

in medicine we compartmentalize but we are this integrated being - more than the disease/organ process that's dysfunctional

Objectives

Identify	Identify the connection between the musculoskeletal system and stress
Describe	Describe connections between the mind and homeostatic mechanisms
Delineate	Delineate social factors which may impact a patients health and wellbeing
Identify	Identify how stress and depression can effect a person's health
Outline	Outline ways to connect with patients on a mental and spiritual level

The UNIT of MIND, BODY, SPIRIT

- ▶ Our thoughts create feelings this becomes a chemical response and induces hormonal changes.
- ▶ Our stresses and fears become neural impulses.
- ▶ **“Acute and chronic stress can cause an imbalance of neural circuitry subserving cognition, decision making, anxiety, and mood with increased or decreased expression of behaviors. This imbalance affects the systemic physiology via neuroendocrine, autonomic, immune, and metabolic mediators.”**



a connection implies something that is separate that needs to be connected- but it is not- there is no connection-

AT Still had it right- we are a UNIT. We don't need a mind body spirit connection- because we are whole, we are one.

We are layers imprinted on each other.

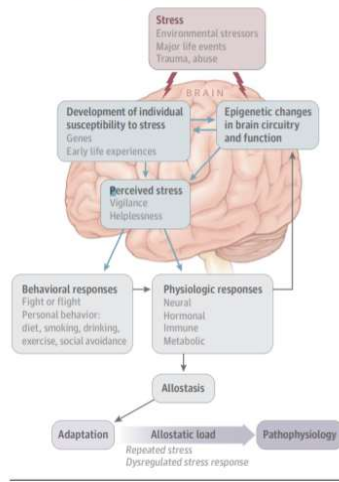
Our emotions, our stresses, or thoughts become the fabric of our physiology- they aren't just connected, they are interwoven together.

Our thoughts and feelings become chemicals and hormones, our stresses and fears neural impulses reaching out to all areas of our body!

STRESS!!!!

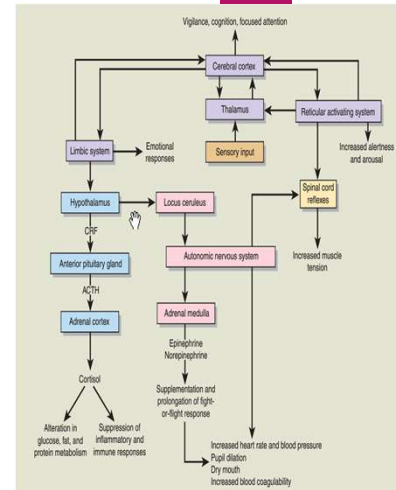
- ▶ Stress effects the HPA access
 - ▶ Hormone release- Cortisol
 - ▶ Alters immune function
 - ▶ Sympathetic tone increases
 - ▶ HR, BP, physiology changes
 - ▶ Effects behavioral choices
- ▶ Short term- this is lifesaving
- ▶ Long term- effects can be devastating

Figure. Central Role of the Brain in Allostasis and the Behavioral and Physiological Response to Stressors



Adapted from McEwen.⁴

McEwen, B. Allostasis and the epigenetics of brain and body health over the life course the brain on stress. JAMA Psychiatry 2017;74(6):551-552



Stress effects our hypothalamic pituitary axis- this drives a flood of chemical, hormonal and neural impulses

There is an increases in sympathetic tone- and an increases cortisol

This significantly effects and alters our immune system, speeds up our heart rate and alters any number of physiologic processes

For the short term? Our physiologic response to stress is lifesaving- for the long term the effects can be devastating

Our body doesn't differentiate the stress from running from a bear or fighting off an infection from a deadline or the charts you need to complete

All of these chronic hormonal and neurologic changes potentially leading to disease, cancer and a multitude of somatic complaints

Effect of Stress on Neurologic Structures

- ▶ McEwen, B. Nasca, C. Gray, J. Stress effects on neuronal structure: hippocampus, amygdala, and prefrontal cortex. Neuropsychopharmacology 2016; 41(1):3-23

▶ Acute stress

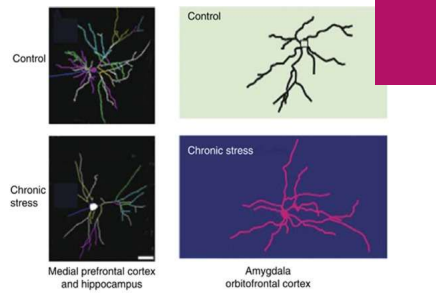
- ▶ Can enhance excitability and promote memory

▶ Chronic stress causes shrinkage of dendrites of the hippocampus

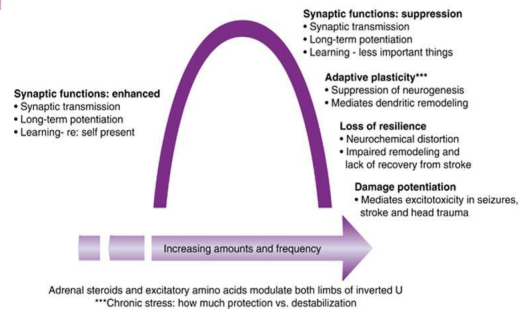
- ▶ Hippocampus is important for learning and memory
- ▶ Also important for mood regulation

▶ Prefrontal cortex with impaired connectivity in the setting of stress

▶ Hypertrophy of the amygdala



Summary: Stress - good and bad
Role in synaptic function, adaptive plasticity and damage



PFC- working memory, executive function and self-regulatory behaviors

Stress and DNA

- ▶ Stress has been found to have epigenetic changes causing methylation and other modifications of DNA. (McEwen, 2017)
- ▶ Prenatal Stress can cause epigenetic changes in the fetus that could cause lasting effects on their genomic expression. (Cao-Lai, 2020).



<https://www.sciencedirect.com/science/article/abs/pii/S0149763416307266> L. Cao-Lai, S.R. de Rooij, S. King, S.G. Matthews, G.A.S. Metz, T.J. Roseboom, M. Szyf, Prenatal stress and epigenetics, *Neuroscience & Biobehavioral Reviews*, Volume 117, 2020, Pages 198-210, ISSN 0149-7634, <https://doi.org/10.1016/j.neubiorev.2017.05.016>.

McEwen BS. Neurobiological and Systemic Effects of Chronic Stress. *Chronic Stress* (Thousand Oaks). 2017 Jan-Dec;1:2470547017692328. doi: 10.1177/2470547017692328. Epub 2017 Apr 10. PMID: 28856337; PMCID: PMC5573220.

