60 and 80. These clinical and demographic characteristics limit the generalizability of study findings and support the need for future studies of more diverse populations. In addition, recent rehabilitation guidelines from the American Heart Association/American Stroke Association recommend early, ongoing treatment of symptoms of depression, and anxiety in stroke survivors. Poststroke depression has been associated with lower levels of engagement in rehabilitation treatments,
survivors and their informal caregivers appears to be interdependent.\textsuperscript{40} In fact, depression rates of informal caregivers may exceed that of the stroke survivor in the early poststroke period.\textsuperscript{41} The American Heart Association/American Stroke Association support the need for stroke survivor-informal caregiver dyad intervention studies, including nonpharmacological trials focused on impacting psychological stressors.\textsuperscript{39} We considered the paucity of mind-body research in the stroke survivor and view our systematic review as an essential step highlighting the need for rigorous mind-body trials in this vulnerable population. Last, our synthesis included only articles published in English and articles meeting our critical appraisal of quality assessment and was, therefore, subject to selection bias.

The poststroke period is a critical time in which to intervene. Although multiple guidelines exist recommending identification and treatment of psychological stressors to improve meaningful outcomes in the stroke population,\textsuperscript{12,42,43} it is important to note that gaps remain. Inflammatory biomarkers are implicated in stroke pathophysiology and serve as potential objective outcomes for mind-body interventions,\textsuperscript{7,44} yet the investigation of biological changes in response to mind-body interventions is absent in the poststroke population. The investigation of biological outcomes in mind-body intervention studies may provide evidence about the interaction between psychological stressors and biological risk factors in stroke survivors, assist in defining recovery biomarkers, and identify stroke survivors most likely to benefit from mind-body interventions. Additionally, the inclusion of autonomic outcomes such as heart rate variability or blood pressure would also be particularly relevant for the stroke population. In an American Heart Association scientific statement summarizing alternative treatments for hypertension, transcendental meditation was the only mind-body intervention with evidence supporting blood pressure reduction.\textsuperscript{45}

While symptoms of mood and anxiety disorders are common sequelae of stroke and warrant interventions to improve mental health outcomes, previous studies indicate other stroke-survivor needs which may benefit from mind-body interventions. For example, studies have indicated sleep disturbances, and fatigue are common and distressing symptoms after stroke.\textsuperscript{46,47} Both adversely affect participation in rehabilitation and QOL.\textsuperscript{46,47} However, sleep disturbances were only examined in 2 of our included studies with no significant findings reported.\textsuperscript{28,31} Given the impact of sleep disturbances and fatigue on poststroke outcomes, early intervention should be considered. Similar to mind-body intervention studies for psychological stressors, mind-body interventions are likely to be potentially effective for poststroke sleep disturbances and fatigue; however, more evidence is needed in the stroke population.\textsuperscript{48,49}

**Conclusions**

Perhaps the most important implication of our review is the finding of a trend toward improvements in psychological stressors and QOL associated with mind-body interventions in stroke survivors. However, the dearth of rigorously designed studies of mind-body interventions in stroke survivors renders further investigation a high priority. While there are signals of mind-body intervention treatment effect, rigorously designed studies with appropriately powered sample sizes and mixed methods are necessary to change clinical guidelines for treatment of stroke survivors.

Our review points the need to delineate essential treatment components in mind-body interventions, discern the adequate duration and dosage of interventions, examine long-term adherence and standardized outcomes, and consider stroke survivor-informal caregiver dyad mind-body interventions. The investigation of biological, autonomic, and other highly relevant outcomes, including sleep disturbances and fatigue, in mind-body intervention studies, is lacking and may provide evidence about the impact of mind-body interventions on a variety of outcomes important for optimal stroke recovery. Further research on mind-body interventions in stroke survivors and their informal caregivers is warranted.

**Acknowledgments**

Appreciation is expressed to Stanley Cron, Jeffrey Rando, and Markeda Wade for their article critique.

**Disclosures**

None.

**References**

Letter by Braillon and Marron Regarding “Mind-Body Interventions, Psychological Stressors, and Quality of Life in Stroke Survivors”

People almost invariably arrive at their beliefs not on the basis of proof but on the basis of what they find attractive.

—Blaise Pascal, “The Art of Persuasion”

To the Editor:

Love et al1 review about mind-body interventions in stroke survivors deserved robust comment.

First, the claim evidence suggests mind-body interventions in other chronic illness populations decrease symptoms of depression, regulate immune responses, and promote resilience overlooked several reviews, including from Cochrane, about various conditions concluding that there was a low or low quality of the evidence because of small number of trials, small numbers of patients, inconsistency in the use of outcome measures, short term follow up, poor blinding, insufficient details about randomization, lack of adequate control (either sham intervention for phase II trials or evidence-based treatments such as cognitive behavioural therapy or pharmacotherapy for phase III trials), among many other flaws and limitations.2,3

Second, anxiety, depression, posttraumatic stress disorders, motor and sensory disabilities, and poor quality of life, are serious conditions, sometimes severe, which deserve much more than mind-body interventions, which are heterogeneous alternative or complementary practices including autogenic training, meditation, prayer, auto-suggestion, tai-chi, and yoga. At the best they could only have specific effect with a small effect size on subjective outcomes.

Third, Love et al1 pledge for further studies must not lead to unconventional practices becoming the response for long-term needs of stroke survivors and of their caregivers even more, as too often basic resources are not adequate.

France has just hit rock bottom despite being the country of Pascal and also of Descartes the founder of 17th-century continental rationalism: the French agency for drug safety (ANSM) just recommended mind-body interventions for another most serious condition, patients with alcohol use disorders.4 PubMed searches cannot retrieve hits for “body mind interventions” AND “addiction” or “alcohol”; (2) cognitive behavioural therapies, social network, and environment-based therapies are the only recommended psychological interventions.

Sugarman warned that human physical and social biology are far more relevant areas of study for doctors than old philosophies based on superstition or irrationality, they may be detrimental to doctors, and therefore to patients.5

Disclosures

Dr Braillon is an expert for several working groups at the French drug agency (ANSM, Agence nationale de sécurité du médicament et des produits de santé), none related to the topic. Friends of Science in Medicine was formed “to emphasise the importance of having health care in Australia based upon evidence, scientifically sound research and established scientific knowledge” (http://www.scienceinmedicine.org.au). The other author reports no conflicts.

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University Hospital
Amiens, France

Loretta Marron, BSc
Friends of Science in Medicine
Queensland, Australia

References

5. Sugarman PA. Mind and body split. Philosophy can be detrimental to doctors. BMJ. 2003;326:601. doi: 10.1136/bmj.326.7389.601/b

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Stroke is available at https://www.ahajournals.org/journal/str

DOI: 10.1161/STROKEAHA.119.024973
Letter to the Editor

Stroke welcomes Letters to the Editor and will publish them, if suitable, as space permits. Letters must reference a Stroke published-ahead-of-print article or an article printed within the past 4 weeks. The maximum length is 750 words including no more than 5 references and 3 authors. Please submit letters typed double-spaced. Letters may be shortened or edited.

Response by Beauchamp et al to Letter Regarding Article, “Mind-Body Interventions, Psychological Stressors, and Quality of Life in Stroke Survivors”

Doubtless you are curious to discover how and why, in the face of expert opinion to the contrary, we have recovered from a hopeless condition of mind and body.

W. Bill, Alcoholics Anonymous Big Book

In Response:

First, we want to thank Braillon and Marron for their letter in response to our publication in Stroke titled, “Mind-body interventions, psychological stressors, and quality of life in stroke survivors.”1 We strongly believe these discussions help us shed light on the importance of understanding and caring for people struggling with psychological stressors while living within the aftermath of stroke.

Second, the author’s assertion that we failed to acknowledge the methodological issues in previous studies is erroneous. Our primary conclusion recognizes that studies to date merely suggest signals of treatment effects from mind-body interventions on psychological stressors and quality of life; however, rigorously designed trials are lacking. We strongly disagree with Braillon and Marron because we believe rigorously designed trials should be conducted and are necessary to permit any conclusions to be drawn on the effectiveness of these specific mind-body interventions. We defend that we should not conclude evidence of absence based solely on the absence of evidence when mind-body interventions have a potential to make a clinically significant impact on mental health.

Third, the idea that psychological stressors deserve much more than mind-body interventions immensely diminishes the opportunities the research community has to offer and provider further evidence of these interventions to manage the complex, poststroke psychological stressors. The implication that further mind-body study in stroke survivors and their informal caregivers may lead to “unconventional practices becoming the response for long-term needs” or to “detrimental” outcomes is a very narrow viewpoint. Health care providers should consider that poststroke psychological stressors can be better managed by recognizing the importance of discussing and considering pharmacological and nonpharmacological treatment options with patients before deciding the best approach to care.2 Given that one size never fits all and the unsatisfactory outcomes of many existing pharmacological therapeutic modalities for psychological stressors, should not the management of poststroke psychological stressors include an integrated recovery plan? Poststroke recovery plans should include a range of treatments that are most appropriate for individual patients.3

Lastly, Braillon and Marron imply that studies on mind-body interventions for addiction and/or alcoholism were omitted. We found searching for specific mind-body interventions rather than the overall category of mind-body to be fruitful. While substance use disorders were not the focus of our systematic review, we would be remiss if we failed to mention the important work conducted by Dr Marianne Marcus and others on mind-body behavioral therapies in therapeutic communities for substance use disorders and behavioral addictions, which emphasizes the importance of mind-body approaches to care in these complex patient populations.4,5

Disclosures

None.

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References

Resilience Predictors in Cardiovascular Disease: A Systematic Review

Mary F. Love, PhD(c), MSN, RN; Geri LoBiondo Wood, PhD, RN, FAAN; Diane Wind Wardell, PhD, RN, APRN; Jennifer E. Sanner Beauchamp, PhD, RN, FAAN

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3. Diane Wind Wardell, PhD, RN, APRN, Cizik School of Nursing, The University of Texas Health Science Center at Houston, 6901 Bertner Avenue Houston, TX 77030

4. Jennifer E. Sanner Beauchamp, PhD, RN, FAAN, Cizik School of Nursing, The University of Texas Health Science Center at Houston, Houston, Texas; 6901 Bertner Avenue Houston, TX 77030

Tables:1; Figures:1

Word Count: 6607

Conflicts of Interest and Sources of Funding: None
Abstract

Background and Purpose

Resilience, the ability to rebound from stress, adversity, or trauma, is influenced by psychological, social, behavioral, and biological factors. A diagnosis of cardiovascular disease can be a stressful or even traumatic event that challenges patients physically and psychologically. The purpose of this systematic literature review is to synthesize the evidence for factors influencing resilience among patients with CVD.

Methods

A systematic search of PubMed, PsycINFO, and CINAHL was conducted from database inception to July, 2018. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines were followed for the review, and study quality was evaluated with the National Institutes of Health Study Quality Assessment Tools.

Results

A total of 622 articles were retrieved for review. Of the 47 articles retained for full text assessment, 22 were deemed eligible for inclusion in the review. Most of the studies were observational, with sample sizes from 11 to >237,000 participants. Psychological factors of depression, anxiety, and perceived stress were inversely associated with resilience, while self-care behaviors were positively associated with resilience.
Summary

Screening for psychological responses, including resilience, at regular intervals during the first year of CVD recovery could facilitate identification of patients at risk for poor outcomes. Further research is needed regarding factors influencing resilience among CVD patients, including the effect of theory-driven interventions on resilience.

Key Words: Resilience; Psychological Resilience; Cardiovascular Disease; Myocardial Infarction; Stroke; Stress
Approximately 17.7 million people died worldwide due to CVD in 2015, resulting in 31% of all global deaths and 37% of deaths among those younger than 70 (1). The prevalence of CVD will likely increase due to greater exposure to lifestyle-related cardiovascular risk factors in developing countries, higher prevalence of obesity, diabetes, and an aging population in developed countries, and trends for increasing risk factors of obesity, diabetes, and diabetes among children and adolescents (1-3). A CVD diagnosis can be a stressful, traumatic or even life-threatening event that results in acute psychological distress for survivors, including symptoms of posttraumatic stress disorder (4-7). Treatments, both medical and surgical, for CVD can also be sources of stress for patients diagnosed with CVD (5). Secondary prevention of CVD has historically focused on traditional cardiac risk factors, which includes medical management of biological factors (hyperlipidemia, hypertension, diabetes) and behavioral factors (smoking, diet, sedentary lifestyle) (8). The incidence and prognosis of CHD is also impacted by nontraditional psychological (depression, anxiety, hostility, Type D personality) and social (low social support, social isolation, low socioeconomic status) risk factors (8-10). These psychological and social factors can negatively impact quality of life and adherence to essential treatments, including self-care behaviors, among CVD patients (8-10).

Resilience has been described as a dynamic process of positively adapting to or managing significant stress, trauma, or adversity (11). Resilience research in adults was initially influenced by research findings on children who demonstrated positive adaptation despite adversity (11). As interest grew in adult
resilience, self-report scales to measure adult resilience emerged based on conceptual definitions of the various researchers. For example, the Resilience Scale (RS) was based on resilience as a personality trait, the Resilience Scale for Adults (RSA) was developed as a measure of protective resources for healthy adjustment, the Connor-Davidson Resilience Scale was developed as a measure of stress-coping ability, and the Brief Resilience Scale (BRS) as the ability to bounce back from stress (12-15). While some researchers operationalize resilience with a specific resilience scale, other researchers utilize different scales or methods depending on their conceptualization of resilience and the context of their study.

Resilience offers a unique lens to guide research with those experiencing significant stress or adversity, such as patients diagnosed with cardiovascular disease (CVD). Psychological, social, behavioral, biological and cultural factors interact to influence how an individual responds to a stressful experience (16). These factors can vary depending on personality, age, and maturity of the individual, the specific challenge and environment, and the availability of resources (16).

Empirical evidence links several positive psychological factors to resilience in adults, including positive emotion, purpose and meaning in life, mindfulness, spirituality, and mood clarity(17-22). In contrast, psychological factors related to negative affect have been inversely related to resilience in adults, including symptoms of anxiety (17), depression (19), and perceived stress (19, 21). Social factors with positive influence on resilience in adults include
being employed (23), higher income and education (24), and social support (24, 25).

Several studies have reported an association between behavioral factors and resilience in adults. Health-promoting behaviors, including physical activity and healthy diet, have been positively associated with higher levels of resilience in patients with chronic kidney disease (23), in other chronic disease patients (26), in mothers of young children, and in older adults (19). Mindfulness meditation training (27) and online mind-body training (20) have been associated with increased resilience in healthy adults. Active coping has also been associated with higher levels of resilience in adult populations (24), and in a mixed sample of adults that included cardiac rehabilitation patients (22).

