

Harnessing healthy lifestyle behaviors for better chronic pain management

Burel R. Goodin, PhD
Professor of Anesthesiology



WashU Medicine



Disclosures



- President, United States Association for the Study of Pain (USASP)
 - Unpaid
- EmpowerMe Psychology, PLLC
 - Paid Consultant
- Novo Nordisk
 - Pending contract for clinical trial to study GLP-1 receptor agonist for people with chronic low back pain and obesity
- 4 AI generated infographics

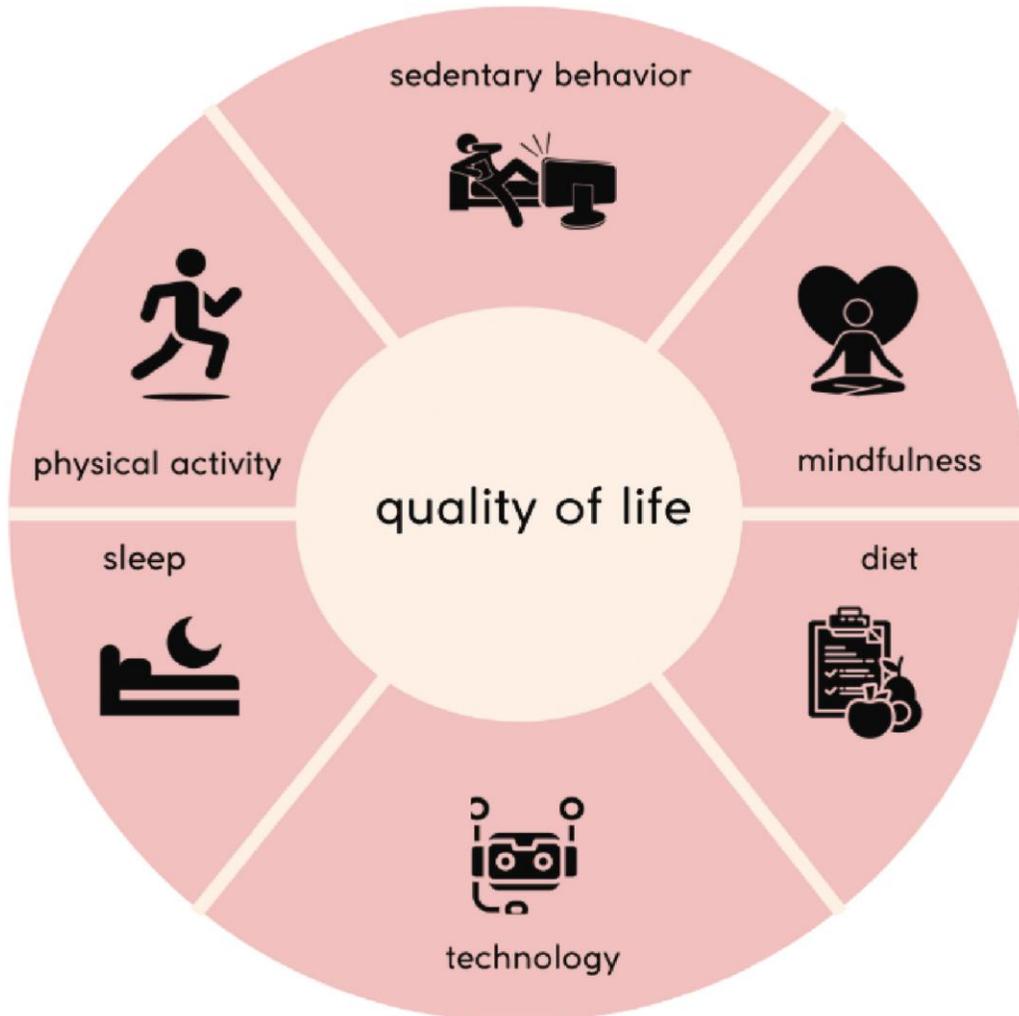


Editorial

Optimizing lifestyle behaviors to support healthy body-mind



Lifestyle Behaviors



- In this talk
 - Diet
 - Sleep
 - Physical Activity
 - Mindfulness



DIET

ORIGINAL INVESTIGATION

Higher habitual dietary caffeine consumption is related to lower experimental pain sensitivity in a community-based sample

Demario S. Overstreet¹ · Terence M. Penn¹ · Sarah T. Cable¹ · Edwin N. Aroke² · Burel R. Goodin^{1,3} 



Dr. Demario Overstreet

The New York Times

Caffeine May Increase Pain Tolerance

A plant-based diet may also help you withstand pain.