“Moreover, adverse early life experience, interacting with alleles of certain genes, produces lasting effects on brain and body via epigenetic mechanisms. While prevention is key, the plasticity of the brain gives hope for therapies that utilize brain–body interactions. Policies of government and the private sector are important to promote health and increase “healthspan.”- McEwen



Stress Has Many Effects

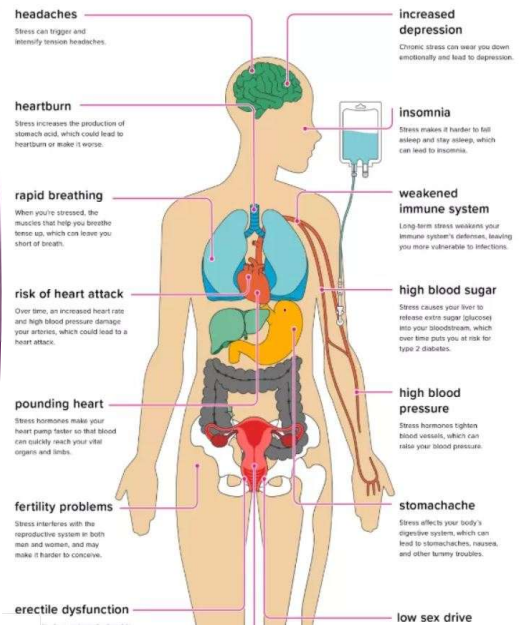
- ▶ Stress, hostility, depression and even personality type can increase a person's risk of stroke and cardiovascular disease
- ▶ Diabetic patients with depression have been shown to have poorer diet, poorer medication regimen adherence and higher healthcare costs.
- ▶ Hospitalized patients with depression have a higher risk of readmission as well as higher morbidity and mortality.
- ▶ Make one more susceptible to colds and illnesses and healing of wounds
- ▶ Stress can effect/contribute to HTN, cardiovascular disease, obesity, diabetes
- ▶ Stress can lower your threshold for pain
- ▶ Worsen skin conditions like eczema, rosacea, psoriasis- causing hives, itching or hair loss
- ▶ Worsen mental health conditions
- ▶ Can cause Reproductive system issues- Males- low testosterone, sperm production, erectile dysfunction, females- irregular menstrual cycles, PMS

<https://www.apa.org/helpcenter/stress-body.aspx>

<https://health.clevelandclinic.org/7-strange-things-stress-can-body/>

Signs of Stress Often Attributed to Disease

- ▶ Teeth grinding
- ▶ Tremors
- ▶ Rashes, hives
- ▶ Muscle spasms
- ▶ Neck/Back/body pain
- ▶ Frequent allergy attacks
- ▶ Heartburn, stomach pain, nausea
- ▶ Constipation, diarrhea,
- ▶ Chest pain, palpitations
- ▶ Excessive anxiety, worry, guilt or nervousness
- ▶ Difficulty breathing, frequent sighing
- ▶ Insomnia, concentration issues, forgetful, overwhelmed



Healthline 2017 the effects of stress on your body

every organ system is affected



Depression Effects on Health

IDENTIFY DEPRESSION TO HELP MANAGE YOUR
PATIENTS OTHER HEALTH ISSUES

May 2016 J Hosp Med

- ▶ Depressive symptoms are associated with higher rates of readmission or mortality after medical hospitalization: A systematic review and meta-analysis
 - ▶ **20.4% likely to be readmitted (those without depression at 13.7%) within 30 days**
 - ▶ **"Medical patients discharged with depressive symptoms were more likely to die within 30 days"**
 - ▶ **73% increased risk of readmission and 2-fold risk of death within 30 days with similar results at 90 days**
- ▶ Burden on the health care system
- ▶ Inadequate care for our patients
- ▶ Depression occurs in 5-58% of hospitalized adults
 - ▶ Often under-recognized and under treated



Depression Predicts All-Cause Mortality

Epidemiological Association from the ACCORD HPOQ study

► **CONCLUSIONS** Depression increases the risk of all-cause mortality and may increase the risk of macrovascular events among adults with type 2 diabetes at high risk for cardiovascular events.

► Other studies demonstrate

► Poor adherence and worse health outcomes in diabetics with depression (psychosomatics)

OBJECTIVE Depression common in Heart failure patients and leads to poorer outcomes on the full macrovascular disease outcomes in type 2 diabetes (JAMA)

RESEARCH DESIGN AND METHODS Depression increases risk of stroke (Stroke)

► Increases risk of MI and cardiac death (Medicine)

Questionnaire (PHQ)-9 was associated with a more than twofold risk of non-cancer and non-atherosclerotic associated mortality (6). However, few studies have examined the effects of depression on macrovascular and microvascular complications. Studies have also not examined the role of preexisting cardiovascular disease (CVD) or intensity of glucose control (9,12).

The ACCORD (Action to Control Cardiovascular Risk in Diabetes) trial offers a unique opportunity to examine the relationship between depression, mortality, and cardiovascular events in a sample receiving standardized diabetes care. The ACCORD trial also includes rig-

Depression can worsen medical illness

Medical illness can create depression

How will you talk to your patients about depressive symptoms

Original Contribution

Chronic Stress, Depressive Symptoms, Anger, Hostility, and Risk of Stroke and Transient Ischemic Attack in the Multi-Ethnic Study of Atherosclerosis

Susan A. Everson-Rose, PhD, MPH; Nicholas S. Roetker, BA; Pamela L. Lutsey, PhD, MPH; Kiarri N. Kershaw, PhD, MPH; W.T. Longstreth Jr, MD, MPH; Ralph L. Sacco, MD, MS; Ana V. Diez Roux, MD, PhD, MPH; Alvaro Alonso, MD, PhD

Background and Purpose—This study investigated chronic stress, depressive symptoms, anger, and hostility in relation to incident stroke and transient ischemic attacks in middle-aged and older adults.

Methods—Data were from the Multi-Ethnic Study of Atherosclerosis (MESA), a population-based cohort study of 6749 adults, aged 45 to 84 years and free of clinical cardiovascular disease at baseline, conducted at 6 US sites. Chronic stress, depressive symptoms, trait anger, and hostility were assessed with standard questionnaires. The primary outcome was clinically adjudicated incident stroke or transient ischemic attacks during a median follow-up of 8.5 years.

Results—One hundred ninety-five incident events (147 strokes; 48 transient ischemic attacks) occurred during follow-up. A gradient of increasing risk was observed for depressive symptoms, chronic stress, and hostility (all P for trend ≤ 0.05), but not for trait anger ($P > 0.10$). Hazard ratios (HRs) and 95% confidence intervals indicated significantly elevated risk for the highest-scoring relative to the lowest-scoring group for depressive symptoms (HR, 1.86; 95% confidence interval, 1.16–2.96), chronic stress (HR, 1.59; 95% confidence interval, 1.11–2.27), and hostility (HR, 2.22; 95% confidence interval, 1.29–3.81) adjusting for age, demographics, and site. HRs were attenuated but remained significant in risk factor-adjusted models. Associations were similar in models limited to stroke and in secondary analyses using time-varying variables.

Conclusions—Higher levels of stress, hostility, and depressive symptoms are associated with significantly increased risk of incident stroke or transient ischemic attacks in middle-aged and older adults. Associations are not explained by known stroke risk factors. (Stroke. 2014;45:00–00.)