Few studies have focused on the relationship between biological factors and resilience. According to Panter-Brick, biological factors with potential influence on resilience include physiological measures such as blood pressure, and biomarkers for stress hormones, immune function, or gene methylation (16). Preliminary evidence suggests psychological factors related to resilience, including positive emotion, purpose and meaning in life, and mindfulness, may be related to dopaminergic, serotonergic, and BDNF signaling processes in the brain (18). Cultural factors influencing resilience refer to broader contexts including factors related to family, community, race, and ethnicity (16).

A recent American Heart Association scientific statement calls for a shift in healthcare focus from “fragmented, episodic, acute care” to CVD prevention and management through “optimal” self-care (10). This change in healthcare
focus aligns with the resilience focus on assets, positive emotions, and positive adaptation rather than on deficits, negative emotions and maladaptation. The objective of this systematic literature review is to synthesize the evidence for factors influencing resilience among patients with CVD.

**Methods**

**Eligibility Criteria**

The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines were followed for this systematic review (28). Studies published in English were considered for inclusion if they met the following criteria: (a) quantitative research design, including experimental, quasi-experimental, or observational studies; (b) adult sample, aged 18 or above; (c) diagnosis of CVD; (d) resilience, including “psychological” or “stress.” Studies were eligible for inclusion if they utilized either a scale specifically designed to operationalize resilience, or a conceptual definition of resilience operationalized by other relevant scales or methods. Articles focused on related concepts (hardiness, adaptation, or adjustment), and studies of mixed populations in which findings were not separated for appropriate age or diagnosis were excluded. Qualitative studies, reviews, systematic reviews without meta-analysis, and unpublished studies were also excluded. Study methodological quality and risk of bias were assessed with the National Institute of Health Quality Assessment Tool appropriate for each individual study design, with a rating of “good” or “fair” required for review inclusion (29).
Search Strategy

The systematic database search, which was initiated in PubMed, utilized Boolean operators to combine variables represented by appropriate Medical Subject Headings and text words. Cardiovascular disease was searched with the following terms: "cardiovascular disease(s)," "myocardial infarction," "acute coronary syndrome," "heart failure," "angina pectoris," "angina," "cerebrovascular disorder(s)," "cerebrovascular disease(s)," "stroke," and "transient ischemic attack." Resilience was represented by "resilience, psychological," "psychological resilience," "resilience," and "resiliency." These terms were then converted for searches in CINAHL Plus and PsycINFO. All three databases were searched from database inception to July, 2018, with no further limits placed on the searches. A hand search was conducted of reference lists from eligible studies.

Study Selection

After removal of duplicates, retrieved articles were screened by title for potential inclusion in the review. Remaining records were then screened first by abstract and then by full-text review to determine final study inclusion for the systematic review. Studies rated "poor" in the initial review by the corresponding author (ML) were then reviewed by one of the coauthors (GLW, DW, or JEB), with consensus between the corresponding and coauthor required for study inclusion.

Data Extraction and Synthesis

Data extracted from each study included citation details; study purpose, design, sample, and setting; and data sources, including methods to
operationalize resilience. Data extracted regarding resilience included scale(s) or other methods to operationalize resilience. Data abstraction focused on predictor variables and findings related to resilience, including summary measures utilized for data analysis. Synthesis of findings is presented in the form of narrative review.

Results

A total of 622 articles (621 through database search, one via hand search) with potential for inclusion were retrieved. Removal of duplicates resulted in 477 records, of which 339 were removed after title review. Of the 138 abstracts screened for inclusion, 47 were retained for full-text assessment. Twenty-two of these studies were deemed eligible for inclusion in the review (30-51) (see Figure).

Descriptive Characteristics of Included Studies

Study characteristics, quality rating, and significant findings regarding resilience are reported in Table 1. Study designs included three quasi-experimental studies, seven cohort studies, and 12 cross-sectional studies. Diagnoses included CVD, coronary heart disease (CHD), coronary artery disease (CAD), stroke, MI, percutaneous intervention (PCI), acute coronary syndrome (ACS), and heart failure (HF). Approximately half of the studies were set in Western Europe, while the rest were set in the Americas, Asia, or Australia. Fourteen studies utilized specific tools to measure resilience, but eight studies relied on other methods to operationalize resilience (Table 1).
Four cohort studies examined existing military conscription databases (n>237,000) for Swedish men (30-33). Two large cohort studies, with sample sizes of 2147 and 954, were set in the United States (34, 35). The remaining study sample sizes ranged from 11 to 532, with the total sample for these remaining 16 studies of 3359 participants. Men comprised from 45% to 100% of the samples in which descriptive data were provided for sex. Race was specifically reported in only two studies, for a total of 116 black participants (36, 49).

**Psychological Factors**

Almost half of the studies explored the relationship between depression and resilience. Higher levels of depressive symptoms were significantly associated with lower levels of resilience in all of these studies, with significant inverse correlations between depressive symptoms and resilience ranging from $r=-0.33$ to $r=-0.87$ (36-39, 40-43). Puterman et al. (35) examined a cohort from the Heart and Soul study and found a significant relationship between major depressive disorder and lower resilience, which was associated with higher emotion suppression, weaker social connections, and less healthy behaviors among those with depression.

Mostly, symptoms of anxiety or stress demonstrated inverse relationships with resilience in CVD patients (36, 37, 41, 42). Two studies reported inverse relationships between anxiety and resilience for inpatients with CVD (37, 41), while perceived stress among CVD outpatients was inversely related to measures of resilience, including optimism and social support (36). Last, while
29% of the variance in posttraumatic stress among patients diagnosed with MI was related to resilience, there was no significant relationship between resilience and peri-traumatic stress (42).

Two studies reported trajectories that focused on psychological factors and resilience in CVD patients (34, 44). Analysis of depressive symptoms, from a period of approximately six years prior to and four years post MI, resulted in four trajectories: (a) resilient class (68%); (b) chronic depression class (14%); (c) emerging depression class (10.9%); (d) depressed-improved class (6.8%) (34). The likelihood of death within four years of MI among patients in the emerging depression class was 67% higher than that for the resilient class (34). The second study focused on the relationship between depressive symptoms, anxiety symptoms, resilience, and illness perceptions among community-dwelling CAD patients (44). In this cross-sectional study, four trajectories of illness perceptions resulted; cluster 4 (13.9%) was associated with significantly higher resilience in comparison to the other three clusters, while cluster 1 (33.1%) was associated with significantly higher levels of depressive symptoms than the other three clusters (44).

Social Factors and Demographics

None of the studies in this review focused on the influence of social factors on resilience, but several reported relationships between baseline measures of socioeconomic status and resilience. Higher income (37), higher economic status (45), and living with family (45) were all positively associated with higher resilience, while indicators of lower socioeconomic status
demonstrated significant associations with low stress resilience (30-32). The only study to evaluate gender differences in resilience reported male sex was associated with higher levels of resilience (41). Opposing findings were reported in the two studies reporting on the influence of age on resilience (37, 38). None of the studies reported any findings regarding racial or ethnic differences in resilience.

**Behavioral Factors**

Among the two studies with measures of self-care behaviors, both found moderate to large positive correlations between self-care measures and resilience (39, 45). In addition, Chang et al. (39) reported the direct and indirect effects of depressive symptoms on self-care maintenance were moderated by resilience in heart failure patients. The only studies with measures of physical activity reported low levels of physical fitness were associated with lower stress resilience (30-32).

**Biological Factors**

All of the four cohort studies of data from the Swedish military-conscription registry found low stress resilience during young adulthood (ages 18-25) was significantly associated with early CVD diagnosis, including early diagnosis of stroke (HR 1.54, 95% CI 1.40-1.70) (30, 32), CHD (HR 1.65, 95% CI 1.56-1.75) (31), and heart failure (HR 2.09, 95% CI 1.96-2.23) (33). In addition, low stress resilience among the Swedish men with early CVD diagnosis was associated with elevated systolic and diastolic blood pressure (30-32). Both of the studies with measures of biomarkers reported a protective relationship
between resilience and biomarkers associated with severity (troponin-I, myoglobin) (46) or risk (leukocytes, neutrophils, leukocyte telomere length) of CHD (35, 46).

**Intervention Studies**

Three intervention studies included in this review reported post-intervention improvements in resilience (47-49). Sun et al. (48) found significant increases in resilience among heart failure patients after a 6-month tai chi intervention, while Chan et al. (47) reported improved resilience for CHD patients after participation in an eight-week cardiac rehabilitation program. Sadler et al. (49) found “marginal increases” in resilience among stroke patients in a feasibility study of a peer-support intervention.

**Discussion**

This review focused on the influence of psychological, social, behavioral, and biological factors on resilience in CVD patients. Several of the included studies focused on psychological factors related to negative affect (e.g. depression, anxiety, and perceived stress), with consistent reports of significant inverse relationships between negative affect and resilience (35-38, 40-42). Screening for psychological responses, including resilience, at regular intervals during the first year of CVD recovery could facilitate identification of patients at risk for poor outcomes. This work should include not only negative factors, such as depression and anxiety, but also positive factors such as optimism, mindfulness, and social support.
The findings regarding illness trajectories among CVD patients, both of which included a resilience trajectory, are indicative of the complexity of psychological responses among CVD patients (34, 35). Consideration of psychological trajectories among CVD participants provides an opportunity to personalize therapy based on individual patient needs. For example, the trajectories identified by Galatzer-Levy & Bonnino (34) suggest the importance of strategies to support resilience or to treat emergent depression among patients with CVD. The work by Kunschitz et al. (35) could also guide interventions targeted at specific patient needs. Patients in the trajectory with highest level of depressive symptoms might benefit from mind-body therapies (in adjunct to pharmacological treatment) to ameliorate emotional distress, while those with a trajectory of poor understanding of CVD might benefit from strategies to increase disease understanding and adherence to prescribed lifestyle changes (70). Further research regarding such trajectories could provide further insight regarding the interaction of relevant factors among CVD patients.

Even though minimal evidence was reported regarding the influence of social, behavioral and biological factors on resilience, the findings for these factors were mostly consistent between studies (30-32, 35, 39, 45, 46). Social factors associated with lower resilience, including low social support and low socioeconomic status, also negatively impact CVD prognosis. In addition, self-care behaviors, including symptom management, adherence to medications, and risk factor modification through appropriate lifestyle changes, can have significant effects on morbidity and mortality of CVD patients (3). Interventions to promote
resilience could enhance self-care behaviors among CVD patients. Both studies of self-care behaviors in CVD patients reported a positive association with resilience (39, 45). While further research is warranted, both the peer-support intervention study (49) and the tai chi intervention study (48) included in this review have a theoretical basis to enhance resilience.

A potential biological protective effect of resilience on risk and severity of CVD was seen in the relationships between resilience and biomarkers for inflammation, severity of MI, and telomere length (35, 36). The findings regarding the association between low stress resilience in young adulthood and increased risk of early CVD diagnosis point to interactions between biological, psychological, and behavioral factors (30-33). Further research is needed to explore relationships between resilience and neuroendocrine, autonomic, and immune responses in patients with CVD, with particular attention to race, ethnicity, and social class. While cultural factors influencing resilience, including family, community, and ethnicity, were not explicitly addressed in any of the included studies, the diversity of geographic settings of included studies represent a variety of cultural factors. The studies in this review utilized a variety of methods to measure resilience. Regardless of how resilience was measured in the individual studies, the conceptual and operational definitions of resilience included some or all of the following factors or attributes: (a) personal competence/ self-efficacy, (b) social support and connections, (c) adaptive coping, (d) a positive outlook, (e) purpose or meaning in life, and (f) emotional regulation.
Limitations

The inclusion and exclusion criteria regarding the resilience construct were thoughtfully chosen with consideration of the current state of resilience research. Other reviewers might come to different conclusions regarding factors influencing resilience in CVD patients based on different inclusion and exclusion criteria for the resilience construct. In addition, only studies with a quality rating of “fair” or “good” were included in this review. While a specific tool was utilized to make these distinctions, some of the studies excluded for poor quality might have been included by different reviewers.

This review only included published studies, which may have resulted in publication bias, and the exclusion of studies with a qualitative design was also a limitation. Selection bias and response bias may have influenced the conclusions drawn within individual studies. Most of the studies were observational, which limits the ability to determine causality or directionality between resilience and influencing factors among patients with CVD. However, the quality of the databases utilized in the large cohort studies minimized the risk of information or misclassification bias and improved the rigor of these studies. The twenty-two studies in this review included participants from Asia, North America, South America, Western Europe, and Australia. Even so, a majority of the participants were white males, thus limiting generalizability of findings to women and minority populations. Also, most of the studies were conducted in more developed countries, limiting the generalizability to less developed countries. Further research should prioritize inclusion of more diverse populations, such as women,
minorities, and residents of low- and middle-income countries, to provide understanding of the factors influencing resilience in CVD in these populations.

Conclusions

Resilience has particular relevance for patients diagnosed with CVD. In addition to responding to the stressful or even traumatic nature of a stroke, ACS, or other CVD diagnosis, patients are also expected to engage in new behaviors including adherence to medication, changes in behaviors such as diet, exercise, and smoking, and adherence to rehabilitation programs. Strategies to enhance resilience have potential to improve outcomes for these patients. This review provides preliminary evidence for factors influencing resilience in the CVD population. Research is needed to further delineate the relationship of these factors with resilience, and to explore interventions to promote resilience among patients suffering from CVD.
References


27. Hwang WJ, Lee TY, Lim KO, Bae D, Kwak S, Park HY, Kwon JS. The effects of four days of intensive mindfulness meditation training (templestay program) on resilience to stress: a randomized controlled trial. Psychol Health Med 2017;1-8


47. Chan IWS, Lai JCL, Wong KWN. Resilience is associated with better recovery in chinese people diagnosed with coronary heart disease. Psychol Health 2006;21(3):335-49.