PsyPost

Home > Exclusive > Psychopharmacology

Study: People who regularly consume caffeine may experience less sensitivity to pain

by Eric W. Dolan — November 12, 2018 in Psychopharmacology

Dietary caffeine consumption was associated with less experimental pain sensitivity, particularly higher heat pain thresholds, higher heat pain tolerance, and higher pressure pain thresholds

Habitual Caffeine Consumption & Pain Sensitivity

Study of 62 Adults Aged 19–77 in a Community Sample



Daily Caffeine Intake:

- Coffee, Tea,
- Soda, Energy Drinks,
- Chocolate



Key Findings:

Higher Caffeine Consumption Linked to:



Higher Heat Pain Threshold



Higher Heat Pain Tolerance



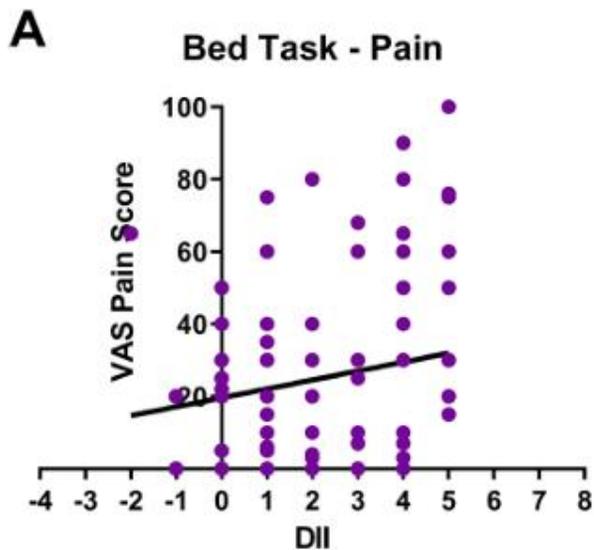
Higher Pressure Pain Threshold

Conclusion:

More Caffeine = Less Pain Sensitivity

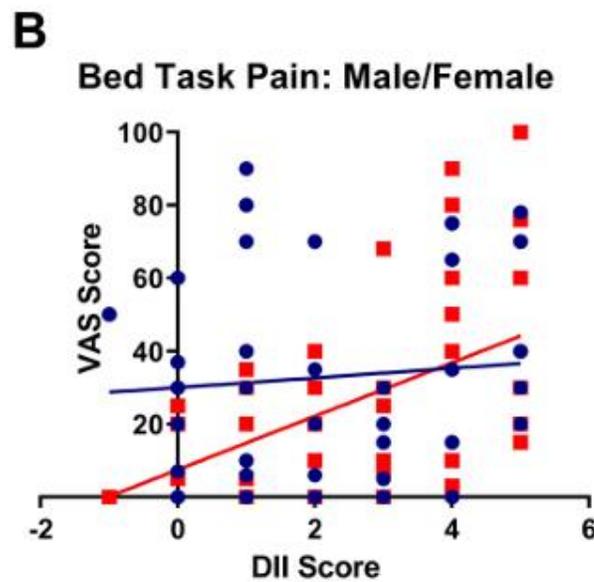
Habitual caffeine use is associated with reduced sensitivity to pain.





Dietary Inflammatory Index (DII) is Associated with Movement-Evoked Pain Severity in Adults with Chronic Low Back Pain: Sociodemographic Differences.

Larissa J. Strath,^{*} Andrew M. Sims,[†] Demario S. Overstreet,^{*} Terence M. Penn,^{*} Rahm J. Bakshi,^{*} Brooke K. Stansel,^{*} Tammie L. Quinn,^{*} Robert E. Sorge,^{*} D. Leann Long,[†] and Burel R. Goodin^{*}



Dr. Larissa Strath



Diet-induced inflammation was associated with greater pain intensity upon getting into and out of bed, and this association was stronger for women compared to men



Nutrition Data System for Research (NDSR)

University of Minnesota Nutrition Coordinating Center

What Does NDSR Do?