Key Words: anger ■ depression ■ emotions ■ hostility ■ stress, psychological ■ stroke

Stress and negative emotions, including depression, anger, hostility, and hostility, adversely affect cardiovascular disease morbidity and mortality.¹ Less is known about their impact on stroke risk, and there are methodological limitations to previ-

ous studies.² A composite of depressive symptoms, perceived stress, neuroticism, and dissatisfaction with life was related to stroke mortality and incident stroke in community-dwelling blacks and whites.³ Anger, a negative emotion related to hos-



Personality Type

HIGHER LEVELS OF STRESS, HOSTILITY, AND DEPRESSIVE SYMPTOMS ARE ASSOCIATED WITH SIGNIFICANTLY INCREASED RISK OF INCIDENT STROKE OR TRANSIENT ISCHEMIC ATTACKS IN MIDDLE-AGED AND OLDER ADULTS

The Musculoskeletal Link to Mood

POSTURE, MOVEMENT, EXERCISE

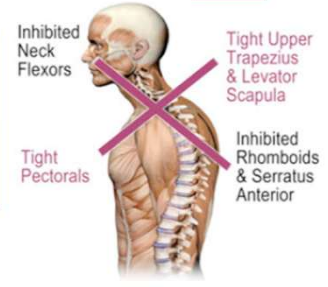


proprioceptive cues can modulate emotion - faces arranged regardless if they knew has more happiness and are less stressed

expressive facial expression or posture can cause more intense emotions through msk feedback
longer posture held - habituation

Posture and Mental Process

- **Slumped Vs. Upright Posture**
 - Effect on Confidence, metacognition
 - Posture can affect direction of thoughts
 - Slumped- lower self esteem and mood and greater fear
 - Influences Productivity
 - Influences Memory
 - Upward head tilting & Posture increased pride
 - Poor posture can leave you vulnerable to crime
 - Slumped posture led to helplessness & lack of persistence
 - Movement in a "yes" pattern produced increased preferences



Upper Crossed Syndrome

"While many of us spend hours every day using **small mobile devices** to increase our productivity and efficiency, interacting with these objects, even for short periods of time might do just the opposite, **reducing our assertiveness and undermining our productivity.**"²⁰

"Sitting upright may be a simple behavioral strategy to help build resilience to stress"

How much is our sitting- our lack of movement- our lack of a full range of physical experience affecting our physical being, and our emotional being

Check out Amy Cuddy's book "Presence" to learn more!

A GREAT podcast to listen to:

<https://www.successpodcast.com/show-notes/2018/11/14/your-secret-to-feeling-powerful-in-lifes-toughest-moments-with-dr-amy-cuddy>

If we begin with the very definition of ATTITUDE- we see that it is the arrangement of the parts of a body or figure: posture. Our very language belies the fact that our postures describe our emotional output via posture and motor behaviors- today we still ask for people's "position" on issues

William James was the first to propose that muscular and autonomic changes were responsible for the generation of emotions back in 1890 since that time, For James, physical bodily changes are the emotion and the critical cues for emotion

Embodied cognition is a concept that has become further propagated and studied- holds that our cognitions, perceptions, and responses to external events are situated in physiological experiences- and that expressive facial and postural responses of a

person influence their emotional experiences through innate neuromuscular feedback mechanisms.

Posture has stimulus properties

- many of the first studies started with facial expressions- noting that it wasn't only an emotional reaction- but had a feedback function in the regulation of that reaction- there were proprioceptive cues from facial feedback which can affect the quality and intensity of that emotion. When faces were modulated into a smile- without patient knowledge of what was occurring- people found themselves to be happier and have more positive responses- other studies have also found that smiling participants- regardless of whether or not they knew they were smiling had lower heart rates during stress recovery- There was actual psychological benefit from maintaining a positive facial expression.- both voluntary and involuntary activation of facial muscles had similar areas of activation in the brain. In this way- as one of the studies titles suggests "grin and Bear it" is an adage with value.
- The experience of affect may be influenced by proprioceptive cues
- Some have even raised the question- is facial expression a health relevant emotional indicator??
- Researchers then began to wonder if a smile can do this- what about posture? It has been postulated that expressive facial and postural responses of a person influence their emotional experiences through innate neuromuscular feedback mechanisms

Some examples of these studies include a Study of sitting in a slouched posture or upright- presented with positive and negative words- slumped posture had more negative recall bias- those upright had no such bias.

2009 study of Japanese schoolchildren who were trained to sit with upright posture were more productive in their writing assignments.

Study of College students- walk in slumped posture or skip- skippers had more energy throughout the day

The longer a posture is held it may result in habituation- so the intensity of the postural influence is strongest at its onset and decreases over time

Cognitive effort is accompanied by a visible or invisible activation of the muscles of the forehead- anger can be induced by having people furrow their brows

FEELINGS can be influenced by sensory input without cognitive interpretation

Several ways embodied cognition can work

1. Body responses can serve as simple clues
2. They can influence the amount of thinking
3. Can influence the direction of thinking
4. Can influence thought confidence

Today in developed countries 75% of work is performed while sitting- how much does our sitting- our lack of movement- our lack of a full range of physical experience affect our physical and emotional being?

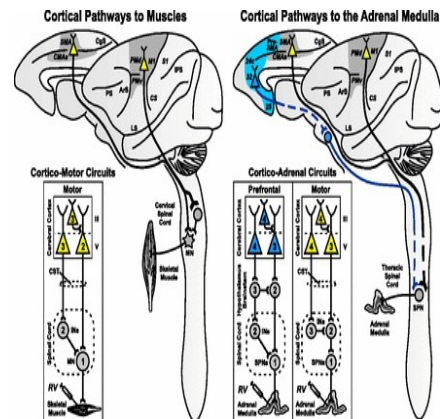
As osteopathic physicians we pay close attention to posture, mechanics and ergonomics and many of us have encountered the offenses of violating tensegrity principles. We know that Technology is transforming how we hold ourselves. The Head weighs 10-12 pounds- bend our necks to 60 degrees- increases stress to 60 pounds- what we used to see in our grandparents we are now seeing in teenagers. We know it leads to this upper crossed type pictures- affecting our neck and upper back, the TMJ, reducing lung capacity, and potentially reducing peristaltic action with slouching

But what if we take a deeper look- When we are sad we slouch- we also slouch when we feel scared or powerless- posture is the same as a depressed posture

Research has found that the size of the electronic device has a linear relationship with how it affects you- the smaller the device the more you must contract your body to use it the more shrunk and inward your posture- shown to lead to submissive attitudes. One might be able to get past this hunch by adjusting their head up and shoulders back when looking at their phone

Motor Cortex Connection to the Adrenals

- ▶ “The **control of the adrenal medulla is embedded in cortical areas that are involved in the control of movement, cognition and affect** (Fig. 5). This means that mental operations like the preparation to move, the appreciation of conflict and feelings of sadness may be linked to the regulation of adrenal function. The cerebral cortex is a site of neural plasticity and information storage. As a consequence, aberrant plasticity could be a cause of or contribute to psychosomatic illnesses, just as the engagement of cortical plasticity through moving, thinking and feeling may help to cure or ameliorate them.”
- ▶ How we move, think and feel impact the stress response through neural connections from the brain to the adrenal glands.



<https://www.pnas.org/doi/10.1073/pnas.1605044113>

A scientist- bothered by the HOW does yoga decrease stress- HOW? By distracting the mind?

Looked at the stress response and how it is facilitated by the adrenal glands

further explained that “the way people usually think about the cortex, it’s very hierarchical.” That is, perceptions come in from the world and get sent from one part of the brain to the next, to the next, to the next. They go all the way up the chain of command to the frontal cortex. That sends some signals down to create motor actions.

If stress is controlled by these few cortical areas—the part of the brain that deals in high-level executive functioning, our beliefs and existential understandings of ourselves—why would any sort of body movement play a part in decreasing stress?