<table>
<thead>
<tr>
<th>Citation</th>
<th>Study Design, Sample, Setting, Quality Rating (++, fair, ++++, good)</th>
<th>Resilience Measure</th>
<th>Statistical Modeling</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bergh, 2016 (30)</td>
<td>Cohort+++</td>
<td>N=237,879 men age 18-21 at military conscription</td>
<td>Stress resilience score based on interview and psychological exam</td>
<td>1.Unadjusted Cox regression model</td>
</tr>
</tbody>
</table>
| Stroke between ages | Summary disease score at conscription | Bergh, 2015 Cohort+++ (31) | Stress resilience score based on interview and psychological exam | Significant association between low stress resilience at young adulthood and early diagnosis:  
|---------------------|--------------------------------------|-----------------------------|------------------------------------------------------------------|----------------------------------------------------------------------------------|
| N=237,879 men age 18-21 at military conscription | 1. Unadjusted Cox regression model | N=10,581 men subsequently diagnosed with CHD in middle age (Sweden) | HR (95%CI) | CHD:  
|                     | 2. Adjusted model for birth year, region, parental SEI, household crowding, cognition, SBP, DBP, CVD diagnosis, physical fitness, BMI at adolescence | | | 1. 1.65 (1.56-1.75)  
|                     |                                      |                            |                    | 2. 1.17 (1.10-1.25)  
|                     |                                      |                            |                    | Fatal MI:  
|                     |                                      |                            |                    | 1. 2.32 (1.86-2.89)  

Ischemic stroke: 1.46 (1.08-1.98); Hemorrhagic stroke: 1.67 (0.88-1.48)
2. 1.49 (1.16-1.90)

Angina:

1. 1.67 (1.56-1.80)
2. 1.18 (1.08-1.28)

Fatal CHD:

1. 2.29 (1.94-2.71)
2. 1.52 (1.27-1.83)

Significant association between low stress resilience at young adulthood and low cognitive function (p<.001); BMI, high or low (p<.001); SBP, high (p=.026); DBP, high (p<.001); low parental SEI (p<.001);
Bergh, 2014 (32)  

**Cohort+++**  
N=237,879 men age 18-21 at military conscription  
N=3411 subsequently diagnosed with stroke in middle age (Sweden)  

<table>
<thead>
<tr>
<th>Stress resilience score based on interview and psychological exam</th>
<th>1. Unadjusted Cox regression model</th>
<th>Significant association between low stress resilience at young adulthood and early diagnosis:</th>
</tr>
</thead>
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<tr>
<td><strong>N=3411</strong></td>
<td><strong>Sr</strong></td>
<td><strong>1.54 (1.40-1.70)</strong></td>
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<tr>
<td>subsequently diagnosed with</td>
<td></td>
<td><strong>Fatal stroke:</strong></td>
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<tr>
<td>Hemorrhagic stroke:</td>
<td></td>
<td><strong>1.76 (1.41-2.20)</strong></td>
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<td></td>
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<td><strong>2. 1.28 (1.00-1.63)</strong></td>
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<tr>
<td>Edward (43)</td>
<td>Cohort++</td>
<td>Connor-Davidson Resilience Scale (CD-RISC)</td>
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<tr>
<td>N = 51 participants with CAD and PCI, data collection at six months and 12 months post-PCI</td>
<td>Male = 80%</td>
<td>Female = 20%</td>
</tr>
</tbody>
</table>

Ischemic stroke:
1. 1.41 (1.24-1.60)
2. 1.08 (0.94-1.24)
<table>
<thead>
<tr>
<th>Study</th>
<th>Cohort</th>
<th>Description</th>
<th>Analysis Model</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robertson (33)</td>
<td>Cohort+++</td>
<td>Stress resilience score</td>
<td>1. Adjusted Cox regression model for age at conscription, conscription year, and test center</td>
<td>Significant associations between low stress resilience at young adulthood and early diagnosis:</td>
</tr>
<tr>
<td></td>
<td>N=1,784,450 men</td>
<td>based on interview and psychological exam</td>
<td></td>
<td>HR (95%CI)</td>
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<td></td>
<td>N=9962 men</td>
<td>subsequently diagnosed with early HF</td>
<td></td>
<td>HF:</td>
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<td></td>
<td>(Sweden)</td>
<td></td>
<td></td>
<td>1. 2.09 (1.96-2.23)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>2. 1.41 (1.30-1.53)</td>
</tr>
<tr>
<td>Galatzer-Levy (34)</td>
<td>Cohort+++</td>
<td>Resilient trajectory=no</td>
<td>Latent growth mixture modeling for trajectories</td>
<td>Four significant trajectories:</td>
</tr>
<tr>
<td></td>
<td>N=2147 participants</td>
<td>increase in depressive symptoms</td>
<td></td>
<td>Resilience: $b=1.59$, SE=0.10, p&lt;.001</td>
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<tr>
<td>Study</td>
<td>Population</td>
<td>Depressive Symptoms</td>
<td>Chronic Depression: $b=5.53,$ SE=0.59, $p&lt;.001$</td>
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<tr>
<td>Retirement Study with MI</td>
<td>Male: 49% Female: 51% (United States)</td>
<td>Emerging Depression: $b=2.41,$ SE=0.37, $p&lt;.001$</td>
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<td>Depressed Improved: $b=1.85,$ SE=0.56, $p&lt;.001$</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Death rate within four years of MI, emerging depression compared to resilience: $b=0.52,$ SE=0.17, $p=.003$ OR 1.67 (95% CI 1.19, 2.35)</td>
<td></td>
</tr>
</tbody>
</table>

Meister (42) Cohort++ RS Hierarchical linear regression for posttraumatic stress, adjusted for age, sex, history of depression ($p=.046$) Low resilience associated with higher resilience significantly associated with lower levels of
<table>
<thead>
<tr>
<th>Puterman Cohort+++</th>
<th>N=948 participants with CVD from the Heart and Soul Study.</th>
<th>Multi-system resiliency: standardized scores for emotion regulation, social connection, and healthy behaviors (sleep, physical activity)</th>
<th>1. Linear regression model adjusted for sociodemographic factors, health conditions, medication use, BMI, smoking, left ventricular ejection fraction,</th>
<th>1. Higher resilience significantly associated with longer telomere length (LTL) $\beta = 0.10$, $p = .003$</th>
<th>2. Resilience moderated interaction of MDD and telomere length: $\beta=148.12$, SE=63.06, $p=.02$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female: 17%</td>
<td></td>
<td>education, peak trauma distress, previous MI, history of depression, resilience</td>
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<tr>
<td>Mean age: 59</td>
<td></td>
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<td></td>
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<tr>
<td>(Switzerland)</td>
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</table>
2. Moderation analysis of mean-centered resiliency on the inverse association between MDD and LTL

<table>
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<tr>
<th>Arrebola- Moreno (46)</th>
<th>Cross-sectional++</th>
<th>RS</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=134 inpatients with ACS</td>
<td>Men:82%</td>
<td>Women:18%</td>
</tr>
<tr>
<td>Mean age: 62 (Spain)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Univariate analysis: Significant inverse correlations between RS self-efficacy and troponin-I (r=-.21), leukocytes (r=-.19)

2. Logistic regression model for troponin-I, adjusted for ST elevation, inflammatory markers, classic risk factors, RS self-efficacy associated with lower levels of troponin: r=-.21*, OR 5.04, p=.003
3. Higher levels of RS self-efficacy associated with lower levels of myoglobin: OR 3.55, p=0.01

3. Model for myoglobin, adjusted for ST elevation, inflammatory markers, classic risk factors, RS self-efficacy, RS, purpose, RS cognitive avoidance

Artinian (36) Cross-sectional+++ Stress resilience: 1. Univariate analysis: 1. Lower levels of: optimism
N=112 CR Measured with Kruskal-Wallis or (p<.0001), adaptive coping
participants LOT, (p=.05), and social support
Barreto (40) Cross-sectional+++ RS 1. Univariate analysis: 1. Lower resilience significantly associated with depression
N=137 inpatients with CVD diagnosis
Men: 67%
Women: 33%
Mean age: 52
(Brazil)

Lower resilience significantly associated with depression: OR 0.13*, (95% CI 0.02-0.81) (p=0.029)

1. Lower optimism significantly associated with depression: OR 0.13*, (95% CI 0.02-0.81) (p=0.01) significantly associated with depression

Race: 100% African American
Men: 45%
Women: 55%
Age range: 52-68
(United States)
<table>
<thead>
<tr>
<th>Carvalho (41)</th>
<th>Cross-sectional++</th>
<th>RS</th>
<th>Univariate analysis with independent t-test</th>
<th>Resilience higher (p = .027) for men than women; lower resilience (p&lt;.042) associated with anxiety in women; lower resilience (p&lt;.001) associated with depression in both sexes</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=120 inpatients with CVD</td>
<td>Men: 68%</td>
<td>Women: 32%</td>
<td>Mean age: 58 (Brazil)</td>
<td></td>
</tr>
<tr>
<td>Chang (39)</td>
<td>Cross-sectional++</td>
<td>RS</td>
<td>1. Univariate analysis: Pearson correlation</td>
<td>1. Resilience significantly inversely correlated (r=-.51) with depression; resilience</td>
</tr>
<tr>
<td>N=201 participants with HF</td>
<td>Men: 70%</td>
<td></td>
<td></td>
<td>2. Moderated mediation analysis for effect of</td>
</tr>
</tbody>
</table>
Women: 30%  
Mean age: 62  
(Taiwan)  
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Resilience on direct effects of depression on self-care confidence ($r = .41$) and self-care maintenance ($r = .28$).

2. Resilience moderated effect of depressive symptoms on self-care maintenance, interaction term depressive symptoms $\times$ resilience on self-care maintenance:

$\beta = 0.02$, $SE = 0.01$, $p < .01$

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Hagglund Cross-sectional++ RS  
(51) N=49 participants with HF

1. Univariate analysis: Pearson's correlation between resilience and fatigue in

No significant association

2. Multiple linear regression for fatigue, adjusted for

univariate or multivariate analysis
<table>
<thead>
<tr>
<th>Study</th>
<th>Design Method</th>
<th>Measure</th>
<th>Method</th>
<th>Findings</th>
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</table>
| Kunschitz (44) | Cross-sectional+++ | RS-13 | Cluster analysis | Four clusters, cluster 4 associated with significantly higher resilience compared to other three clusters: 
- cluster 1 = distressed, poor illness understanding 
- cluster 2 = moderately distressed, long-time expectation 
- cluster 3 = lowly distressed, long-time expectation 
- cluster 4 = very lowly distressed, short-time expectation |
| Liu (50) | Cross-sectional++ | RS (Chinese) | Stepwise hierarchical linear regression | Resilience predictor of psychological health ($\beta = .003$, SE = .001, $p = .002$) |
| Male: 73% | psychological health, adjusted for demographic variables, clinical variables, depression, resilience significantly mediated effects of depressive symptoms on psychological health ($a \times b = -0.005$. 95% bias-corrected bootstrap CI -0.010, -0.001) |
| Female: 27% | |
| Mean age: 63 | |
| (Taiwan) | |

2. Model for physical health

<table>
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<tr>
<th>Liu (37)</th>
<th>Cross-sectional++</th>
<th>CD-RISC</th>
<th>Univariate analysis: Pearson’s correlation, independent t-test, or one-way ANOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=88 participants with AMI and PCI</td>
<td>Resilience significantly inversely correlated with depression ($r=-.87$) and anxiety ($r=-.85$); resilience significantly associated with age&lt;60 ($p=.031$) and higher income ($p&lt;.001$)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Shin (45)

Cross-sectional+++

N=532 participants with CVD

Men: 53%

Women: 47%

Mean age: 60

Cardiovascular Disease Resilience Scale

1. Univariate analysis: t-test, ANOVA
2. Model test: path analysis for effects of activity status, internal health locus of control, and resilience on YS-TOHP

1. Resilience significantly correlated with YS-TOHP ($r = 0.581$), internal locus of control ($r=0.144$), activity status ($r=0.152$); resilience associated with higher economic status ($F=14.949$, $p=.001$), living with family ($t=4.408$, $p<.001$)

2. Resilience ($\beta=0.67$, $p<.001$) associated with YS-TOHP, accounting for 37% of the variance. Internal locus control and activity status significantly
<table>
<thead>
<tr>
<th>Toukhsati (38)</th>
<th>Cross-sectional+++ N=419 participants with CVD</th>
<th>SOC 13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men: 69%</td>
<td>Mean age: 66</td>
<td>1. Univariate analysis: ANOVA</td>
</tr>
<tr>
<td>Women: 31%</td>
<td>Mean age: 68</td>
<td>2. Backwards hierarchical linear regression adjusted for demographics and SOC factors</td>
</tr>
</tbody>
</table>

1. Higher resilience associated (p<.01) with age ≥ 65; resilience significantly correlated to depression (r = -0.79) |

2. Model accounted for 65% of the variance in depression, with significance (p < .001) for comprehensibility (β = -0.24, SE=0.25), manageability (β = -0.19, SE=0.29),

(β=0.13-0.14, p≤.002) associated with resilience, accounting with 4% of the variance.
Chan (47) Quasi-experimental++ N = 67 participants in eight-week CR program with diagnoses of CHD and PTCA

Male: 64%

Female: 36%

Mean age: 63 (Hong Kong)

Composite of z scores from Chinese versions of RSES, LOT, and Mastery Scale 1. Repeated measures ANOVA for main and interaction effects of resilience and CR on outcomes

2. Multiple regression: path analysis for effect of resilience on posttraumatic growth

1. Main effects: higher resilience associated with greater improvements in mental health [F(1,65) = 6.97, p < .01], total cholesterol [F(1,65) = 3.99, p < .01], physical health [F(1, 65) = 3.04, one-tailed p < .05], total cholesterol [F(1,65) = 5.99, p < .05], LDL cholesterol [F(1,65) = 8.08, p < .01].

meaningfulness (β = -0.46, SE=0.24)
Sadler (49) | Quasi-experimental feasibility+++ | BRS | BRS scores at baseline and immediately post intervention | Resilience increased marginally (from BRS 3.6 to BRS 3.8) 

N=11 stroke survivor participants in six-week support group intervention 

Men: 64% 
Women: 36% 
Age Range: 63-87 
White=63%

= 4.39, p < .05], 6-minute walk test [F(1,65) = 14.44, p < .01]

2. Higher resilience predicted higher posttraumatic growth, $\beta=.37, p<.01$
Sun (48) Quasi-experimental++ N=41 HF participants in six-month Tai Chi intervention
Men: 52%
Women: 48%
Mean age: 69
White: 100%

RSA scores at baseline and immediately post intervention analyzed with univariate ANOVA, with Cohen’s $d$ ES
pre=31.64 ± 6.86, post=35.19 ± 4.32 (p=.01, ES=.63); Self-esteem pre=14.17 ± 2.56, post=15.51 ± 1.61 (p=.01, ES=.65)

Note. SEI=socioeconomic index; HR=hazard ratio; CI=confidence interval; CHD=coronary heart disease; SBP=systolic blood pressure; DBP=diastolic blood pressure; CVD=cardiovascular disease; BMI=body-mass index; AMI=acute myocardial infarction.
myocardial infarction; MI=myocardial infarction; CAD=coronary artery disease; PCI=percutaneous coronary intervention; CD-RISC=Connor-Davidson Resilience Scale; HF=heart failure; IQ=intelligence quotient; OR=odds ratio; RS=resilience scale; MDD=major depressive disorder; LTL=leukocyte telomere length; ACS=acute coronary syndrome; CR=cardiac rehabilitation; LOT=Life Orientation Test; YS-TOHP=Yangsaeng Traditional Oriental Health Promotion; SOC-13=Sense of Coherence-13; PTCA=Percutaneous Transluminal Coronary Angioplasty; RSES=Rosenberg Self-Esteem Scale; BRS=Brief Resilience Scale; RSA=Resilience Scale Adults; ES=effect size
Figure. Flow diagram of literature search.
The Effects of Meditation, Race, and Anxiety on Stroke-Survivor Resilience: A Secondary Analysis of Existing Data

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Twitter @uthealthstroke

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Abstract

**Purpose:** To test the effect of meditation on resilience of community-dwelling stroke survivors, and to identify resilience predictor variables in these survivors.