Collects Dietary Intake Data

- 24-Hour Recalls & Food Records
- Brand-Name & Restaurant Foods
- Multiple-Pass Interview Method



Provides Nutrient Analysis

- 170+ Nutrients & Food Components
- Macronutrients, Vitamins, Minerals



Standardizes Dietary Data

- Consistent Coding
- Comparable Results Across Studies



Supports Diet-Health Research

- Obesity, Heart Disease, Diabetes,
- Mental Health & More

Why Researchers Use NDSR

Accurate Nutrient Data

Reliable & Comprehensive



Diet Quality Indices

Assess Dietary Health

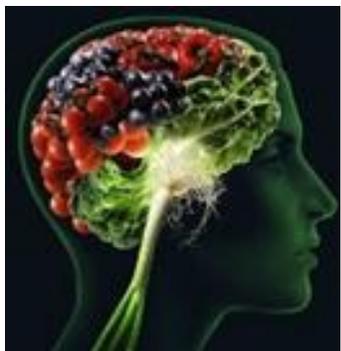


High Data Quality

Precise & Consistent



Essential for Nutrition & Health Research



Where Are We Now: Diet As Intervention



- Diet is a modifiable lifestyle factor that can both exacerbate and reduce pain.



Dr. Rob Sorge



- Oxidative stress
- Immune cell activation
- Proinflammation



- Decrease oxidative stress
- Decreased immune cell activation
- Anti-inflammation

- Prolong recovery from injury
- Disrupt gut bacteria
- Increase vulnerability to chronic pain and degenerative diseases (e.g., osteoarthritis)

- Reduce chronic pain symptoms
- Promote healthy gut
- Improve quality of life

RESEARCH Open Access

The effect of a low-carbohydrate diet on evoked pain and quality of life in Non-Hispanic black women with knee osteoarthritis: a pilot study

Asia M. Wiggins¹, Larissa J. Strath², Gray E. McPherson¹, Barbara A. Gower³, Amy M. Goss³, Burel R. Goodin⁴ and Robert E. Sorge^{1*}



Dr. Asia Wiggins

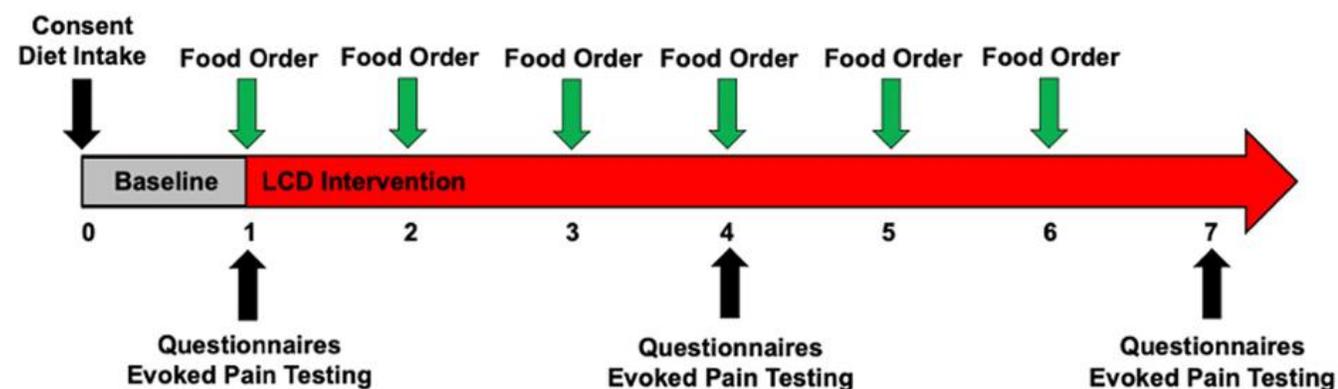


Fig. 1 General participant timeline showing matriculation through the study

Participants were directed to only eat the food provided from the study for the study duration, in order to reduce their total (not net) carbohydrate intake to ≤ 40 g/day.