They used rabies- inject it into an organ and the nerves that feed the organ will take up the virus up to the cns- they injected the adrenals of monkeys

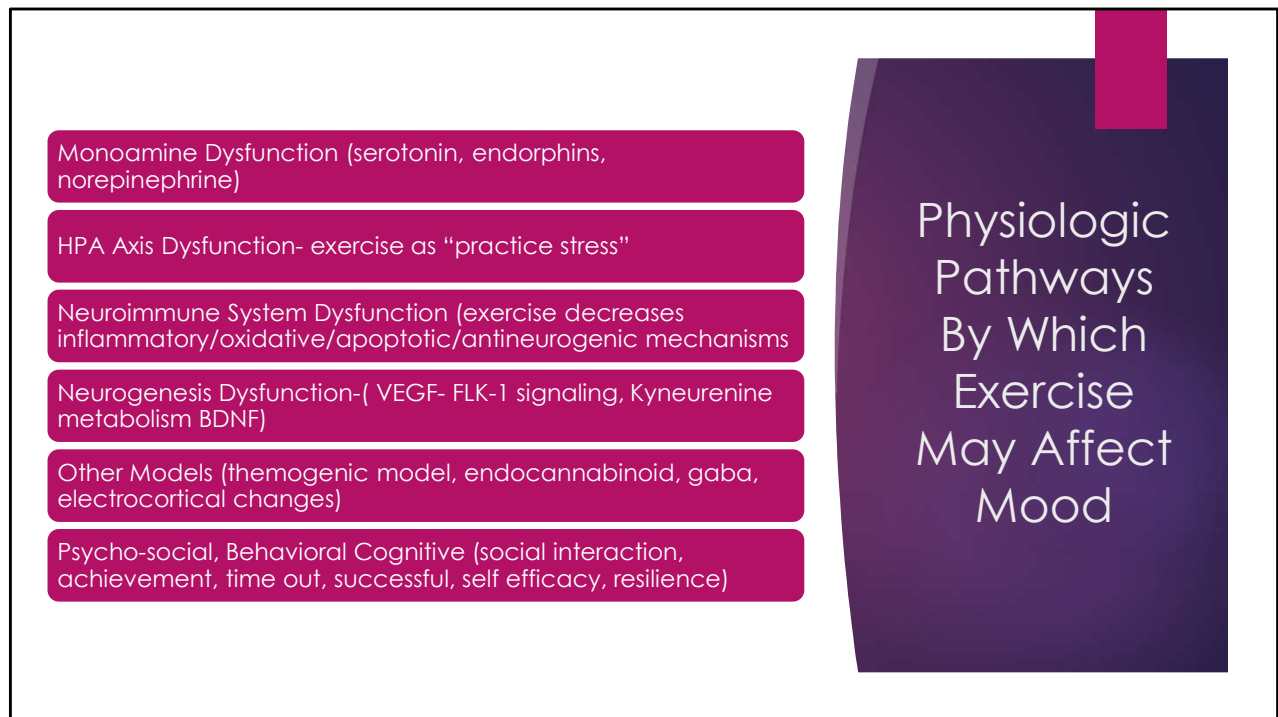
But the brains connection to the adrenals is much more complex
Motor cortices are tied directly to the stress response

A person is shown from the waist up, performing a yoga pose (Urdhva Dhanurasana or Upward Bow Pose) on a large, flat rock. They are wearing a dark, long-sleeved top and a dark, long-sleeved bottom. Their arms are extended upwards, and their legs are bent at the knees, with their feet flat on the rock. The background is a blurred landscape with green hills and a blue sky with some clouds.

Stress and Movement

- ▶ "Something about axial control has an impact on stress responses," Strick reasons. **"There's all this evidence that core strengthening has an impact on stress. And when you see somebody that's depressed or stressed out, you notice changes in their posture.** When you stand up straight, it has an effect on how you project yourself and how you feel. Well, lo and behold, **core muscles have an impact on stress.** And I suspect that if you activate core muscles inappropriately with poor posture, that's going to have an impact on stress."

<https://www.theatlantic.com/science/archive/2016/08/cortical-adrenal-orchestra/496679/>



Monoamines- Increase in response to stressors and pain

Opioids

B- endorphin calms the sympathetic nervous system and provides analgesic relief

May stay elevated 2-3 days

Serotonin

increases with activity (increased production)

Norepinephrine and Epinephrine

increased levels with activity (increased release)

Dopamine

Increased levels with activity

HPA axis

- Prolonged stress can lead to increased cortisol levels
- Early life events can lead to a persistent sensitization of the HPA-axis
- Dysregulation related to psychiatric disorders
- Depression usually has hyperactivity of the HPA axis
- Exercise leads to a physiological

“toughness”

So patients have risk factors- exposure to stress- genetic polymorphisms which then triggers a cascade of neural-injury

It has been theorized that decreased rates of adult neurogenesis is partly responsible for depressed mood

Many current antidepressant medications result in hippocampal neurogenesis in lab animals

hippocampal neurogenesis plays a critical role in cognitive function and also emotional well-being and development and improvement of depression

B- endorphins have been linked to growth which we have already talked about and lower levels of serotonin have been linked to neurogenesis dysfunction

VEGF (vascular endothelial growth factor) increases with exercise- also linked to growth

In an experiment with mice- when they were given an inhibitor for the VEGF-Flk- 1 pathway- the exercise effects of neurogenesis in the hippocampus were attenuated- it might be through this pathway that exercise stimulates growth.

Kynurenine pathway is the way in which tryptophan is metabolized- stress , cortisol or other inflammatory mediators can activate this pathway. The metabolites from this pathway have been implicated in brain disorders including depression. Kynurenine aminotransferases (KATs) in the periphery can change kynurenine into kynurenic acid which reduces the amount that reaches the brain- increase in KATs in exercising rats- see the potential for exercise as a key adjunct therapy for stress related disorders because of this pathway.

Additionally Reduced serotonin leads to more vulnerability of cells to stress and sets up a positive feedback loop for continued neurobiological damage- kynurenine further metabolized- neurotoxic causes apoptosis

BDNF (brain derived neurotrophic factor) involved in brain neuroplasticity, differentiation and survival of neurons- normal levels associated with maintenance of normal cognitive function and mood- impairments lead to reduced memory, learning, depressive symptoms and anxiety.- shown to significantly increase with exercise- and increase more so with high intensity vs low intensity aerobic exercise.

Exercise has a neuroprotective and anti-inflammatory effect on the brain and stress

related neuropsychiatric pathologies

Psychobiological describes a chemical, behavioral and cognitive factors to explain the effects of exercise- we've already talked about potential chemical and neural pathways- however there are still behavioral and cognitive factors to be considered when using exercise as an antidepressant.

It has been proposed that exercise releases positive thoughts and feelings- which may help break down a depressive affect spiral- our thoughts create us daily

Catalyze a transformation

How many people here have been working out and had a particular insight to something you were working on?

Exercise may not resolve the problem- but may offer temporary relief- like an aspirin

Can cause distraction, interrupt rumination, alteration of consciousness

Cardiovascular fitness isn't the whole picture as people have immediate effects- however the longer the subjects were in the exercise group the greater the decrease in depression

Time out- one study looked at exercise while studying and while just working out- and the "time out" session was the only one in which anxiety was reduced- supporting the time out assertion

Supportive environment necessary for self-efficacy- those who received negative feedback about exercise had more anxiety than those who received positive feedback

Activities that target self efficacy may be particularly effective in reducing anxiety- 45 minutes of mixed martial arts was associated with greater decreases in anxiety and increases in positive affect than 45 minutes on a stationary bike

"Anatomical studies tend to depict images that are two dimensional, thus missing the most important element, emotional life. At the same time, psychology, which is committed to the study of emotion, lacks an anatomical understanding. Without anatomy, emotions do not exist."⁹

~Stanley Keleman

"FEELINGS HAVE A SOMATIC ARCHITECTURE"⁹

Emotions
↓
Posture Shifts
↓
Sensorimotor changes



When we look through anatomy texts, we see only the structures the bones and joints, muscles and ligaments- a 2 D picture of our very physicality- from the psychology side we have no pictures- only abstract notions of cognition, emotion, mood. While we acknowledge some structure functions aspect of the mind/body link- the importance of the monoamines, serotonin, norepinephrine, dopamine- we need to dive deeper- beyond the physical chemistry of mood but to the musculoskeletal structures involved

A person cannot have existence apart from their physical body and physical postures and shapes change with emotional experiences- these feelings are communicated by positional shifts and postural changes, proprioception and sensorimuscular system elicited through our somatic architecture. This embodiment is the way a person transforms their inner experience into a personal shape.