**Methods:** Sub-study with secondary analysis of existing data from the parent study, MEditatioN for post stroke Depression (MEND). The effect of meditation on resilience of stroke-survivors (n=20) in the intervention group was evaluated with paired samples t-test. Demographic, clinical, and psychological predictor variables of baseline resilience for all stroke survivors (n=35) were evaluated with univariate analysis and general linear modeling (GLM).

**Results:** The increase in stroke-survivor resilience scores from baseline (mean 3.46, SD=.81) to intervention completion (mean 3.57, SD 1.02) was not statistically significant (t=.60, df 19, p=.56). One-way ANOVA with Tukey post hoc analysis revealed baseline resilience was significantly lower (p=.02) for NH Black participants than for NH White participants. GLM with resilience as the dependent variable, race as a fixed factor, and trait anxiety as a covariate was significant (F3,30, p = .002), and accounted for nearly 33% of the variance in baseline resilience.

**Conclusion:** Trait anxiety and NH Black race were associated with lower resilience in these stroke survivors. Meditation interventions to enhance resilience may support stroke-survivor recovery, but further research is needed.

**Keywords:** Stroke; Resilience; Psychological; Meditation; Mind-Body Therapies; Race; Anxiety; Cerebrovascular Disorders
Introduction

Stroke, a leading cause of death and disability in the US, exerts substantial physical and psychological stress on stroke survivors(1). As a result of the stroke event, survivors may suffer from physical impairments, communicative disorders, and cognitive issues(2). Stroke may also result in psychological issues, including symptoms of depression, anxiety, and posttraumatic stress. Initial response to stroke may be characterized by apprehension and fear, while responses later in stroke recovery may include feelings of hopelessness and lack of motivation (3). Poststroke treatment focuses on rehabilitating functional impairments and preventing future stroke, resulting in significant gaps in the identification and treatment of psychological effects of stroke (1). These psychological effects, when left unrecognized, can profoundly affect the stroke survivor’s recovery.

As stroke survivors struggle to make meaning of life after stroke, the ability to draw on characteristics such as determination, perseverance, a positive outlook, hope, inner strength, and humor can facilitate recovery(2). White et al.(4) identified four trajectories in poststroke psychological recovery: resilience, ongoing mood disturbance, emergent mood disturbance, and recovery from mood disturbance. The resilient trajectory is characterized by adaptability, an ability to embrace the future, previous experiences of mastery/resilience, being optimistic rather than pessimistic, and feeling appreciative to be alive after the stroke (4). Resilience can facilitate adaptation to changes in functional abilities, and engagement in multiple health behaviors among stroke survivors (5).
**Resilience**

For this research study, resilience was conceptualized as the ability to rebound from stress or adversity(6, 7). A stressful or adverse event, such as stroke, challenges the individual physically and/or psychologically and poses a significant threat for a negative outcome(8, 9). Individuals with a resilient outcome may experience symptoms related to anxiety or depression after a stressful event, but they are able to maintain functioning despite these experiences(10). Among adult populations, positive psychological factors empirically related to resilience include positive emotion, purpose and meaning in life, mindfulness, and self-compassion(11-14).

Demographic, psychological, and clinical variables may impact resilience, but few studies have examined associations between such variables and post-stroke resilience(15). Low stress resilience in young men has been associated with higher risk of stroke during middle age (unadjusted HR 1.54, 95% CI 1.40-1.70), and with increased length of hospital stay following ischemic stroke (unadjusted HR 1.46, 95% CI 1.12-1.98(16, 17). Among patients with diagnoses of other cardiovascular diseases, including heart failure and acute coronary syndrome, depressive symptoms, anxiety symptoms, perceived stress, and posttraumatic stress have shown significant inverse relationships with resilience(18-24). Demographic factors positively associated with resilience among cardiovascular disease populations include higher income, higher economic status, male sex, and living with family(20, 22, 25). Results regarding the association of age and resilience among survivors of a cardiac event are mixed(22, 24). Moderate to large positive correlations between resilience and self-care measures have been noted in cardiovascular disease populations, including patients with heart failure(21, 25). One
published study focused on the effect of a peer-support group intervention on post-stroke resilience. Ten of the eleven participants demonstrated slight increases in resilience after completion of the 6-week intervention(26).

*Mind-body therapies*

Mind-body therapies (such as meditation, tai chi, and yoga) focus on the interactions among the brain, mind, body, and behavior(27). Mind-body therapies have been associated with improvements in psychological outcomes in the elderly, patients with chronic disease, and patients with cardiovascular diseases(28). A study of the effects of an eight-week mindfulness-based-stress-reduction program in women with cardiovascular disease found significant improvements in the intervention group for measures of anxiety, emotional expression, and reactive coping(29) A recent systematic review of mind-body interventions in heart failure retrieved only two studies with meditation as the intervention; both studies reported significant improvements for outcomes of depression and quality of life(30). While significant between-group differences are lacking, mind-body therapies have shown trends for improvement in stroke survivor quality of life, anxiety, and depression(31).

*Resilience and mind-body therapies*

Resilience, a dynamic process of adaptation in the face of considerable stress, is amenable to change through intervention(9, 32). A key component of meditation practice is cultivating mindfulness, which is defined as the nonjudgmental acceptance of the present moment(33). Empirical evidence suggests mind-body practices have the potential to improve resilience, possibly through the cultivation of mindfulness. A cross-sectional
study of 134 middle-aged and older adults indicated the effect of stressors on mental health was “buffered” by mindfulness, which was referred to as a “resiliency factor”(34). Hwang et al.(35) compared the effect of a meditation intervention with relaxation in 51 healthy adults and found a significant interaction effect for the intervention and time on both resilience and mindfulness at the three-month follow-up. A prospective cohort study of 513 health professionals with moderate to high stress levels found significant acute improvements in mindfulness (p<.001) and resilience (p<.01) after completion of online mind-body skills training (36). Significant improvements in resilience of heart-failure patients were noted after participation in a 6-month tai chi intervention(37).

Therefore, the purpose of this study was to test the effect of meditation on stroke-survivor resilience. The relationship between stroke-survivor resilience and demographic variables, psychological variables, and clinical variables was also explored. Younger age, female sex, and symptoms of anxiety and depression were expected to be associated with lower levels of resilience. The central hypothesis was that post-stroke resilience, which may be moderated by demographic, psychological, and clinical variables, would be improved by meditation practice. The underlying rationale is that meditation enhances resilience in stroke survivors by fostering mindfulness.

**Methods**

**Design**

This study was a sub-study with secondary analysis of existing de-identified data from the MEditatioN for post stroke Depression (MEND) study. MEND was a pilot randomized controlled trial regarding the effect of a four-week meditation intervention on outcomes for adult community-dwelling stroke survivors and their informal caregivers.
An expert interventionist delivered the breath-based meditation intervention in weekly group sessions for the stroke survivors and informal caregivers. Participants were recruited and enrolled at a university-affiliated stroke clinic located in a large US metropolitan city. Adult community-dwelling stroke survivors were eligible for MEND if they had experienced a stroke event within the past 12 months. Stroke survivors with severe cognitive impairment were excluded, as were those either receiving psychotherapy or practicing meditation.

**Human subjects protection**

The MEND study and this sub-study were approved by the institutional review board, and written informed consent was obtained from all participants before study enrollment, including consent for future data sharing.

**Sample**

Stroke survivors with Brief Resilience Scale (BRS) data available at baseline (T0) and immediately post-intervention (T1) were included in the analysis of the effect of meditation on resilience. All stroke survivors with baseline BRS data were also included in the analysis for predictor variables of resilience. The informal caregivers enrolled in MEND were excluded from this sub-study.

**Measures**

Available baseline measures included demographic, clinical, and psychological variables. Self-reported demographic variables examined included age, gender, race, ethnicity, education, marital status, income, and religious beliefs. Electronic health record clinical variables examined included type of stroke and time since stroke. Self-reported
psychological variables examined included symptoms of anxiety, measured with the State-Trait Anxiety Inventory (STAI-Y), and symptoms of depression, measured with the Center for Epidemiologic Studies Depression Scale (CES-D).

Baseline and post-intervention measures of resilience were also available. Resilience was measured with the Brief Resilience Scale (BRS), a self-report instrument with six items on a 5-point Likert type scale, with choices ranging from “strongly disagree” to “strongly agree” (7). The resilience level is based on the average of the responses on the six questions, after reverse coding of 3 items (38). Higher scores on the BRS correspond to higher levels of resilience. Smith et al.(7) hypothesized the BRS, which was developed to assess resilience as the ability to bounce back from stress, would be unidimensional, and related to both resilience resources and health outcomes. Multivariate analysis of the BRS resulted in a model with five variables hypothesized to influence resilience: Mindfulness, mood clarity, purpose in life, optimism, and active coping(38).

The BRS has demonstrated adequate evidence for internal consistency reliability (Cronbach’s alpha of .8 to .9) and for test-retest reliability (r=.7, one-month interval)(7). Adequate evidence for construct validity was also reported. Factor analysis (n = 354) resulted in a one-factor solution, with item loadings ranging from .6 to .9. Convergent validity was demonstrated by correlations with the Connor-Davidson Resilience Scale (CD-RISC, r =.6) and the Ego Resilience Scale (r =.5)(7).

Data analysis
Descriptive statistics were computed for the demographic, clinical, psychological and resilience variables. Data for continuous variables were inspected for normality, skewness, kurtosis and outliers. Internal consistency reliability of the BRS scale was analyzed with Cronbach’s coefficient alpha. A paired samples t-test was used to test the effect of meditation on resilience of stroke-survivors in the intervention group. Power analysis with G*Power for a two-tailed test with \( \alpha \leq .05, \beta \leq .20 \), and sample size of 20 yielded a Cohen’s d of .66 was needed to detect a statistically significant increase in resilience from baseline to immediately post-intervention(39).

Predictors of resilience were evaluated from baseline data for included stroke survivors. The univariate relationship between resilience and each predictor variable was evaluated with the appropriate statistical test (independent t-test, one-way ANOVA, Spearman rank-order correlation coefficient, or Pearson product-moment correlation) based on the measurement level (nominal, ordinal, interval) of the predictor variable. Univariate results were inspected for statistical significance (\( \alpha \leq .05 \)) and evidence of multicollinearity. General linear modeling (GLM) was used to develop the model which best explained the relationship of predictor variables to baseline stroke-survivor resilience, with a univariate significance level of \( \alpha \leq 0.10 \) required for initial GLM inclusion. Data analysis was performed with SPSS version 25(40).

**Results**

The stroke survivors in this sub-study (n = 35) were relatively young (mean 58.3 years, SD 13.9), more likely to be female (62.9%), and mostly within the first six months of stroke recovery (74.8%). Forty-nine percent of participants were non-Hispanic (NH) Black, followed by those who were NH White (34.3%) and those who were Hispanic
(17.1%) (Table 1). Internal consistency reliability testing with Cronbach’s coefficient alpha indicated adequate evidence of reliability for both baseline and post-intervention BRS (α=.8)(41). All of the interval-level variables (BRS, STAI-T, STAI-S, CES-D, age, time since stroke) met the assumptions for normality.

The small increase in stroke-survivor (n=20) BRS scores from baseline (mean 3.46, SD=.81) to intervention completion (mean 3.57, SD 1.02) was not statistically significant (t=.60, df 19, p=.56) (Table 2). Post-hoc analysis indicated BRS mean difference of .12 (95% CI -.29-.53) followed a normal distribution (skewness 1.0, SE .51; kurtosis -.20, SE .99). Post-hoc power analysis for the BRS mean difference indicated a Cohen’s d of .13 (small effect size) for this sample (n=20) with α ≤ .05 and β = .20.

Univariate analysis resulted in four predictor variables that met a priori criterion (α ≤ .10) for inclusion in multivariate analysis. As seen in Table 3, baseline resilience was inversely correlated with depressive symptoms (CES-D, r = -.32, p =.07), trait anxiety (STAI-T, r = -.51, p = .003), and state anxiety (STAI-S, r = .36, p =.05). The only other predictor variable to meet this a priori criterion was race. One-way ANOVA results for the univariate relationship between baseline resilience (BRS score) and self-reported race (NH White, NH Black, Hispanic) were statistically significant, F2,33=3.97, p<.03. Tukey post hoc analysis revealed the baseline resilience scores were statistically significantly lower (p=.02) for NH Black participants than for NH White participants. Baseline resilience was not significantly different between Hispanic and NH Black (p=.53) or Hispanic and NH White (p=.52) participants. In a post-hoc chi-square analysis of the individual BRS items, NH Black participants were significantly (p=.008) more likely than NH White participants to disagree with item 3, which endorses a shorter
recovery time from stressful events. There were no further significant relationships between baseline resilience and predictor variables, including those for resilience and sex or age.

GLM was applied to baseline stroke-survivor data, with resilience as the dependent variable, race as a fixed factor, and trait anxiety, state anxiety, and depressive symptoms as covariates. While the initial model was statistically significant ($F_{5,27} = 4.95, p=.002$), the only psychological variable with statistical significance was trait anxiety ($F_{2,27} = 9.80, p=.004$). In addition, depressive symptoms, state anxiety, and trait anxiety demonstrated high bivariate correlations ($r \geq .87-.90, p=.000$). Depressive symptoms and state anxiety were removed from the model, resulting in a final model with baseline resilience as the dependent variable, race/ethnicity as a fixed factor, and trait anxiety as a covariate. This model was statistically significant ($F_{3,30} = 6.32, p = .002$) and accounted for 33% of the variance in baseline resilience (Table 4).

**Discussion**

The effect of meditation on resilience was not statistically significant in this sample of community-dwelling stroke survivors. This finding may be related to the small sample size ($n=20$) and the small effect size (Cohen’s $d = .13$) for the observed increase in BRS scores from baseline to post-intervention. The findings from this study were expected to provide preliminary evidence regarding the effect of meditation on post-stroke resilience. Larger randomized controlled studies powered to detect between-group differences for the effect of meditation on stroke-survivor resilience are indicated.

The inverse correlations of resilience with symptoms of anxiety and depression align with previous findings in other cardiovascular disease populations (21-23, 42-44).
However, only trait anxiety remained significant in the final multivariate model. The STAI-Y was developed to measure both state anxiety, which reflects anxiety-related feelings in a particular point in time, and trait anxiety, which reflects an increased tendency to respond with anxious symptoms to situations perceived as stressful(45). Some researchers have suggested specific items on the STAI-Y trait scale actually reflect dysphoric mood, or depression, rather than anxiety, while others have questioned the scale validity due to inconsistent responses for state and trait anxiety in the face of psychological as opposed to physical threats(46). Chun et al.(47) recently reported phobic anxiety was the most prevalent type of anxiety for a cohort of stroke-survivors in the first 3 months of recovery. These differences in anxiety measures and subtypes should be considered in future studies of resilience predictor variables for stroke survivors.