BREAKFAST

Choose **FOUR (4)** from the following prepared meals (including **ONE (1)** as a substitute):

Food Item	Number Requested (1-4)	Substitute (Y or N)
Atkins Bacon Scramble Bowl	1 2 3 4	Y N
Jimmy Dean Egg Frittatas: Bacon, Ham, and Veggie	1 2 3 4	Y N
Jimmy Dean Delights Breakfast Sandwich	1 2 3 4	Y N
Jimmy Dean Simple Scramble: Bacon and Cheese	1 2 3 4	Y N
Jimmy Dean Breakfast Bowl: Ham, Egg and Cheese	1 2 3 4	Y N
Jimmy Dean Breakfast Bowl: Meatlovers	1 2 3 4	Y N

Choose **THREE (3)** from the following recipe meals (including **ONE (1)** as a substitute):

Food Item	Number Requested (1-3)	Substitute (Y or N)
Avocado Egg Bake	1 2 3	Y N
Scrambled Eggs, Greek yogurt, blueberries*	1 2 3	Y N
Egg Muffins	1 2 3	Y N
Omelet	1 2 3	Y N
Fried Bell Pepper, Eggs and Bacon	1 2 3	Y N
Savory Rice Cakes: Guacamole, Eggs and Bacon	1 2 3	Y N

FRIED BELL PEPPER, EGGS, & BACON

INGREDIENTS

- 1 tbsp olive oil
- 1/2 bell pepper
- 2 eggs
- 2 slices of bacon
- 1/4 tsp salt
- 1/4 tsp pepper

DIRECTIONS

1. Heat large skillet over medium heat for about 2 minutes.
2. Add sliced bacon to large skillet. Flip strips as needed for about 8-12 minutes, or until they reach desired crispness.
3. Drain bacon strips on a paper-towel-lined platter until ready to serve.
4. Using a separate skillet, heat olive oil in medium skillet over medium heat, about 4 minutes.
5. Add sliced bell pepper rings. Cook 1 minute on each side.
6. Crack an egg into each bell pepper ring. Lower heat to medium-low. Cook until whites are set, 5-10 minutes.
7. Season with salt and pepper, and serve with side bacon strips.

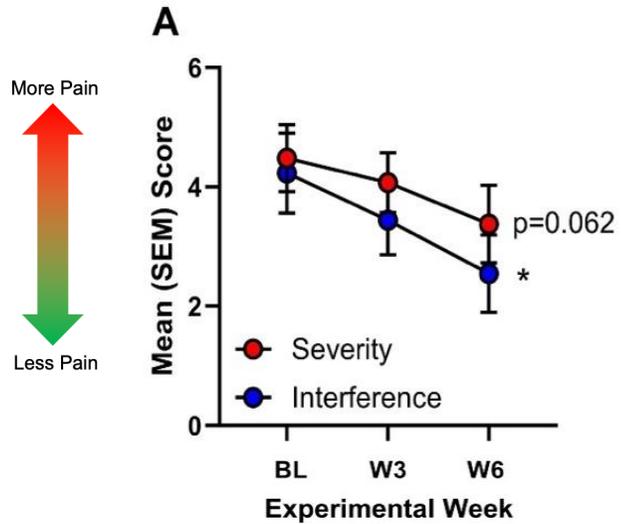
Shipt

Corporation

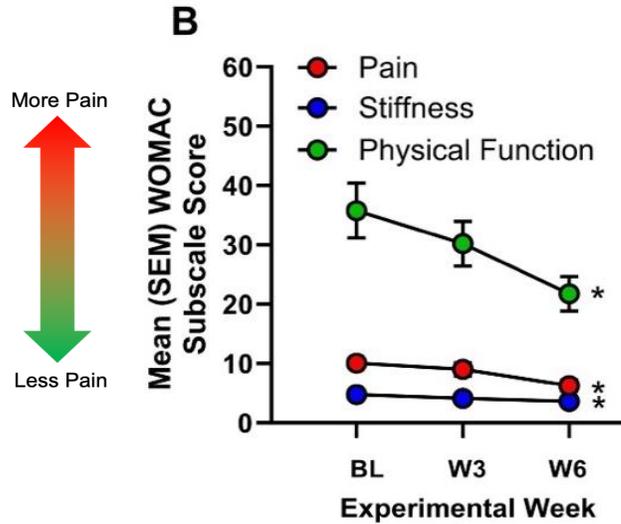


Shipt is an American delivery service owned by Target Corporation. It is headquartered in Birmingham, Alabama. In December 2017, it was announced that Target Corpora [Wikipedia](#) More