Beginning by observing the very uprightness our posture, each individuals unique accommodation to gravitational struggle- developmental struggle and emotional struggle is reflected- our posture- our shape, is the result of our battles and challenges, defeats and insults defining our shape and changing our relationship with gravity.

As we observe for posture, denoting the plumline from EAM to shoulder, hip to knee to ankle- we should move beyond purely biomechanical abstractions and begin to observe the collapse of defeat, the rigidity of fear and identify the somatic architecture of resultant patterns of feelings and experiences.

And if we believe that our mental and emotional states are expressed through our anatomical structures- that would lead us to know that deep emotions and trauma may not be resolved until they have been worked on somatically?

And similar to feeling our patients bodies and getting a palpatory picture of physical insults and the biomechanics of the injury- can we find the pattern of insults and neural muscular changes to identify the emotions behind it.



Trauma and Emotion

HOW CAN LIFE TRAUMAS EFFECT THE BODY, MIND AND SPIRIT



Adverse Childhood Experiences (ACES)

- ▶ Study performed through Kaiser- 9,508 responses
- ▶ Adverse childhood events included: psychological, physical or sexual abuse, violence against mother, living with household members who were substance abusers, mentally ill or suicidal or imprisoned.
- ▶ **The more childhood exposure to ACEs, they have higher risks for:**
 - ▶ Alcoholism, drug abuse, depression, suicide, smoking, poor self-rated health, >50 sexual intercourse partners, STD, physical inactivity, obesity
 - ▶ CAD, Cancer, Chronic lung disease, skeletal fractures, liver disease

Felitti, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults- The adverse childhood experiences (ACE) study. *American Journal of Preventative Medicine* 1998;14(4):245-258

How Trauma Lodges in the Body

► <https://onbeing.org/programs/bessel-van-der-kolk-how-trauma-lodges-in-the-body-mar2017/>

► **Podcast- Bessel Van Der Kolk**

► Van der Kolk, B. The body keeps the score: Memory and the evolving psychobiology of posttraumatic stress. 1994 Harvard Medical School

► http://www.franweiss.com/pdfs/sensorimotor_vanderkolk_1994.pdf

► The body keeps the score Brain, mind, and body in the healing of trauma

- **Psychological effects of trauma are stored in the body and have a biological stress response**
 - Recalibrates the brains alarm system
 - Trauma is not something that happened in the past- its an imprint on the mind, brain and body
 - Trauma actually alters the way we think via circuitry
- **Long after a traumatic experience any hint of danger can mobilize disturbed brain circuits and secrete stress hormones**
 - The body needs to learn that the danger has passed.
- **These people often present with depression, anxiety and PTSD**
 - Medications suppress problems but don't address underlying issues.

Mind, Body, Spirit Treatment

HOW CAN WE BRING THESE
CONCEPTS INTO OUR EVERYDAY
INTERACTION WITH PATIENTS?



Meditation & Breath

- ▶ Parasympathetic stimulating
Improved HRV
- ▶ Reduced heart rate variability demonstrates autonomic inflexibility- either too much sympathetic tone or not enough parasympathetic tone
- ▶ Individuals with lower HRV have been found to be physically or emotionally sicker, older, less aerobically fit, physically compromised or at greater risk of dying.
- ▶ Baroreceptor Reflex
- ▶ Emotions, blood pressure heart rate and respiratory rate all exist as one
- ▶ 6 Breaths per minute



Many meditation practices have you focus on your breath

You have access to it at any moment- and it changes moment to moment, stress, relaxation, happiness, depression all affect the rate and depth of your breath- so you can use it as an assessment tool, but also it can be used as a **doorway- to tap directly into and take control of your autonomic nervous system.**

Slowing your breath down has a deeply parasympathetic effect

And there is some interesting science behind breath and how it does this-

- **Deep breathing has been shown to demonstrate improved heart rate variability-** as we know a measure of homeostasis and cardiac health. a staccato beat beat beat is not as healthy as a more variable beating heart- **higher HRV measures show lower biomarkers for stress, improved resilience and better cognitive function.**
- **Reduced heart rate variability demonstrates autonomic inflexibility- either too much sympathetic tone or not enough parasympathetic tone**

- **Individuals with lower HRV have been found to be physically or emotionally sicker, older, less aerobically fit, physically compromised or at greater risk of dying.**
- Lower HRV has also been found in patients with **PTSD**- in fact a **JAMA Psychiatry** article found that US marines with Lower HRV prior to deployment had higher vulnerability to PTSD. This helps to identify further factors that show our body is a unit- that a cardiac physiologic function via the autonomic nervous system can have implications on the very resilience of a human being.

During normal breathing- there is not much additional variation in HRV- but with deep breathing we can have more of an influence

HRV is systematically related to breathing frequency with greater amplitudes and slower respirations-

6 breaths per minute is the magic number- breathing at this rate is thought to produce the highest oscillations in heart rate and most efficient gas exchange

Additionally breathing in this slow way can affect the baroreceptor reflex

Afferents from the baroreceptor reflex track back to the **nucleus solitarius** in the brainstem which communicates directly with the **amygdala**. The brain center of fear. Understanding this physiology advances our idea of the continuum- the unit of our **body- how emotions and blood pressure, heart rate and respiratory rate all exist as one.**

and we can feel this on ourselves- so make sure you are sitting comfortably on your ischial tuberosities- your sit bones- and we will do a bit of breathwork now- note that you should never force your breath- if you feel short of breath or get dizzy- just return to your normal breathing- breathing through your nose

Find your pulse- feel it- monitor it- empty all your breath and then take a long slow inhale- feel it quicken by just a little bit- inhalation is a sympathetic response then take a long slow exhale and feel your heart rate slow- this is a parasympathetic response

See if you can inhale for a count of 4 or 6 and exhale for a count of 4 or six. Slow your breath down. Gently take control of your autonomic nervous system.

Can you feel what breathing slower does for you- can you feel your physiology- can you become more aware of internal body sensations.

Can you bring more breath to different parts of your body? To your pelvic floor? To your toes?

Can you notice the pause in-between- the space in-between- inhalation and

exhalation. Maybe consider your breath as a box- a long slow steady inhale, a pause, a long slow steady exhale, a pause

With each breath we pause- we take a break

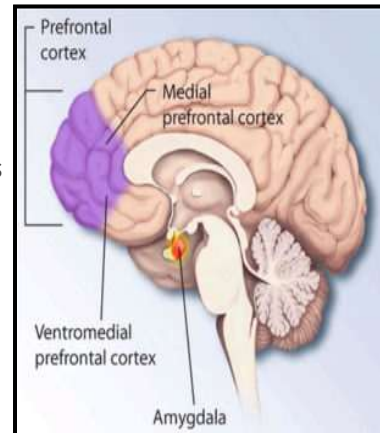
What lives in that pause- in that space- can you elongate it and live there? Again- not forcing anything the body isn't willing to do- pranayama- breath work is potent stuff- it changes physiologic processes- so if it doesn't feel good- let it go and return to your normal breath!