**Race and age**

The significantly lower baseline resilience for NH Black stroke survivors in this study, as compared to NH White stroke survivors, is a novel finding. The demographic characteristics of this sample, which included a higher percentage of NH Black participants than seen in many clinical trials, may have provided adequate power to uncover effects not seen in other studies. NH Black survivors were also more likely than NH White survivors to “disagree” with the BRS item that endorsed a shorter time frame to recover from a stressful event. African Americans are more likely than Whites to identify stress as a risk factor for stroke; recent evidence suggests perceived psychosocial stress is associated with increased risk of stroke (48, 49).

Race-related stress, which encompasses racism and discrimination experienced by African Americans, may negatively influence resilience, but few studies have addressed
relationships between race-related stress and resilience (50, 51). The effect of race-related stress on hopelessness in adult, community-dwelling African Americans was buffered by self-esteem social support, a resilience factor described as having others to compare oneself to favorably (50). Among low-income African American men during the first year after the birth of a child, resilience resources of self-esteem, collective efficacy, and social support were negatively correlated with depressive symptoms in univariate analysis, but in the final multivariate model, experiences of racism and avoidant coping were the only significant predictors of depressive symptoms (51). Both of these studies identified collective efficacy and interconnectedness as potential resilience resources among African Americans (50, 51). To our knowledge, the only published study to specifically address resilience among African Americans with cardiovascular disease examined the relationship between resilience and baseline depression in a sample of cardiac rehabilitation participants (52). Among these African Americans with CHD, depression was associated with lower levels of resilience factors (optimism, adaptive coping, social support), and with higher levels of stress and problematic coping. As in our study, there were no significant differences in resilience between male and female sex (52). The findings in our study did not support our hypothesized relationships between younger age and female sex with lower baseline resilience for these stroke survivors. It is possible these findings are related to the overall younger age and higher prevalence of females in our sample. The age (mean 58), sex (female 63%) and racial (NH Black 49%) demographic characteristics of the MEND study sample mirror trends recently reported for the US stroke population (53). Data from the Reasons for Geographic And Racial Differences in Stroke (REGARDS) cohort indicate higher stroke mortality for Blacks in
comparison to Whites, with a hazard ratio (HR) of 4.0 at age 45, decreasing to a HR of about 1.0 at age 85(54). This racial disparity in stroke mortality was attributed to a higher incidence of stroke among Blacks rather than higher case fatalities (51). Acute stroke hospitalizations between 1995 and 2012 increased significantly for both males and females between the ages of 18-54(55), and stroke incidence increased significantly between 1993 and 2005 in both Black and White adults aged 20-54(56). This increase in stroke hospitalizations among younger patients was associated with an increased prevalence of traditional stroke risk factors, including a near doubling of the prevalence of multiple risk factors(55).

In addition to traditional risk factors, the effect of non-traditional risk factors on stroke has been explored. The impact of life course socioeconomic position (SEP) on cardiovascular events (composite of coronary heart disease and stroke) was examined in an African American cohort from the Jackson Heart Study(57). Adult SEP (education, income, wealth, public assistance), but not childhood SEP, was a predictor for adverse cardiac events in younger and female African Americans. In contrast, for a large cohort of Swedish men, the significant association between low stress resilience at ages 18-21 and higher risk of stroke between the ages of 31 and 58 was slightly attenuated by indicators of lower childhood socioeconomic status (parental occupation, household crowding), which were significantly associated with lower resilience(16).

These findings regarding stroke incidence underscore the need for primary and secondary stroke prevention efforts in both younger and NH Black populations, with attention to traditional and nontraditional risk factors. A focus Since resilience has been associated with higher levels of healthy behaviors and self-care measures in other
populations, including those with CVD diagnoses, strategies to enhance resilience might also improve adherence to self-care measures among stroke survivors. Of race-related stress, potential racial differences in stroke-survivor resilience, including the relationships between resilience and psychological factors, social factors, and race-related stress, should be explored in larger samples of diverse stroke populations. Attention to the reliability and validity of conceptual and operational definitions of resilience among racially diverse populations will provide rigor to these future studies. The effects of theory-driven interventions, such as those focused on social support, coping strategies, or meditation, on stroke-survivor resilience should be tested in diverse populations that include racial and ethnic minorities, women, and younger stroke survivors.

**Strengths and limitations**

A sub-study with secondary analysis of existing data is associated with both strengths and limitations. The MEND study was a rigorously designed pilot study with adequate randomization and allocation concealment. Almost half of the MEND stroke survivors were NH Black, nearly two-thirds were female, and the mean age was 58. These demographic characteristics of the MEND participants were also a strength, providing preliminary evidence regarding stroke-survivor resilience in this more diverse population. The meditation interventionist was an expert in the field, and intervention fidelity measures were adhered to throughout the study. The BRS instrument, which was included in the MEND data collection, aligned conceptually with the meditation intervention and the sub-study research question.
However, this sub-study was limited to variables collected in the MEND study. The sub-study PI (ML) hypothesized meditation would improve stroke-survivor resilience through the mechanism of mindfulness, but the ability to draw such a conclusion was limited because MEND did not measure mindfulness. Future studies of the effect of meditation on resilience should include variables, such as mindfulness, which might elucidate specific intervention mechanisms on the resilience outcome.

The MEND study was powered for depression as a primary outcome, but not specifically for the sub-study resilience outcome. This study focused on within-group measures for the meditation group, which may have resulted in history and maturation threats to internal validity. The small sample size may also have impacted the validity of findings, particularly in consideration of the anticipated small to medium effect size for the resilience outcome. The nonprobability, purposive sample strategy may have resulted in selection bias, and sampling in a single stroke clinic limits generalizability of study findings. Findings for these community-dwelling stroke survivors in the first 12 months of recovery may not be applicable to stroke survivors who are older, have more severe cognitive or functional impairments, live in different environments, or are in a chronic phase of stroke recovery. Other limitations were directly related to the sub-study design. The exclusion of participants lost to follow-up may have resulted in nonresponse bias as those who participated in the intervention may have differed from those who dropped out.

**Conclusions**

Stroke is a sudden event that results in considerable stress for survivors. Psychological responses to stroke can include symptoms of anxiety, depression, and perceived stress. The survivors’ response to stroke-induced stress has a strong impact on
recovery, including the ability to engage in essential post-stroke self-management practices. New knowledge gained from studies of stroke-survivor resilience may facilitate the identification of stroke survivors in need of interventions, such as meditation, to enhance resilience. Sex, and age. Our findings of lower baseline resilience among NH Black stroke survivors, and also for those with higher levels of trait anxiety, are intriguing and merit further study in larger samples. Fostering resilience supports recovery of stroke survivors, and may offer a first step toward improved engagement in important self-care and secondary prevention measures.

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**Declaration of Interest:** The authors report no conflicts of interest.
References


Table 1

**Participant Characteristics**

<table>
<thead>
<tr>
<th>Baseline Characteristics</th>
<th>Stroke Survivors (n=35)</th>
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<tbody>
<tr>
<td>Time since stroke, in days; mean (SD), range</td>
<td>112.5 (103.4), 5-345</td>
</tr>
<tr>
<td>5-188 days, n (%)</td>
<td>26 (74.3%)</td>
</tr>
<tr>
<td>189-345 days, n (%)</td>
<td>9 (25.7%)</td>
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<tr>
<td>Stroke type</td>
<td></td>
</tr>
<tr>
<td>Ischemic, n (%)</td>
<td>26 (63.4%)</td>
</tr>
<tr>
<td>Hemorrhagic, n (%)</td>
<td>5 (12.2%)</td>
</tr>
<tr>
<td>Transient, n (%)</td>
<td>10 (24.4%)</td>
</tr>
<tr>
<td>Age, in years; mean (SD), range</td>
<td>58.3 (13.9), 32-83</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
</tr>
<tr>
<td>Female, n (%)</td>
<td>22 (62.9%)</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>13 (37.1%)</td>
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<tr>
<td>Race and Ethnicity</td>
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<tr>
<td>NH Black, n (%)</td>
<td>17 (48.6%)</td>
</tr>
<tr>
<td>NH White, n (%)</td>
<td>12 (34.3%)</td>
</tr>
<tr>
<td>Hispanic, n (%)</td>
<td>6 (17.1%)</td>
</tr>
<tr>
<td>Marital Status</td>
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<tr>
<td>-------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Single, n (%)</td>
<td>19 (54.3%)</td>
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<tr>
<td>Married, n (%)</td>
<td>16 (45.7%)</td>
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<table>
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<th>Education</th>
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<tr>
<td>High school/GED, n (%)</td>
<td>10 (28.6%)</td>
</tr>
<tr>
<td>Vocational/some college, n (%)</td>
<td>14 (40%)</td>
</tr>
<tr>
<td>College degree, n (%)</td>
<td>11 (31.5%)</td>
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<tr>
<th>Annual income</th>
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<tr>
<td>Under $25,000, n (%)</td>
<td>10 (29.4%)</td>
</tr>
<tr>
<td>$25,000-$49,999, n (%)</td>
<td>10 (29.4%)</td>
</tr>
<tr>
<td>$50,000-$99,999</td>
<td>6 (17.7%)</td>
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<tr>
<td>$100,000 or above</td>
<td>8 (23.5%)</td>
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<tr>
<th>Religious beliefs</th>
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<tr>
<td>Christian, n (%)</td>
<td>31 (93.9%)</td>
</tr>
<tr>
<td>Other, n (%)</td>
<td>2 (6.1%)</td>
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</table>

*Note.* NH = non-Hispanic
Table 2

*Paired Samples T-Test: Pre-Post Brief Resilience Scale Scores for Meditation*

*Group (n=20)*

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>95% CI of Mean</th>
<th>95% CI of Mean</th>
<th>t</th>
<th>Significance</th>
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<tr>
<td>Difference:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower Bound</td>
<td>.12</td>
<td>-.29</td>
<td>.53</td>
<td>.60</td>
<td>.56</td>
</tr>
<tr>
<td>Upper Bound</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* CI = Confidence Interval
Table 3

*Correlations of Baseline Brief Resilience Scale to Participant Characteristics*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Pearson Correlation</th>
<th>Spearman Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CES-D</td>
<td>$r = -.32, p = .07$</td>
<td></td>
</tr>
<tr>
<td>STAI-S</td>
<td>$r = -.36, p = .05$</td>
<td></td>
</tr>
<tr>
<td>STAI-T</td>
<td>$r = -.51, p = .003$</td>
<td></td>
</tr>
<tr>
<td>Time since stroke</td>
<td>$r = -.09, p = .63$</td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>$r = .10, p = .60$</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>$r_s = .174, p = .33$</td>
<td></td>
</tr>
<tr>
<td>Annual income</td>
<td>$r_s = .177, p = .33$</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* CES-D = Center for Epidemiologic Studies Depression Scale; STAI-S = State-Trait Anxiety Inventory-State; STAI-T = State-Trait Anxiety Inventory-Trait
Table 4

*Baseline Predictors of Resilience: GLM Between-Subjects Effects*

<table>
<thead>
<tr>
<th></th>
<th>Type III Sum</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>7.41*</td>
<td>3</td>
<td>2.47</td>
<td>6.32</td>
<td>.002</td>
</tr>
<tr>
<td>Intercept</td>
<td>75.37</td>
<td>1</td>
<td>75.37</td>
<td>192.78</td>
<td>.000</td>
</tr>
<tr>
<td>Race</td>
<td>2.95</td>
<td>2</td>
<td>1.48</td>
<td>3.77</td>
<td>.04</td>
</tr>
<tr>
<td>STAI-T</td>
<td>3.51</td>
<td>1</td>
<td>3.51</td>
<td>8.98</td>
<td>.005</td>
</tr>
</tbody>
</table>

*Note.* *R Squared = .387 (Adjusted R Squared = .326); df = degrees of freedom; STAI-T = State-Trait Anxiety Inventory-Trait
Appendix A

Approval Letter: University of Texas Health Science Center Houston

Committee for Protection of Human Subjects
NOTICE OF APPROVAL TO IMPLEMENT REQUESTED CHANGES

January 15, 2019

HSC-SN-17-0583 - MEdition for post stroke Depression (MEND)
PI: Dr. Jennifer Beauchamp

Reference Number: 181440

PROVISIONS: Unless otherwise noted, this approval relates to the research to be conducted under the above referenced title and/or to any associated materials considered at this meeting, e.g. study documents, informed consent, etc.

APPROVED: By Expedited Review and Approval

CHANGE APPROVED: The Effect of Meditation on Stroke-Survivor Resilience: A Secondary Data Analysis Version 1.1

REVIEW DATE: 01/14/2019
APPROVAL DATE: 01/15/2019
CHAIRPERSON: Charles C. Miller, III, PhD

Upon receipt of this letter, and subject to any provisions noted above, you may now implement the changes approved.

CHANGES: The principal investigator (PI) must receive approval from the CPHS before initiating any changes, including those required by the sponsor, which would affect human subjects, e.g. changes in methods or procedures, numbers or kinds of human subjects, or revisions to the informed consent document or procedures. The addition of co-investigators must also receive approval from the CPHS. ALL PROTOCOL REVISIONS MUST BE SUBMITTED TO THE SPONSOR OF THE RESEARCH.

INFORMED CONSENT: Informed consent must be obtained by the PI or designee(s), using the format and procedures approved by the CPHS. The PI is responsible to instruct the designee in the methods approved by the CPHS for the consent process. The individual obtaining informed consent must also sign the consent document. **Please note that if revisions to the informed consent form were made and approved, then old blank copies of the ICF MUST be destroyed. Only copies of the appropriately dated, stamped approved informed consent form can be used when obtaining consent.**
UNANTICIPATED RISK OR HARM, OR ADVERSE DRUG REACTIONS: The PI will immediately inform the CPHS of any unanticipated problems involving risks to subjects or others, of any serious harm to subjects, and of any adverse drug reactions.

RECORDS: The PI will maintain adequate records, including signed consent documents if required, in a manner that ensures subject confidentiality.
Appendix B

Study Protocol
Protocol Title: The Effect of Meditation on Stroke-Survivor Resilience: A Secondary Data Analysis

Principal Investigator: Mary F. Love, PhD(c), MSN, RN

Co-Investigators: Jennifer E. Sanner Beauchamp, PhD, RN; Geri LoBiondo-Wood, PhD, RN, FAAN; Anjail Sharrief, MD, MPH

General Information: This research project is a sub-study with secondary analysis of deidentified data from the MEditatioN for post stroke Depression study (MEND), IRB HSC-SN-17-0583.