BPI-SF

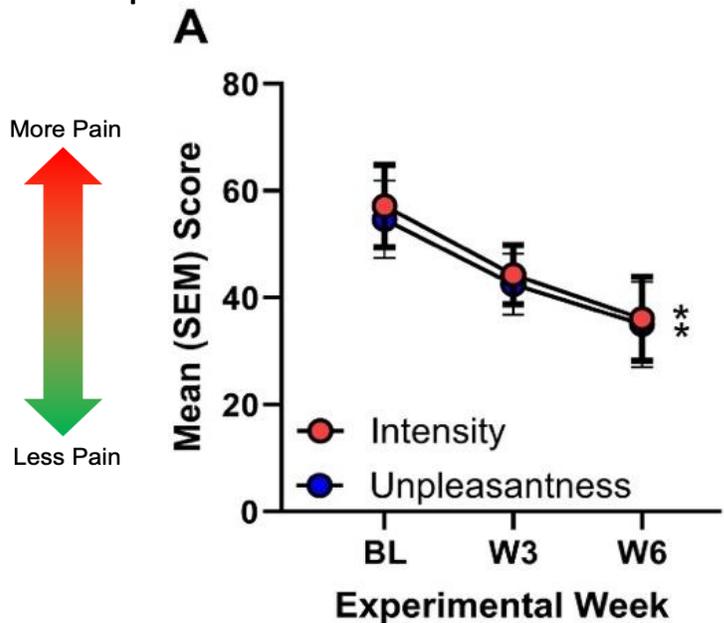


WOMAC

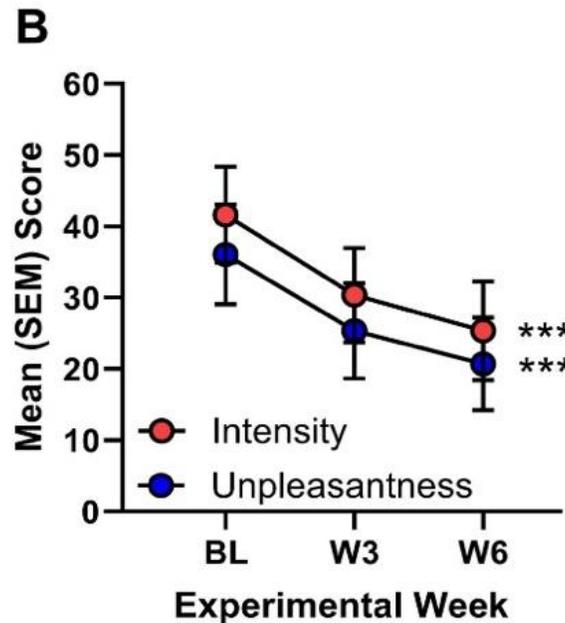


Overall			
	N= 14	Mean	SD
Age (years)		55.93	7.79
Weight (pounds)		230	40
Height (inches)		63	4
Total Carbohydrate (grams)		150.06	37.36

Repeated Chair Stands Task



Timed Walk Task



The LCD seems to decrease knee pain severity on self-report measures (BPI-SF, WOMAC) as well as decrease movement-evoked pain (repeated chair stands, timed walk task).

*p<0.05, ***p<0.001



It May Be That....

1. The LCD (a nutrient-rich diet *with a reduction in highly processed starches and poor-quality seed oils*) can provide a variety of positive benefits for painful knee osteoarthritis
 - KOA-related pain and disability
 - Quality of life and overall health
2. The observed data above highlights the effect of diet and nutrition on chronic pain outcomes in a relatively short period of time (i.e., 3 or 6 weeks).



DietaryGuidelines.gov



Low Carbohydrate Diet

- Participants were directed to only eat the food provided from the study for the study duration, in order to reduce their total (not net) carbohydrate intake to ≤ 40 g/day.

USDA Diet

- Consume foods that are in nutrient-dense forms, lean or low-fat and prepared without added fats, sugars, refined starches, or salt.
- Based upon 2,000-calorie diet (designed to meet the nutritional needs of adults [aged 19 and older] as recommended by the USDA).