And now that we have been doing this practice for a moment- return to your normal breath- remember how we checked in in the beginning? What does it feel like now?

In yoga we talk about Sthira (steadiness) and Sukha (ease).- is your breath steady? Is it easy?

Meditation & Structural/Functional Changes in the Brain

- ▶ Researchers have been studying alterations in morphology and neural mechanisms with EEG and FMRI- so looking at both structural and functional changes in the brain
- ▶ Though there is still variability in some of the finding, most studies indicate that with **regular meditation the gray matter volume in the orbito-frontal cortex, ventromedial prefrontal cortex and anterior insula increases as well as larger volumes of the hippocampus**
- ▶ These areas are critical for emotional regulation and response control as well as learning and memory processes- they allow us to regulate negative emotion, self direct cognition



<https://blogs.scientificamerican.com/guest-blog/what-does-mindfulness-meditation-do-to-your-brain/>

Meditation can not only effect your HRV and alter autonomic functions in your body, but it may actually change the size and shape of your brain!

Researchers have been studying alterations in morphology and neural mechanisms with EEG and FMRI- so looking at both structural and functional changes in the brain

Though there is still variability in some of the finding, most studies indicate that with **regular meditation the gray matter volume in the orbito-frontal cortex, ventromedial prefrontal cortex and anterior insula increases as well as larger volumes of the hippocampus**

These areas are critical for emotional regulation and response control as well as learning and memory processes- they allow us to regulate negative emotion, self direct cognition

The brain also activates different regions during meditation including the hippocampus and the insula- again areas of emotional processing and self awareness

Size and function of the brain can also decrease- such as in the amygdala- the warning bell of the brain- some studies have shown that those who meditate may decrease in the size of the amygdala

Using particular nerves or particular neural pathways is a **little like hiking on a trail- our neurons form greater dendritic connections** well used trails will have a deep groove- but what if these trails are dysfunctional as in patients who experience trauma, PTSD or simply common everyday stressors of life? Their well worn trail is the limbic system fear centers which gets activated easily during times of stress and throws us into freeze/fight/flight mode-

Meditation is a way to tap back into our intentional state

How can we create and generate new pathways, new trails- trails we make deep grooves in by walking them everyday- clearing away the brush? Trails that allow us to move away from emotional, fearful responses to being able to better engage our prefrontal cortex

This is how meditation can be used to treat people who have experienced or lived through trauma- by steering our mind away from the amygdala – the fearful alarm system of the brain to the prefrontal cortex- strengthening these pathways and allowing us better access to our rational mind.

Mindfulness meditation focuses on stabilizing attention, releasing sensations and emotions without affective reaction and provides a way to monitor thoughts without being effected by them- self awareness- a type of meta cognition

Citation: Taren AA, Creswell JD, Gianaros PJ (2013) Dispositional Mindfulness Co-Varies with Smaller Amygdala and Caudate Volumes in Community Adults. PLoS ONE 8(5): e64574. <https://doi.org/10.1371/journal.pone.0064574>

145 people- functional MRI in people who practiced mindfulness

- Smaller amygdala volumes (prior studies with altered amygdala responses)

- Lower caudate volumes

 - Associated with negative affect

 - “These findings help identify candidate structural neurobiological pathways linking mindfulness with reduced stress and negative affectivity in a broad range of studies”

Mantra Chanting Singing

- ▶ Has an effect on the vagus nerve
- ▶ Vagus nerve has a direct effect on the neuroendocrine-immune axis
- ▶ Vagus nerve has a direct connection to the hippocampus and indirectly to amygdala
- ▶ Slows breathing to 6 breaths per minute



Mantra, chanting and singing can also be used as a means of meditation- It also has a parasympathetic response- thought to be mediated via the vagus nerve.

The vagus nerve (the wandering protector) is a major component of autonomic nervous system balance, homeostasis and the neuroendocrine-immune axis where it plays a key role in an anti inflammatory effect- even directly effecting immune cells

many forget that it has both afferent- up to 70-80% of the vagus fibers can be afferent- sensory- bringing sensory innervation IN

The **dorsal vagal complex** also projects directly to the hippocampus, raphe nucleus and indirectly to the locus coeruleus and amygdala- major sources of serotonin and noradrenergic neurons- areas of the brain that attend to fear, anxiety, pain modulation, emotional responses

Newer information is coming out each day about the vagus nerves afferent role and how it may affect mood

And it's already being used via **Vagal nerve stimulation** with an electronic stimulator used for headaches, seizures, heart failure and it's antidepressant effects

Mantra, chanting and singing- though we are not sure how yet- may affect the vagus nerve in several ways

- via sound vibrations around vagal innervation around the ear includes the auricular branch of the auricular nerve which also innervates the external auditory meatus and concha.
- Various forms of paced breathing may be influence brain electrical activity which might be mediated by VNS arising from the diaphragm. Animal models have demonstrated innervation of the crura of the diaphragm by the vagus nerve- so diaphragm motion may influence vagus afferents via vagal mechanoreceptors.
- Also the recurrent laryngeal nerve is a branch off of the vagus nerve- various types of singing, mantra or chanting may have an effect on vagus afferents.

In fact, singing, chanting and mantra are all paced breathing- found to slow one's breath down to that 6 breath per minute ratio we previously discussed

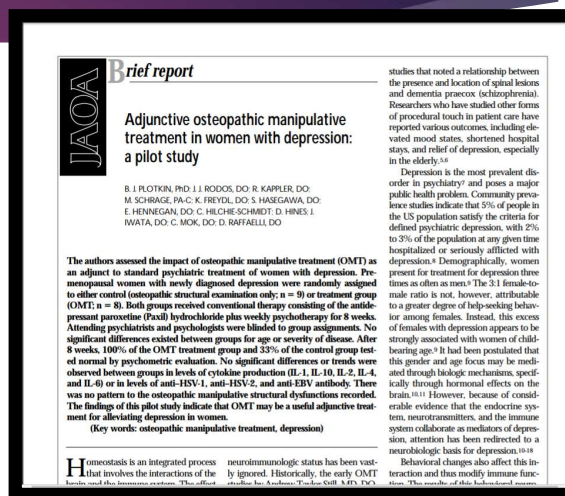
Small studies have had some interesting results

An Italian study looked at recitation of the **ave maria (in latin) or mantra (om-mani-padme-om) or regular breathing** or metronome breathing on RR interval, blood pressure and cerebral circulation. 23 healthy subjects were measured with EKG, respiration, wrist blood pressure and doppler ultrasound.

Respirations were slowed to 6 per minute with improved HRV, baroreceptor reflex sensitivity and rhythmic fluctuations in cerebral blood flow.

Osteopathic Manipulative Medicine and Depression

- ▶ Addressing structural somatic dysfunction can improve body health and assist with mood
 - ▶ Postural restrictions and shortening of flexor muscles with prolonged depressed posture
 - ▶ Vagus nerve
- ▶ Hands on medicine is healing
- ▶ Emotional releases with treatment



<https://www.degruyter.com/document/doi/10.7556/jaoa.2015.019/html>

-First year medical students reporting decrease in fatigue and depression with OMT.

A decreased cranial motion has been reported in patients with depression and other psychological disturbances. studies have shown the complex interplay of psychological state and neuroendocrine-immune function. This includes alterations in rates of healing, immune function and autonomic tone during psychological disturbances.

Other somatic manifestations in depression are related to postural changes.