Background:

Stroke is the leading cause of disability in the United States; approximately 800,000 Americans currently live with stroke (Winstein et al., 2016). Stroke exerts substantial physical and psychological stress on stroke survivors. Poststroke treatment focuses rehabilitating functional impairments and preventing future stroke. This focus on physical effects of stroke results in significant gaps in the identification and treatment of psychological effects of stroke (Winstein et al., 2016). Stroke survivors are expected to adhere to treatments such as physical therapy, speech therapy, and occupational therapy. In addition, secondary prevention of stroke requires adherence to medications, dietary changes, exercise, and stress management. Stroke survivors may feel overwhelmed when faced with these challenges in early recovery (Boger, Demain, & Latter, 2015). Strategies to address the psychological effects of stroke have the potential to positively influence recovery for stroke survivors.

According to Williams and Murray (2013), initial response to stroke may be characterized by apprehension and fear, while responses later in stroke recovery may include feelings of hopelessness and lack of motivation. Changes in self-perception may result from the sudden changes in physical, cognitive, or communication abilities resulting from stroke (Sarre et al., 2014). These responses, when left unrecognized, can profoundly affect the stroke survivor’s recovery.

Early stroke recovery seems to follow a trajectory of either resilience or significant psychological stress (White et al., 2012). Stroke survivors who follow a resilient trajectory may be better equipped to engage in necessary treatments. Resilience, viewed as a dynamic process of adaptation in the face of considerable stress, is amenable to change through intervention (Windle, 2011; Wagnild, 2009). To our knowledge, only one published study has focused on the effect of an intervention on poststroke resilience. In that feasibility study, ten of the eleven participants demonstrated slight increases in resilience after completion of the 6-week group peer-support intervention (Sadler et al., 2017).

Among adult populations, positive psychological factors empirically related to resilience include positive emotion, purpose and meaning in life, mindfulness, and spirituality (Kemper, Mo, & Khayat, 2015; Kemper & Khirallah, 2015; Rutten et al., 2013; Senders, Bourdette, Hanes, Yadav, & Shinto, 2014). In contrast, psychological factors related to negative affect have been inversely related to resilience in adults, including symptoms of anxiety, depression, and perceived stress (Cal de Sa, Glustak, & Santiago, 2015; Leontjevas, de Beek, Lataster, & Jacobs, 2014). Higher income and education, and social support are linked to higher levels of resilience in adults (Garcia-Dia, DiNapoli, Garcia-Ona, Jakubowski, & O’Flaherty, 2013; Sinclair & Wallston, 2004). Health-promoting behaviors have been positively associated with higher levels of resilience in patients with chronic kidney disease (Ma et al., 2013) and in older women (Wagnild, 2009). In addition, increased physical activity and increased consumption of fruits and vegetables were associated with higher levels of resilience among a sample of elderly adults (Perna et al., 2012).

Few studies have reported on the relationship between resilience and demographic, psychological, or behavioral factors in stroke survivors. Low stress resilience in young men has been
associated with higher risk of stroke during middle age (unadjusted HR 1.54, 95% CI 1.40-1.70). and with increased length of hospital stay following ischemic stroke (unadjusted HR 1.46, 95% CI 1.12-1.98) (Bergh, Udumyan, Appelros, Fall, & Montgomery, 2016; Bergh et al., 2014). Among patients with diagnoses of other cardiovascular diseases, including heart failure and acute coronary syndrome (ACS), higher levels of depressive symptoms have been significantly correlated with lower resilience, with inverse correlation from r=0.51 to r=0.87 (Artinian et al., 2009; Barreto et al., 2017; Carvalho et al., 2016; Chang, Wu, Chiang, & Tsai, 2017; Liu et al., 2018; Meister et al., 2016; Toukhsati et al., 2017). Anxiety, perceived stress, and posttraumatic stress have also shown significant inverse relationships with resilience among various CVD populations (Artinian et al., 2009; Carvalho et al., 2016; Liu et al., 2018; Meister et al., 2016). Demographic factors positively associated with resilience among CVD populations include higher income, higher economic status, and living with family (Liu et al., 2018; Shin, Kim, & Jung, 2015). Lastly, moderate to large positive correlations between resilience and self-care measures have been noted in CVD populations including patients with heart failure (Chang et al., 2017; Shin et al., 2015).

Mind-body practices (such as tai chi, yoga, and meditation) focus on the interactions among the brain, mind, body, and behavior (National Center for Complementary and Integrative Health, 2017). Most meditation practices involve attentional focus which includes attention to the breath, thoughts, and/or feelings (Chaoul et al., 2014). Through meditation, the individual gains awareness of the bidirectional relationship between the mind and the body (Chaoul et al., 2014). This aspect of meditation is particularly relevant for stroke survivors due to the prevalence of both physical and psychological stroke effects. A key component of meditation practice is cultivating mindfulness, which is defined as the nonjudgmental acceptance of the present moment (Kabat-Zin, 2017).

Mind-body therapies have been associated with improvements in psychological outcomes in the elderly, patients with chronic disease, and patients with cardiovascular disease (Sorrell, 2015; Chan & Larson, 2015; Younge et al., 2015). A pilot study of the effects of an eight-week mindfulness based stress reduction (MBSR) program in women with CVD found significant improvements in the intervention group for measures of anxiety, emotional expression, and reactive coping (Tacón, McComb, Caldera, & Randolph, 2003). A recent systematic review of mind-body interventions in heart failure retrieved only two studies with meditation as the intervention; both studies reported significant improvements for outcomes of depression and quality of life (Gok Metin et al., 2018). Relatively few studies have been conducted to evaluate the effect of mind-body interventions on outcomes for stroke survivors. These studies, which include either yoga or tai chi as the intervention, found positive trends in outcomes of anxiety, depression, and quality of life, but few significant between-group differences (Chan, W., Immin, M. A., & Hillier, S. 2012; Taylor-Piliae et al., 2014; Immin, Hillier, & Petkov, 2014; Schmid et al., 2012; TaylorPiliae & Coull, 2012). Most of these studies were small pilot or feasibility studies, and none of the studies addressed resilience as an outcome.

Few studies have explored the relationship between resilience and mindfulness. A cross-sectional study of 134 middle-aged and older adults indicated the effect of stressors on mental health was “buffered” by mindfulness, which was referred to as a “resiliency factor” (de Frias & Whyne, 2015, p. 205). A prospective cohort study of 513 health professionals with moderate to high stress levels found significant acute improvements in mindfulness (p<.001) and resilience (p<.01) after completion of online mind-body skills training (Kemper & Khirallah, 2015). Hwang et al. (2017) compared the effect of an intensive meditation intervention with relaxation in 51 healthy adults and found a significant interaction effect for the intervention and time on resilience and mindfulness at the three-month follow up.

IRB NUMBER: HSC-SN-17-0583
IRB APPROVAL DATE: 01/15/2019
The primary hypothesis for this research project is that among adult community-dwelling patients diagnosed with stroke in the past 12 months, a 4-week, breath-based meditation intervention will result in improved resilience when measured at baseline and upon completion of the four-week intervention. We also hypothesize that among community-dwelling adult patients diagnosed with stroke in the past 12 months, female gender will be associated with lower baseline resilience, age will be positively correlated with resilience, while symptoms of anxiety and depression will be inversely correlated with resilience.

Objectives

The purpose of this research project is to obtain preliminary evidence regarding the effect of meditation on stroke-survivor resilience. The primary objective of this research project is to test the effect of a meditation intervention on resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. The secondary objective is to identify potential predictor variables of resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery.

The primary outcome of resilience will be measured with the Brief Resilience Scale (BRS), a self-report instrument with six items on a 5-point Likert type scale. Three of the items are reverse scored. The resilience level is based on the average of the responses on the six questions, after reverse coding of items 2, 4, and 6 (Smith et al., 2013). Higher scores on the BRS correspond to higher levels of resilience.

The BRS was developed to assess resilience as the ability to bounce back from stress. Smith et al. (2008) hypothesized the BRS scale would be unidimensional and would be related to resilience resources as well as to health outcomes. Initial scale development testing resulted in adequate evidence for internal consistency reliability (Cronbach’s alpha of 0.8 to 0.9) and for test-retest reliability (r=0.7, one month interval) (Smith et al., 2008). Adequate evidence for construct validity was also reported. Factor analysis (n = 354) resulted in a one-factor solution, with item loadings ranging from 0.6 to 0.9. Convergent validity was demonstrated by correlations with the Connor-Davidson Resilience Scale (CD-RISC, r =0.6) and the Ego Resilience Scale (r =0.5) (Smith et al., 2008).

The secondary outcomes, predictor variables of resilience, include demographic, clinical, and psychological variables. Demographic variables collected via self-report at baseline include: age, gender, race (five categories), education (seven categories), marital status (four categories), income (six categories), and religious beliefs (six categories). Clinical variables collected at baseline through electronic record review include type of stroke (ischemic, hemorrhagic, or transient ischemic attack) and date of stroke. Psychological variables include symptoms of anxiety (STAI-Y) and symptoms of depression (CES-D).

Study Design

This research project is a sub-study with secondary analysis of deidentified data from the MEND study. MEND is a pilot, randomized controlled trial (RCT) regarding the effect of a four-week meditation intervention on psychological and biological outcomes for stroke survivors and their informal caregivers.

Study Population

The study population for this research project consists of the adult community-dwelling stroke survivors in the MEND study. Inclusion criterion for the primary objective is the stroke-survivors randomized to the meditation intervention, with BRS data available at baseline and immediately after the four-week meditation intervention. Inclusion criterion for the secondary objective is the stroke-
survivors enrolled in the MEND study with BRS data available at baseline. Exclusion criterion is the informal caregivers enrolled in the MEND study.

Statistics

The data analysis for the sub-study will be a secondary data analysis of the existing, deidentified MEND data. Descriptive statistics will be computed for the demographic, clinical, psychological and BRS variables. Internal consistency reliability of the BRS scale will be analyzed with Cronbach's alpha, with an a priori criteria of $\alpha \geq .80$.

The primary objective of this research project is to test the effect of meditation on resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. The data analysis for this aim will focus on within-group measures of resilience in the intervention group. The statistical approach to test the hypothesis will be a paired t-test. The G*Power 3.1.9.2 software was utilized to compute a sensitivity analysis for a two-tailed test with $\alpha \geq .05$, $\beta .80$, and a sample size of between 16 and 24. The effect size (Cohen's d) needed to detect a statistically significant increase in resilience from baseline (T0) to post-intervention (T1) varies from .74 (sample size 16) to .59 (sample size 24).

The second objective of this research project is to identify potential predictor variables of baseline resilience in community-dwelling stroke survivors during the first 12 months of stroke recovery. The data analysis for this aim will focus on all stroke survivors with baseline resilience data. The predictors of resilience will include seven demographic variables: age, gender, race, education, marital status, income, and religious beliefs. Clinical variables assessed as predictor variables will include type of stroke and time since stroke. Psychological variables will include symptoms of anxiety (score on the STAI-Y) and symptoms of depression (score on the CES-D). Univariate analysis will be utilized to evaluate the relationship between resilience and each predictor variable. The relationship between gender and resilience will be analyzed with an independent t test, with $\alpha \leq 0.10$ required for inclusion in the multivariate model. The bivariate correlation between the remaining predictor variables and resilience will be determined with the Pearson product-moment correlation (for continuous data) or the Spearman rank-order correlation coefficient (for categorical data) (Hawkins, 2014). Multiple linear regression analysis will then be utilized to develop the model which best predicts resilience.

Ethics

IRB approval for this research project will be requested only through the UT Health Houston CPHS. The data received by the researcher will be deidentified, so there will be no link to participant protected health information. All UTH procedures and guidelines regarding data security and PHI will be followed by the investigator. All enrolled MEND participants completed a written informed consent process. Participants also consented to future use of their data with other investigators for research purposes.

Data Handling and Record Keeping

The deidentified MEND data will be shared with the primary investigator through UTH Secure Share.

Frequency data will be inspected for normality, skewness, and outliers. The data will also be inspected for missing values, which will be imputed with multiple imputation through the SPSS missing value feature. The MEND study statistician has coded the BRS data to meet the scale requirements for reverse scoring and averaging of item responses. The BRS data will also be inspected for floor or ceiling effects.
Publication Plan

Research results will be submitted to appropriate peer-reviewed journals for publication.

References


myocardial infarction. Psychosomatic Medicine, 78(3), 327-334. doi:10.1097/PSY.0000000000000278 [doi]


Appendix C

Instruments
The Brief Resilience Scale

Bruce W. Smith, University of New Mexico, bwsmith@unm.edu

**Instructions:** Use the following scale and circle one number for each statement to indicate how much you disagree or agree with each of the statements.

<table>
<thead>
<tr>
<th></th>
<th>1 = Strongly Disagree</th>
<th>2 = Disagree</th>
<th>3 = Neutral</th>
<th>4 = Agree</th>
<th>5 = Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I tend to bounce back quickly after hard times..</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>I have a hard time making it through stressful events.........................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>It does not take me long to recover from a stressful event........................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>It is hard for me to snap back when something bad happens.......................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>I usually come through difficult times with little trouble..........................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>I tend to take a long time to get over set-backs in my life..........................</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
Center for Epidemiologic Studies Depression Scale (CES-D), NIMH

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way during the past week.

<table>
<thead>
<tr>
<th>Week</th>
<th>During the Past</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rarely or none of the time (less than 1 day)</td>
</tr>
<tr>
<td></td>
<td>Some or a little of the time (1-2 days)</td>
</tr>
<tr>
<td></td>
<td>Occasionally or a moderate amount of time (3-4 days)</td>
</tr>
<tr>
<td></td>
<td>Most or all of the time (5-7 days)</td>
</tr>
<tr>
<td>1. I was bothered by things that usually don’t bother me.</td>
<td>☐</td>
</tr>
<tr>
<td>2. I did not feel like eating; my appetite was poor.</td>
<td>☐</td>
</tr>
<tr>
<td>3. I felt that I could not shake off the blues even with help from</td>
<td>☐</td>
</tr>
<tr>
<td>my family or friends.</td>
<td>☐</td>
</tr>
<tr>
<td>4. I felt I was just as good as other people.</td>
<td>☐</td>
</tr>
<tr>
<td>5. I had trouble keeping my mind on what I was doing.</td>
<td>☐</td>
</tr>
<tr>
<td>6. I felt depressed.</td>
<td>☐</td>
</tr>
<tr>
<td>7. I felt that everything I did was an effort.</td>
<td>☐</td>
</tr>
<tr>
<td>8. I felt hopeful about the future.</td>
<td>☐</td>
</tr>
<tr>
<td>9. I thought my life had been a failure.</td>
<td>☐</td>
</tr>
<tr>
<td>10. I felt fearful.</td>
<td>☐</td>
</tr>
<tr>
<td>11. My sleep was restless.</td>
<td>☐</td>
</tr>
<tr>
<td>12. I was happy.</td>
<td>☐</td>
</tr>
<tr>
<td>13. I talked less than usual.</td>
<td>☐</td>
</tr>
<tr>
<td>15. People were unfriendly.</td>
<td>☐</td>
</tr>
<tr>
<td>16. I enjoyed life.</td>
<td>☐</td>
</tr>
<tr>
<td>17. I had crying spells.</td>
<td>☐</td>
</tr>
<tr>
<td>18. I felt sad.</td>
<td>☐</td>
</tr>
<tr>
<td>19. I felt that people dislike me.</td>
<td>☐</td>
</tr>
<tr>
<td>20. I could not get “going.”</td>
<td>☐</td>
</tr>
</tbody>
</table>

SCORING: zero for answers in the first column, 1 for answers in the second column, 2 for answers in the third column, 3 for answers in the fourth column. The scoring of positive items is reversed. Possible range of scores is zero to 60, with the higher scores indicating the presence of more symptomatology.
Self-Evaluation Questionnaire

Below are directions and a few sample items of the State-Trait Anxiety Inventory for Adults (Forms Y-1 and Y-2). Both online and paper reproduction licenses are available. Click on the Translations tab for available languages.