DIRECTPain

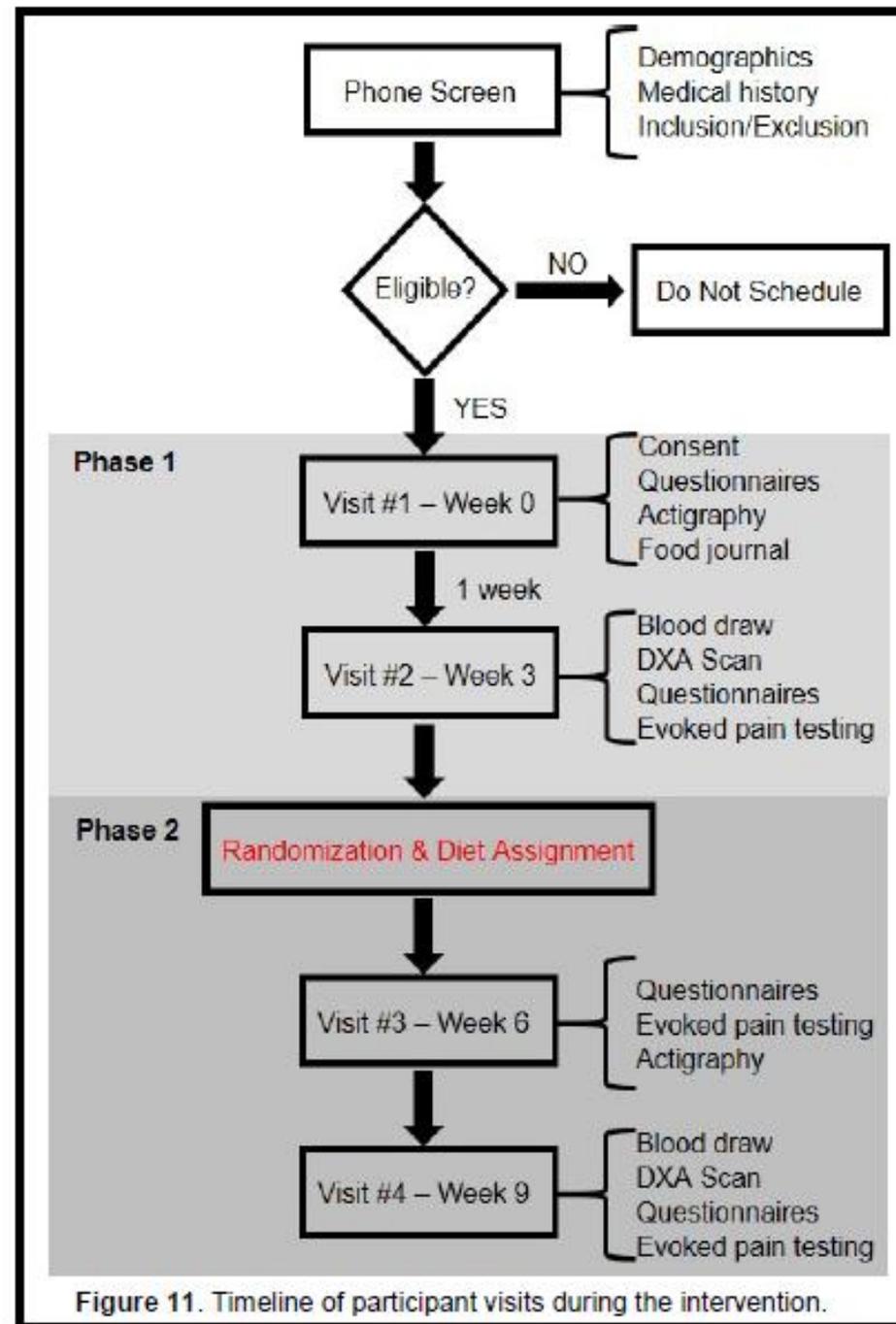
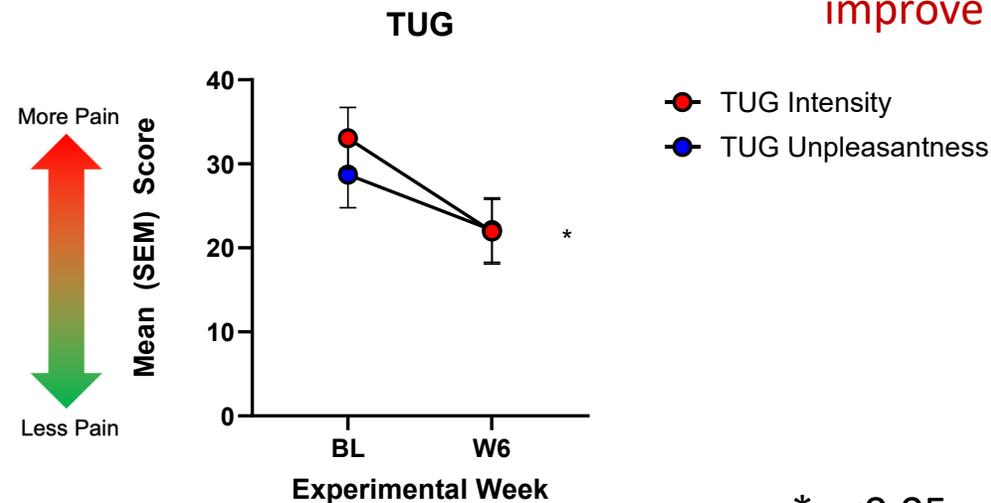