The depressed patient tends to adopt a slouched forward posture, which leads to the development of exhalation dysfunctions in the ribcage (and shallow breathing) and shortening of the psoas muscles, lower back pain, with partial un-doming of the abdominal diaphragm.

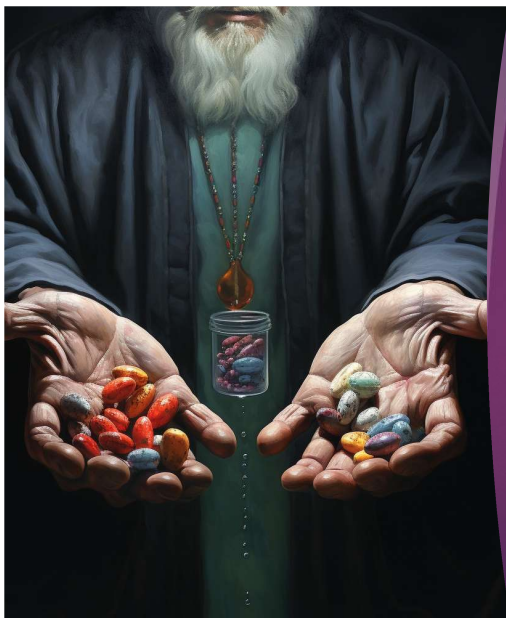
Additionally,

there is hyperflexion of the cervical spine as well as increased

kyphosis in the thoracic spine and a dropped sternum allowing for less full breaths.

Patients suffering from depression and other psychological disturbances often have shallow and rapid breathing, causing a dysfunction of the respiratory-circulatory system to effectively return lymph to the central circulation and venous blood to the heart.

This change in posture can also lead to chronic pain along with the affected, slouched regions. Hence, an OMT focus on these systems would aid in treatment



Prayers, Intentions, Positive Thinking & Placebo



Prayers

- ▶ Harris, W et al. A randomized, controlled trial of the effects of remote, intercessory prayer on outcomes in patients admitted to the coronary care unit. Arch Intern Med 1999;159(19):2273-2278
 - ▶ **'Remote, intercessory prayer was associated with lower CCU course scores. This result suggests that prayer may be an effective adjunct to standard medical care.'**
- ▶ Astin et al. The efficacy of "distant Healing": A systematic review of randomized trials. Ann Intern Med 2000;132:903-910
 - ▶ **The methodologic limitations of several studies make it difficult to draw definitive conclusions about the efficacy of distant healing. However, given that approximately 57% of trials showed a positive treatment effect, the evidence thus far merits further study**

The Power of Placebo

- ▶ Kaptchuk, T. Miller, F. Placebo effects in medicine. NEJM 2015;373:8-9
<http://www.nejm.org/doi/full/10.1056/NEJMp1504023#t=article>
- ▶ **"Placebo effects rely on complex neurobiologic mechanisms involving neurotransmitters (e.g., endorphins, cannabinoids, and dopamine) and activation of specific, quantifiable, and relevant areas of the brain (e.g., prefrontal cortex, anterior insula, rostral anterior cingulate cortex, and amygdala in placebo analgesia)"**
- ▶ The effects of symbols and clinician interaction can dramatically enhance the effectiveness of pharmaceuticals
- ▶ There can be nocebo effects as well
 - ▶ Anticipation of negative effects of medication or therapy
 - ▶ If you tell your patient about side effects- more likely to have them!
 - ▶ 4-26% of people in studies who receive placebos discontinue them due to side effects

Or to borrow terms from the behavioral social sciences, healing interactions "frame," "anchor," or "nudge" patients toward shifts in their perceptions of their symptoms and illness, making them less disturbed or perturbed

Medicine has used placebos as a methodologic tool to challenge, debunk, and discard ineffective and harmful treatments. But placebo effects are another story; they are not bogus

Great podcast on the power of placebo

<http://brainsciencepodcast.com/bsp/2016/127-Benedetti>



Human Connection

THE IMPORTANCE OF CONNECTION

BMJ Heart 2016

- ▶ **Conclusion: deficiencies in social relationships are associated with an increased risk of developing CAD and stroke**
 - ▶ Comparable to smoking and **GREATER** than risks due to obesity and HTN
- ▶ **Loneliness and social stress activates the HPA axis, activates inflammation, gene expression, oxidative stress, glucocorticoid resistance**
- ▶ **Strong social relationships can increase survival by as much as 50% compared to those with weaker relationships**
- ▶ We talk to our patients about smoking, lowering cholesterol and losing weight. What about encouraging social interaction?

Loneliness and social isolation as risk factors for coronary disease and stroke: systematic review and meta-analysis of longitudinal observational studies

Nicole K Valtorta¹, Mona Kanaan², Simon Gilbody³, Sara Ronzi⁴, Barbara Hanratty⁵

Author affiliations +

Abstract

Background The influence of social relationships on morbidity is widely accepted, but the size of the risk to cardiovascular disease (CVD) is unclear.

Objective This systematic review and meta-analysis to investigate the association between loneliness or social isolation and risk of CVD (CHD) and stroke.

Methods Sixteen electronic databases were systematically searched for longitudinal studies set in high-income countries published up until May 2015. Two independent reviewers screened studies for inclusion and extracted data. We assessed the quality of the evidence using a component approach and pooled data for analysis using random effects models.

Results Of the 35 925 records retrieved, 23 papers met inclusion criteria for the narrative review. They reported data from 11 longitudinal datasets, for a total of 4628 CHD and 3002 stroke events recorded over follow-up periods ranging from 3 to 15 years. Reports of 11 CHD studies and 8 stroke studies provided data suitable for meta-analysis. Poor social relationships were associated with a 29% increase in risk of incident CHD (pooled relative risk: 1.29, 95% CI 1.04 to 1.59) and a 32% increase in risk of incident stroke (pooled relative risk: 1.32, 95% CI 1.04 to 1.68). Subgroup analyses did not identify any differences by gender.

Conclusions Our findings suggest that deficiencies in social relationships are associated with an increased risk of developing CVD and stroke. Future studies are needed to investigate whether interventions targeting loneliness and social isolation can prevent two of the leading causes of death and disability in high-income countries.

Study registration number CRD42014010225.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5831910/>
Another descriptive article

Bringing this into your patients lives

- ▶ Yoga, Tai chi, or other mindful movement
- ▶ Exercise
- ▶ Counselling, CBT
- ▶ Meditation
- ▶ Encouraging Community
- ▶ Prayer or positive thinking for your patients
- ▶ Addressing Stressors
- ▶ What brings you Joy
- ▶ Sleep
- ▶ Healthy eating

Table 2

Interventions that help the brain change itself

Regular physical activity

Increased hippocampal volume and PFC blood flow and improved executive function and memory ([Erickson et al., 2011](#)).

Mindfulness-based stress reduction

Reducing anxiety decreases amygdala volume in those individuals who responded to a mindfulness-based stress reduction therapy ([Holzel et al., 2010](#)).

Social support and integration

Experience Corps for elderly volunteers, who showed improved executive function, increased blood flow in PFC, and better overall health with slower decline.

Meaning and purpose (eudaimonia) are a likely component along with social support and increased physical activity ([Carlson et al., 2009](#)).

To develop a meditation habit: try the easiest thing- one minute

Pick a time of day or time it with something specific so you can't forget

I had a teacher who once told me how important meditation was- and I said I had a hard time finding time to meditate- he said- I see you are wearing pants today- how did you find time to put your pants on- and I said- well of course-I can't go out **pantless**- ah he said- you have to make meditation as important as putting on pants- you just can't not do it!