Directions

A number of statements which people have used to describe themselves are given on the following pages. Read each statement and then select the appropriate button to indicate how you feel right now, that is, at this moment. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

Not at all - Somewhat - Moderately so - Very much so

Directions

A number of statements which people have used to describe themselves are given on the following pages. Read each statement and then select the appropriate button to indicate how you generally feel.

Almost never - Sometimes - Often - Almost always

Items marked by * are required.
Items marked by * are required.
Appendix D

Supplemental Tables for Manuscript C
Univariate Analyses of Baseline Resilience with Demographic and Clinical Variables

1. Sex

### Independent Samples Test

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>BRS_0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>3.921</td>
<td>.056</td>
<td>1.098</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>1.220</td>
<td>.309</td>
<td>31.973</td>
</tr>
</tbody>
</table>

2. Ethnicity

### Independent Samples Test

<table>
<thead>
<tr>
<th></th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>BRS_0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>.432</td>
<td>.516</td>
<td>.120</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>.127</td>
<td>.903</td>
<td>7.754</td>
</tr>
</tbody>
</table>
3. Race

### Descriptives

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>12</td>
<td>3.9722</td>
<td>.72764</td>
<td>.21005</td>
<td>3.5099</td>
<td>4.4345</td>
<td>3.17</td>
<td>5.00</td>
</tr>
<tr>
<td>Black</td>
<td>16</td>
<td>3.2187</td>
<td>.67418</td>
<td>.16854</td>
<td>2.8595</td>
<td>3.5780</td>
<td>2.33</td>
<td>4.83</td>
</tr>
<tr>
<td>Hispanic</td>
<td>6</td>
<td>3.5833</td>
<td>.72072</td>
<td>.29423</td>
<td>2.8270</td>
<td>4.3397</td>
<td>2.33</td>
<td>4.50</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>3.5490</td>
<td>.76159</td>
<td>.13061</td>
<td>3.2833</td>
<td>3.8148</td>
<td>2.33</td>
<td>5.00</td>
</tr>
</tbody>
</table>

### Test of Homogeneity of Variances

<table>
<thead>
<tr>
<th>BRS_0</th>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on Mean</td>
<td>.449</td>
<td>2</td>
<td>31</td>
<td>.642</td>
</tr>
<tr>
<td>Based on Median</td>
<td>.238</td>
<td>2</td>
<td>31</td>
<td>.790</td>
</tr>
<tr>
<td>Based on Median and with adjusted df</td>
<td>.238</td>
<td>2</td>
<td>30.722</td>
<td>.790</td>
</tr>
<tr>
<td>Based on trimmed mean</td>
<td>.440</td>
<td>2</td>
<td>31</td>
<td>.648</td>
</tr>
</tbody>
</table>

### ANOVA

<table>
<thead>
<tr>
<th>BRS_0</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3.902</td>
<td>2</td>
<td>1.951</td>
<td>3.968</td>
<td>.029</td>
</tr>
<tr>
<td>Within Groups</td>
<td>15.239</td>
<td>31</td>
<td>.492</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.141</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Multiple Comparisons

<table>
<thead>
<tr>
<th>(I) Race</th>
<th>(J) Race</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
</tr>
<tr>
<td>White</td>
<td>Black</td>
<td>.75347*</td>
<td>.26775</td>
<td>.022</td>
<td>.0945</td>
</tr>
<tr>
<td>Hispanic</td>
<td>White</td>
<td>-.75347*</td>
<td>.26775</td>
<td>.022</td>
<td>-1.4125</td>
</tr>
<tr>
<td>Hispanic</td>
<td>Black</td>
<td>-.36458</td>
<td>.33564</td>
<td>.530</td>
<td>-1.1907</td>
</tr>
</tbody>
</table>
Hispanic White  |  -.3889 |  .35056 |  .516 |  -1.2517 |  .4739  
Black          |  .36458 |  .33564 |  .530 |  -.4615  |  1.1907  

* The mean difference is significant at the 0.05 level.

**BRS_0**

Tukey HSD<sup>a,b</sup>

<table>
<thead>
<tr>
<th>Race</th>
<th>N</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>16</td>
<td>3.2187</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>6</td>
<td>3.5833</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>12</td>
<td>3.9722</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sig.</td>
<td></td>
<td>.063</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means for groups in homogeneous subsets are displayed.

- b. The group sizes are unequal. The harmonic mean of the group sizes is used.
Type I error levels are not guaranteed.

### 4. Stroke Type

**Descriptives**

<table>
<thead>
<tr>
<th>BRS_0</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
<td>Upper Bound</td>
<td></td>
</tr>
<tr>
<td>Ischemic</td>
<td>22</td>
<td>3.5985</td>
<td>.79957</td>
<td>.17047</td>
<td>3.2440</td>
<td>3.9530</td>
<td>2.33</td>
</tr>
<tr>
<td>Hemorrhagic</td>
<td>4</td>
<td>3.6250</td>
<td>.47871</td>
<td>.23936</td>
<td>2.8633</td>
<td>4.3867</td>
<td>3.33</td>
</tr>
<tr>
<td>Transient</td>
<td>8</td>
<td>3.3750</td>
<td>.82013</td>
<td>.28996</td>
<td>2.6894</td>
<td>4.0606</td>
<td>2.33</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>3.5490</td>
<td>.76159</td>
<td>.13061</td>
<td>3.2833</td>
<td>3.8148</td>
<td>2.33</td>
</tr>
</tbody>
</table>
Test of Homogeneity of Variances

<table>
<thead>
<tr>
<th></th>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRS_0</td>
<td>Based on Mean</td>
<td>.648</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Based on Median</td>
<td>.775</td>
<td>2</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Based on Median and with adjusted df</td>
<td>.775</td>
<td>2</td>
<td>30.678</td>
</tr>
<tr>
<td></td>
<td>Based on trimmed mean</td>
<td>.689</td>
<td>2</td>
<td>31</td>
</tr>
</tbody>
</table>

ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>.319</td>
<td>2</td>
<td>.160</td>
<td>.263</td>
<td>.771</td>
</tr>
<tr>
<td>Within Groups</td>
<td>18.821</td>
<td>31</td>
<td>.607</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.141</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Religion

Descriptives

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>95% Confidence Interval for Mean</th>
<th>Between-Component Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lower Bound</td>
<td>Upper Bound</td>
</tr>
<tr>
<td>Christianity</td>
<td>31</td>
<td>3.5645</td>
<td>.79545</td>
<td>.14287</td>
<td>3.2727</td>
<td>3.8563</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>3.1667</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>3.5521</td>
<td>.78567</td>
<td>.13889</td>
<td>3.2688</td>
<td>3.8353</td>
</tr>
<tr>
<td>Model Fixed Effects</td>
<td></td>
<td>.79545</td>
<td>.14062</td>
<td>3.2649</td>
<td>3.8393</td>
<td></td>
</tr>
<tr>
<td>Random Effects</td>
<td></td>
<td>.14062</td>
<td>1.7654</td>
<td>5.3388</td>
<td></td>
<td>-.24743</td>
</tr>
</tbody>
</table>

a. Warning: Between-component variance is negative. It was replaced by 0.0 in computing this random effects measure.
### ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>.153</td>
<td>1</td>
<td>.153</td>
<td>.242</td>
<td>.626</td>
</tr>
<tr>
<td>Within Groups</td>
<td>18.982</td>
<td>30</td>
<td>.633</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19.135</td>
<td>31</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 6. Marital Status

#### Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRS_0</td>
<td>34</td>
<td>3.5490</td>
<td>.76159</td>
<td>2.33</td>
<td>5.00</td>
</tr>
<tr>
<td>What is your marital status?</td>
<td>35</td>
<td>2.51</td>
<td>.818</td>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Ranks

<table>
<thead>
<tr>
<th>What is your marital status?</th>
<th>N</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRS_0 Never been married</td>
<td>4</td>
<td>12.38</td>
</tr>
<tr>
<td>Divorced or separated</td>
<td>11</td>
<td>17.55</td>
</tr>
<tr>
<td>Married</td>
<td>16</td>
<td>19.06</td>
</tr>
<tr>
<td>Widowed</td>
<td>3</td>
<td>15.83</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>

#### Test Statistics\(^{a,b}\)

<table>
<thead>
<tr>
<th></th>
<th>BRS_0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kruskal-Wallis H</td>
<td>1.551</td>
</tr>
<tr>
<td>df</td>
<td>3</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.671</td>
</tr>
</tbody>
</table>

\(^a\) Kruskal Wallis Test  
\(^b\) Grouping Variable: What is your marital status?
7. Income

**Ranks**

What is your approximate yearly household income before taxes; include total income of all adults living in your household: (Check one box)

<table>
<thead>
<tr>
<th>Income Range</th>
<th>N</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under $25,000</td>
<td>9</td>
<td>16.00</td>
</tr>
<tr>
<td>$25,000 - $49,999</td>
<td>10</td>
<td>15.25</td>
</tr>
<tr>
<td>$50,000 - $74,999</td>
<td>4</td>
<td>15.00</td>
</tr>
<tr>
<td>$75,000 - $99,999</td>
<td>2</td>
<td>20.25</td>
</tr>
<tr>
<td>$100,000 - $149,999</td>
<td>3</td>
<td>20.67</td>
</tr>
<tr>
<td>$150,000 and over</td>
<td>5</td>
<td>20.40</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>33</td>
<td></td>
</tr>
</tbody>
</table>

**Test Statistics**

<table>
<thead>
<tr>
<th></th>
<th>BRS_0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kruskal-Wallis H</td>
<td>1.885</td>
</tr>
<tr>
<td>df</td>
<td>5</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.865</td>
</tr>
</tbody>
</table>

a. Kruskal Wallis Test
b. Grouping Variable: What is your approximate yearly household income before taxes; include total income of all adults living in your household: (Check one box)

8. Education
### Ranks

What is the highest level of education completed?

(Check one box)  

<table>
<thead>
<tr>
<th>Education Level</th>
<th>N</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>12th grade (high school or GED)</td>
<td>9</td>
<td>15.22</td>
</tr>
<tr>
<td>Vocational/technical</td>
<td>5</td>
<td>11.90</td>
</tr>
<tr>
<td>Some college, but no degree</td>
<td>9</td>
<td>22.44</td>
</tr>
<tr>
<td>College diploma (Associate or Bachelor degree)</td>
<td>8</td>
<td>18.13</td>
</tr>
<tr>
<td>Graduate degree (Master degree or higher)</td>
<td>3</td>
<td>17.17</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td></td>
</tr>
</tbody>
</table>
### Test Statistics\textsuperscript{a,b}

<table>
<thead>
<tr>
<th></th>
<th>BRS 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kruskal-Wallis H</td>
<td>4.343</td>
</tr>
<tr>
<td>df</td>
<td>4</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.362</td>
</tr>
</tbody>
</table>

\textsuperscript{a} Kruskal Wallis Test  
\textsuperscript{b} Grouping Variable: What is the highest level of education completed? (Check one box)
Multivariate Analyses of Baseline Resilience with Predictor Variables

1. General Linear Model with resilience as dependent variable, race as a fixed factor, and state anxiety, trait anxiety, and depression as covariates

<table>
<thead>
<tr>
<th>Between-Subjects Factors</th>
<th>Value Label</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td>1</td>
<td>White</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Black</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Hispanic</td>
</tr>
</tbody>
</table>

Levene's Test of Equality of Error Variances

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable: BRS_0</td>
<td>0.878</td>
<td>2</td>
<td>30</td>
<td>0.426</td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Race + STAI_T_0 + CESD_0 + STAI_S_0

Descriptive Statistics

<table>
<thead>
<tr>
<th>Race</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>3.9722</td>
<td>0.72764</td>
<td>12</td>
</tr>
<tr>
<td>Black</td>
<td>3.2111</td>
<td>0.69712</td>
<td>15</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3.5833</td>
<td>0.72072</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>3.5556</td>
<td>0.77243</td>
<td>33</td>
</tr>
</tbody>
</table>
# Tests of Between-Subjects Effects

**Dependent Variable: BRS_0**

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>9.134(^a)</td>
<td>5</td>
<td>1.827</td>
<td>4.953</td>
<td>.002</td>
<td>.478</td>
</tr>
<tr>
<td>Intercept</td>
<td>32.708</td>
<td>1</td>
<td>32.708</td>
<td>88.676</td>
<td>.000</td>
<td>.767</td>
</tr>
<tr>
<td>Race</td>
<td>2.238</td>
<td>2</td>
<td>1.119</td>
<td>3.034</td>
<td>.065</td>
<td>.183</td>
</tr>
<tr>
<td>STAI_T_0</td>
<td>3.616</td>
<td>1</td>
<td>3.616</td>
<td>9.803</td>
<td>.004</td>
<td>.266</td>
</tr>
<tr>
<td>CESD_0</td>
<td>.539</td>
<td>1</td>
<td>.539</td>
<td>1.461</td>
<td>.237</td>
<td>.051</td>
</tr>
<tr>
<td>STAI_S_0</td>
<td>.502</td>
<td>1</td>
<td>.502</td>
<td>1.362</td>
<td>.253</td>
<td>.048</td>
</tr>
<tr>
<td>Error</td>
<td>9.959</td>
<td>27</td>
<td>.369</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>436.278</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>19.093</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) R Squared = .478 (Adjusted R Squared = .382)

## Parameter Estimates

**Dependent Variable: BRS_0**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.750</td>
<td>.523</td>
<td>9.082</td>
<td>.000</td>
<td>3.677 - 5.824</td>
<td>.753</td>
</tr>
<tr>
<td>[Race=1]</td>
<td>.376</td>
<td>.306</td>
<td>1.229</td>
<td>.230</td>
<td>-.252 - 1.005</td>
<td>.053</td>
</tr>
<tr>
<td>[Race=2]</td>
<td>-.217</td>
<td>.306</td>
<td>-.709</td>
<td>.484</td>
<td>-.845 - .022</td>
<td>.018</td>
</tr>
<tr>
<td>[Race=3]</td>
<td>0(^a)</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.018</td>
</tr>
<tr>
<td>STAI_T_0</td>
<td>-.064</td>
<td>.020</td>
<td>-3.131</td>
<td>.004</td>
<td>-.106 - -.022</td>
<td>.266</td>
</tr>
<tr>
<td>CESD_0</td>
<td>.024</td>
<td>.020</td>
<td>1.209</td>
<td>.237</td>
<td>-.017 - .065</td>
<td>.051</td>
</tr>
<tr>
<td>STAI_S_0</td>
<td>.023</td>
<td>.020</td>
<td>1.167</td>
<td>.253</td>
<td>-.017 - .063</td>
<td>.048</td>
</tr>
</tbody>
</table>

\(^a\) This parameter is set to zero because it is redundant.
**Estimated Marginal Means**

**Estimates**

Dependent Variable: BRS_0

<table>
<thead>
<tr>
<th>Race</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
<th>Lower Bound</th>
<th>Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>3.894</td>
<td>.177</td>
<td></td>
<td>3.531</td>
<td>4.257</td>
</tr>
<tr>
<td>Black</td>
<td>3.300</td>
<td>.161</td>
<td></td>
<td>2.970</td>
<td>3.631</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3.517</td>
<td>.253</td>
<td></td>
<td>2.997</td>
<td>4.037</td>
</tr>
</tbody>
</table>

a. Covariates appearing in the model are evaluated at the following values: STAI_T_0 = 40.91, CESD_0 = 17.70, STAI_S_0 = 41.48.