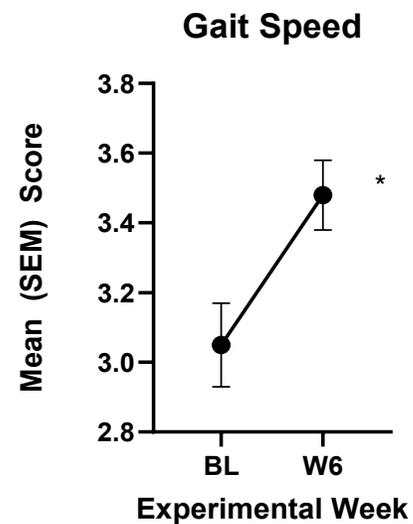
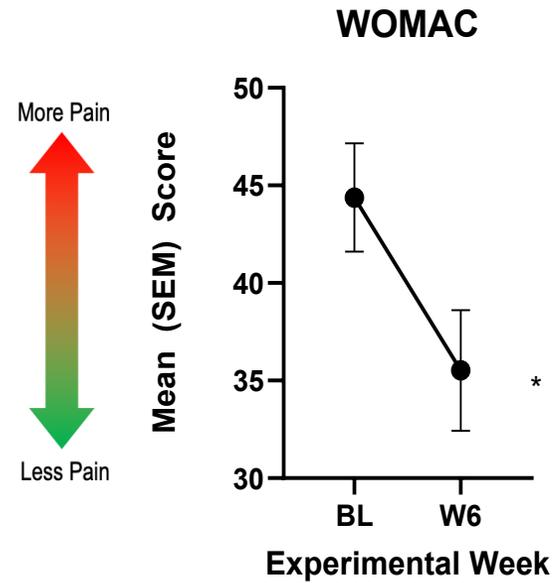
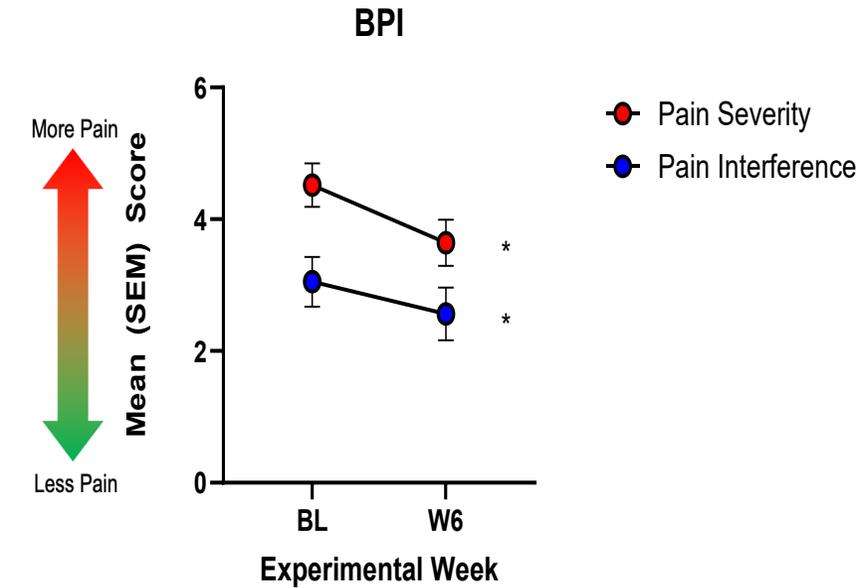