Sometimes I think using apps and technology seems counterintuitive to meditation- I mean afterall- it's often our phones and our technology that we need to get away from! But they can serve as an awesome tool and resource for getting you started!

Many are free- while you can get more features with a paid subscription

What many of these have in common are **reminders, alarms** to remind you to take a pause and take a breath

Ranges of time from minutes to half an hour

Track progress to stay engaged, motivate, and some apps even propose **challenges** or some like insight timer

connect you with others who are meditating at the same time on a world map

Some are geared towards **particular outcomes** such as sleep, compassion, depression, anxiety

Find that works for you- not all meditations are created equal and one may resonate with you more than another- you may like one that focuses on:

Mindfulness during different parts of your day- walking, in the shower, commutes, mealtime

Breathing techniques

Guided meditation

Stilling the mind

Mantras

Body Scans

Soothing sounds

Music, stories, animations

Include fitness or movement

Smart Technology Meditation

- ▶ Meditopia
- ▶ Headspace
- ▶ Calm
- ▶ MINDBODY
- ▶ Expand
- ▶ Insight Timer
- ▶ Smiling Mind
- ▶ Meditation Timer Pro
- ▶ Sattva
- ▶ Stop, Breathe & Think
- ▶ 10% Happier
- ▶ Breethe
- ▶ Simply Being
- ▶ Omvana
- ▶ Aura



HEADSPACE®
TREAT YOUR HEAD RIGHT



How a handshake can
begin to make you feel
well

Wolfgang G. Gilliar DO
TEDXNYIT

[HTTPS://WWW.YOUTUBE.COM/WATCH?V=OD5MFKAO_VK&APP=DESKTOP](https://www.youtube.com/watch?v=OD5MFKAO_VK&app=desktop)

Bibliography

- ▶ Felitti, V. et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The adverse childhood experiences study. *Am J Prev Med* 1998;14(4):245-258
- ▶ Everson-Ros, S. et al. Chronic stress, Depressive symptoms, anger, hostility, and risk of stroke and transient ischemic attack in the multi-ethnic study of atherosclerosis. *Stroke (AHA Journals)* 2014;45:00-00
- ▶ Moussavi, S. et al. Depression, chronic diseases and decrements in health: results from the world health surveys. *The lancet* 2007;370(9590): 851-58
- ▶ Ciechanowski, P, et al. Depression and diabetes: impact of depressive symptoms on adherence, function, and cost. *Arch Intern Med* 2000;160(2):3278-85
- ▶ Valtorta et al. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *BMJ* 2016;0:1-8
- ▶ Pederson, J. et al. Depressive symptoms are associated with higher rates of readmission or mortality after medical hospitalization : a systematic review and meta-analysis. *Journal of Hospital Medicine* 2015;11(5):373-380
- ▶ Nair, S. et al. Do Slumped and upright postures affect stress responses? a randomized trial. American Psychological Association 2014; <http://dx.doi.org/10.1037/hea0000146>
- ▶ Kraft, T. et al. Grin and bear it: the influence of manipulated facial expression on the stress response. *psychological science* 2012 published on-line
- ▶ Harkin, A. Muscling in on depression. *NEJM*. 2014;371(24):2333-2334

Bibliography Continued

1. Everson-Ros, S. et al. Chronic stress, Depressive symptoms, anger, hostility, and risk of stroke and transient ischemic attack in the multi-ethnic study of atherosclerosis. *Stroke (AHA Journals)* 2014;45:00-00
2. Mousavi, S. et al. Depression, chronic diseases and decrements in health: results from the world health surveys. *The Lancet* 2007;370(9590): 851-58
3. Ciechanowski, P. et al. Depression and diabetes: impact of depressive symptoms on adherence, function, and cost. *Arch Intern Med* 2000;160(2):3278-85
4. Valtorta et al. Loneliness and social isolation as risk factors for coronary heart disease and stroke: systematic review and meta-analysis of longitudinal observational studies. *BMJ* 2016;0:1-8
5. Pederson, J. et al. Depressive symptoms are associated with higher rates of readmission or mortality after medical hospitalization : a systematic review and meta-analysis. *Journal of Hospital Medicine* 2015;11(5):373-380
6. Bergland, C. Diaphragmatic Breathing exercises and your vagus nerve. *Psychology Today*. May 16, 2017
7. Lehrer, P., Gevirtz, R. Heart rate variability biofeedback: how and why does it work? *Front. Psychol.* July 2014
8. Wang, S. et al. Effect of slow abdominal breathing combined with biofeedback on blood pressure and heart rate variability in prehypertension. *J Altern Complement Med*. 2010; 16(10):1039-45
9. Svoboda, R., Blossom, S. Sthira and sukha: steadiness and ease. *Yoga international* <https://yogainternational.com/article/view/sthira-and-sukha-steadiness-and-ease>
10. Minassian, A. et al. Association of predeployment heart rate variability with risk of postdeployment posttraumatic stress disorder in active-duty marines. *JAMA Psychiatry*. October 2015;72(10):979-986
11. Young, R. Sensory and motor innervation of the crural diaphragm by the vagus nerves. *Gastroenterology* March 2010; 138(3):1091-1101
12. Bernardi, L. et al. Effect of rosary prayer and yoga mantras on autonomic cardiovascular rhythms: comparative study. *BMJ* 2001;323(7327):1446-1449

Bibliography Continued

1. Gao, J. et al. Repetitive religious chanting modulates the late-stage brain response to fear and stress provoking pictures. *Front. Psychol.* 2017
2. Howland, R. Vagus nerve stimulation. *Curr Behav Neurosci Rep.* 2014;1(2):64-73
3. Kalyani, B. et al. Neurohemodynamic correlates of 'OM' chanting: A pilot functional magnetic resonance imaging study. *Int j Yoga.* 2011 Jan-Jun;4(1):3-6
4. Fischer, K. Best Meditation Apps of 2018. *Healthline.* April 2018. <https://www.healthline.com/health/mental-health/top-meditation-iphone-android-apps>
5. Agate, J. 10 best mindfulness apps. *Independent.* February 2018. <https://www.independent.co.uk/extras/indybest/gadgets-tech/phones-accessories/best-mindfulness-apps-for-anxiety-free-sleep-iphone-top-for-kids-a8217931.html>
6. Pascoe, M., Thompson, D., Jenkins, Z., Ski, C. Mindfulness mediates the physiological markers of stress: systematic review and meta-analysis. *Journal of Psychiatric Research.* 2017;95:156-178
7. Browning, K., Verheijden, S., Boeckstaens, G. The vagus nerve in appetite regulation, mood, and intestinal inflammation. *Gastroenterology* 2017;152(4):730-744
8. Luders, E., Toga, A., Lepore, N., Gaser, C. the underlying anatomical correlates of long term meditation: larger hippocampal and frontal volumes of gray matter. *NeuroImage* 2009;45(3):672-678
9. Holzel, B. et al. Mindfulness practice leads to increases in regional brain matter density. 2012;191(1):36-43
10. Zeidan, F. et al. Neural correlates of mindfulness meditation-related anxiety relief. *Social cognitive and affective neuroscience* 2014;9(6):751-759
11. Luders, E. et al. The unique brain anatomy of meditation practitioners: alterations in cortical gyrification. *Front.Hum. Neurosci* 2012 <https://doi.org/10.3389/fnhum.2012.00034>