**Univariate Tests**

Dependent Variable: BRS_0

<table>
<thead>
<tr>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contrast</td>
<td>2.238</td>
<td>2</td>
<td>1.119</td>
<td>3.034</td>
<td>.065</td>
</tr>
<tr>
<td>Error</td>
<td>9.959</td>
<td>27</td>
<td>.369</td>
<td></td>
<td>.183</td>
</tr>
</tbody>
</table>

The F tests the effect of Race. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

2. General linear model with resilience as dependent variable, race as fixed factor, and trait as a covariate

**Between-Subjects Factors**

<table>
<thead>
<tr>
<th>Value Label</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>White</td>
</tr>
<tr>
<td>2</td>
<td>Black</td>
</tr>
<tr>
<td>3</td>
<td>Hispanic</td>
</tr>
</tbody>
</table>
### Descriptive Statistics

**Dependent Variable:** BRS_0

<table>
<thead>
<tr>
<th>Race</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>3.9722</td>
<td>.72764</td>
<td>12</td>
</tr>
<tr>
<td>Black</td>
<td>3.2188</td>
<td>.67418</td>
<td>16</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3.5833</td>
<td>.72072</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>3.5490</td>
<td>.76159</td>
<td>34</td>
</tr>
</tbody>
</table>

### Levene's Test of Equality of Error Variances

**Dependent Variable:** BRS_0

<table>
<thead>
<tr>
<th>F</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.106</td>
<td>2</td>
<td>31</td>
<td>.139</td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Race + STAI_T_0

### Tests of Between-Subjects Effects

**Dependent Variable:** BRS_0

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>7.411a</td>
<td>3</td>
<td>2.470</td>
<td>6.318</td>
<td>.002</td>
<td>.387</td>
</tr>
<tr>
<td>Intercept</td>
<td>75.371</td>
<td>1</td>
<td>75.371</td>
<td>192.775</td>
<td>.000</td>
<td>.865</td>
</tr>
<tr>
<td>Race</td>
<td>2.950</td>
<td>2</td>
<td>1.475</td>
<td>3.773</td>
<td>.035</td>
<td>.201</td>
</tr>
<tr>
<td>STAI_T_0</td>
<td>3.510</td>
<td>1</td>
<td>3.510</td>
<td>8.976</td>
<td>.005</td>
<td>.230</td>
</tr>
<tr>
<td>Error</td>
<td>11.729</td>
<td>30</td>
<td>.391</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>447.389</td>
<td>34</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>19.141</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a. R Squared = .387 (Adjusted R Squared = .326)
Parameter Estimates

<table>
<thead>
<tr>
<th>Parameter</th>
<th>B</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
<th>95% Confidence Interval</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>4.440</td>
<td>.383</td>
<td>11.584</td>
<td>.000</td>
<td>3.657 - 5.223</td>
<td>.817</td>
</tr>
<tr>
<td>[Race=1]</td>
<td>.416</td>
<td>.313</td>
<td>1.329</td>
<td>.194</td>
<td>-.223 - 1.054</td>
<td>.056</td>
</tr>
<tr>
<td>[Race=2]</td>
<td>-.245</td>
<td>.302</td>
<td>-.810</td>
<td>.424</td>
<td>-.861 - .372</td>
<td>.021</td>
</tr>
<tr>
<td>[Race=3]</td>
<td>0a</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>. - .</td>
<td>.</td>
</tr>
<tr>
<td>STAI_T_0</td>
<td>-.023</td>
<td>.008</td>
<td>-2.996</td>
<td>.005</td>
<td>-.038 - -.007</td>
<td>.230</td>
</tr>
</tbody>
</table>

a. This parameter is set to zero because it is redundant.

Estimated Marginal Means

<table>
<thead>
<tr>
<th>Race</th>
<th>Mean</th>
<th>Std. Error</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>3.933a</td>
<td>.181</td>
<td>3.563 - 4.303</td>
</tr>
<tr>
<td>Black</td>
<td>3.273a</td>
<td>.157</td>
<td>2.951 - 3.594</td>
</tr>
<tr>
<td>Hispanic</td>
<td>3.517a</td>
<td>.256</td>
<td>2.994 - 4.041</td>
</tr>
</tbody>
</table>

a. Covariates appearing in the model are evaluated at the following values: STAI_T_0 = 40.38.

Pairwise Comparisons

<table>
<thead>
<tr>
<th>(I) Race</th>
<th>(J) Race</th>
<th>Mean Difference</th>
<th>Std. Error</th>
<th>Sig.</th>
<th>95% Confidence Interval for Difference</th>
<th>95% Confidence Interval for Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>Black</td>
<td>.660*</td>
<td>.241</td>
<td>.010</td>
<td>.168 - 1.152</td>
<td>.152 - 1.168</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>.416</td>
<td>.313</td>
<td>.194</td>
<td>-.223 - 1.054</td>
<td>-.232 - 1.044</td>
</tr>
<tr>
<td>Black</td>
<td>White</td>
<td>-.660*</td>
<td>.241</td>
<td>.010</td>
<td>-1.152 - -.168</td>
<td>-1.168 - -.152</td>
</tr>
<tr>
<td></td>
<td>Hispanic</td>
<td>-.245</td>
<td>.302</td>
<td>.424</td>
<td>-.861 - .372</td>
<td>-.868 - .369</td>
</tr>
<tr>
<td>Hispanic</td>
<td>White</td>
<td>-.416</td>
<td>.313</td>
<td>.194</td>
<td>-1.054 - .223</td>
<td>-1.064 - .218</td>
</tr>
<tr>
<td>Black</td>
<td>.245</td>
<td>.302</td>
<td>.424</td>
<td>.372</td>
<td>.223 - .861</td>
<td>.230 - .859</td>
</tr>
</tbody>
</table>

Based on estimated marginal means

* The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).
### Univariate Tests

**Dependent Variable:** BRS_0

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
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<th>F</th>
<th>Sig.</th>
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<tr>
<td>Contrast</td>
<td>2.950</td>
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<td>1.475</td>
<td>3.773</td>
<td>.035</td>
<td>.201</td>
</tr>
<tr>
<td>Error</td>
<td>11.729</td>
<td>30</td>
<td>.391</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The F tests the effect of Race. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.
Appendix E

CITI Completion Certificate
This is to certify that:

Mary Love

Has completed the following CITI Program course:

GCP – Social and Behavioral Research Best Practices for Clinical Research
GCP – Social and Behavioral Research Best Practices for Clinical Research 1 - Basic Course

Under requirements set by:

University of Texas Health Science Center at Houston

Verify at www.citiprogram.org/verify/7wa43a2-439-a383-89d6-f99bf6fd79eb-24677693
Appendix F

Curriculum Vitae
# EDUCATION

<table>
<thead>
<tr>
<th>Degree</th>
<th>Institution</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. Nursing (in progress)</td>
<td>The University of Texas Health Science Center at Houston, Texas</td>
<td>5/2019 (scheduled)</td>
</tr>
<tr>
<td>Research focus: The effect of meditation on resilience of community-dwelling stroke survivors. Adviser: Dr. Jennifer Beauchamp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M.S.N, with highest honors Gerontology Track, Education Role</td>
<td>The University of Texas Health Science Center at Houston, Texas</td>
<td>2002</td>
</tr>
<tr>
<td>Master’s thesis: Gender Differences in Cardiac Rehabilitation Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B.S.N, with highest honors</td>
<td>The University of Texas at Austin, Texas</td>
<td></td>
</tr>
</tbody>
</table>

## Other Education

<table>
<thead>
<tr>
<th>Certification</th>
<th>Certifying Body</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatric Intensive Care Preceptorship Course</td>
<td>Harris Hospital Methodist, Fort Worth, Texas</td>
<td>1983</td>
</tr>
<tr>
<td>Critical Care Registered Nurse Core Review Program</td>
<td>Eastern Regional Accreditation Committee of the American Nurses Association</td>
<td>1984</td>
</tr>
<tr>
<td>Exercise Specialist Workshop</td>
<td>Hammons Heart Institute, Springfield, Missouri</td>
<td>1992</td>
</tr>
<tr>
<td>American Association of Cardiovascular and Pulmonary Rehabilitation Annual Conference</td>
<td>American Association of Cardiovascular and Pulmonary Rehabilitation</td>
<td>1992</td>
</tr>
<tr>
<td>Texas Association of Cardiovascular and Pulmonary Rehabilitation Annual Conference</td>
<td>Texas Association of Cardiovascular and Pulmonary Rehabilitation</td>
<td>1993, 1994, 2016</td>
</tr>
</tbody>
</table>
**Licensure & Certification**

**State**
- Registered Nurse (# 500854)
  Board of Nurse Examiners for the State of Texas
  Active
  1982-present

- Registered Nurse (#84441)
  Board of Nurse Examiners for the State of Colorado
  Inactive
  1986-1989

**Certificate**
- Cardiac Rehabilitation Nurse (CRN)
  American Nurses Credentialing Center
  1995-1998

- Critical Care Registered Nurse (CCRN)
  American Association of Critical-Care Nurses Certification Corporation
  1985-1988

- Advanced Cardiac Life Support (ACLS)
  American Heart Association
  1985-1996

**Professional Experience**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Position Title</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midland Memorial Hospital, Midland, Texas</td>
<td>Registered Nurse Intensive Care Unit</td>
<td>1982-1985</td>
</tr>
<tr>
<td>Hospice of Midland; Visiting Nurse Service, Midland, Texas</td>
<td>Registered Nurse Contract Nurse</td>
<td>1985-1986</td>
</tr>
<tr>
<td>University Hospital, Denver, Colorado</td>
<td>Registered Nurse, Cardiology Protocol Coordinator</td>
<td>1986-1988</td>
</tr>
<tr>
<td>Northwest Texas Hospital, Amarillo, Texas</td>
<td>Registered Nurse Coronary Care Unit</td>
<td>1988-1991</td>
</tr>
<tr>
<td>High Plains Baptist Hospital, Amarillo, Texas</td>
<td>Program Coordinator, Cardiac Rehabilitation</td>
<td>1991-1994</td>
</tr>
</tbody>
</table>
Heart Health Center  
Houston, Texas  
Registered Nurse, Cardiac Rehabilitation  
1995-1996

The University of Texas at Houston  
Cizik School of Nursing  
Instructor, online undergraduate research course  
2018

**HONORS & AWARDS**

<table>
<thead>
<tr>
<th>Award</th>
<th>Awarding Institution</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sigma Theta Tau International Inductee</td>
<td>The University of Texas at Austin, Epsilon Theta Chapter</td>
<td>1982</td>
</tr>
<tr>
<td>Excellence in Nursing</td>
<td>Northwest Texas Hospital Amarillo, Texas</td>
<td>1990</td>
</tr>
<tr>
<td>PARTNERS Scholarship (full tuition, fees, books)</td>
<td>University of Texas Health Science Center at Houston, Cizik School of Nursing</td>
<td>2016</td>
</tr>
<tr>
<td>Best Poster, Research Day</td>
<td>University of Texas Health Science Center at Houston, Cizik School of Nursing</td>
<td>2017</td>
</tr>
</tbody>
</table>

**PUBLICATIONS**

**Peer-Reviewed Publications**


**PRESENTATIONS**

**Local**


**Regional/ State**


**PROFESSIONAL SERVICE**

**Editorial Panels**

<table>
<thead>
<tr>
<th>Journal</th>
<th>Role</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal of the American Heart Association (JAHA)</td>
<td>Peer Reviewer, Invited</td>
<td>2018-present</td>
</tr>
</tbody>
</table>

**Professional Memberships**

<table>
<thead>
<tr>
<th>Role</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Association of Critical Care Nurses</td>
<td>1982-1992</td>
</tr>
<tr>
<td>Texas Association of Cardiovascular and Pulmonary Rehabilitation</td>
<td>1991-1996, 2016-present</td>
</tr>
<tr>
<td>American Heart Association</td>
<td>2018-present</td>
</tr>
<tr>
<td>Southern Nursing Research Society</td>
<td>2018-present</td>
</tr>
</tbody>
</table>

**INSTITUTIONAL SERVICE**

<table>
<thead>
<tr>
<th>Institution</th>
<th>Role</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest Texas Hospital</td>
<td>Coordinator, Patient Education for Coronary Care Unit</td>
<td>1988-1991</td>
</tr>
<tr>
<td>Amarillo, Texas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Plains Baptist Hospital</td>
<td>Quality Care Committee</td>
<td>1991-1994</td>
</tr>
<tr>
<td>Amarillo, Texas</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Representative for Heart Health Center

**COMMUNITY SERVICE**

<table>
<thead>
<tr>
<th>Organization</th>
<th>Role</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Heart Association</td>
<td>Fundraiser</td>
<td>2002-2012</td>
</tr>
<tr>
<td>Westview School</td>
<td>Room parent</td>
<td>2001-2003</td>
</tr>
<tr>
<td>Commonwealth Elementary School</td>
<td>Coordinator, Library Volunteers</td>
<td>2004-2007</td>
</tr>
<tr>
<td>Fort Settlement Middle School</td>
<td>Coordinator, Theater Department Volunteers</td>
<td>2008-2011</td>
</tr>
<tr>
<td>Fort Settlement Middle School</td>
<td>Theater Volunteer of the Year Award</td>
<td>2010, 2011</td>
</tr>
<tr>
<td>Clements High School</td>
<td>Member, Theater Booster Club</td>
<td>2011-2015</td>
</tr>
<tr>
<td>Clements High School</td>
<td>Member, Choir Booster Club Fundraising Chairman, Choir Booster Club</td>
<td>2012-2015</td>
</tr>
</tbody>
</table>