Figure 11. Timeline of participant visits during the intervention.

DIRECTPain



Dr. Rob Sorge



The diets seem to decrease knee pain severity on self-report measures (BPI-SF, WOMAC), as well as decrease movement-evoked pain (TUG), and improve physical function (gait speed)

* $p < 0.05$



SLEEP



RESEARCH
EDUCATION
TREATMENT
ADVOCACY



The Journal of Pain, Vol 14, No 12 (December), 2013: pp 1539-1552
Available online at www.jpain.org and www.sciencedirect.com

Critical Review

The Association of Sleep and Pain: An Update and a Path Forward

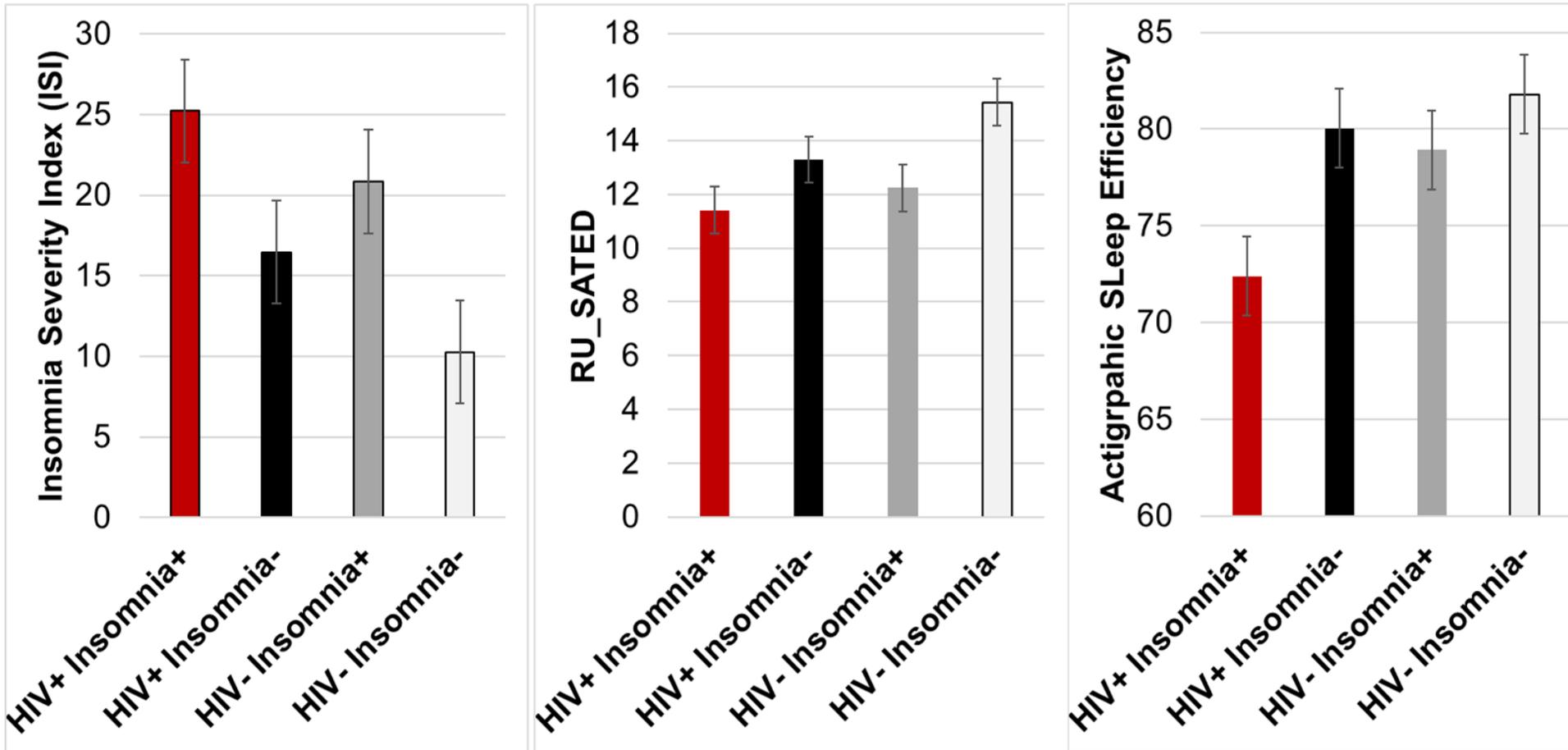
Patrick H. Finan,^{*} Burel R. Goodin,^{†,‡} and Michael T. Smith^{*}

^{}Department of Psychiatry and Behavioral Sciences, Johns Hopkins University School of Medicine, Baltimore, Maryland.*

Departments of [†]Psychology and [‡]Anesthesiology, University of Alabama-Birmingham, Birmingham, Alabama.



HIPPI Findings - Sleep



Caroline Webb

Webb, Goodin, et al.
Journal of Pain, Under Review

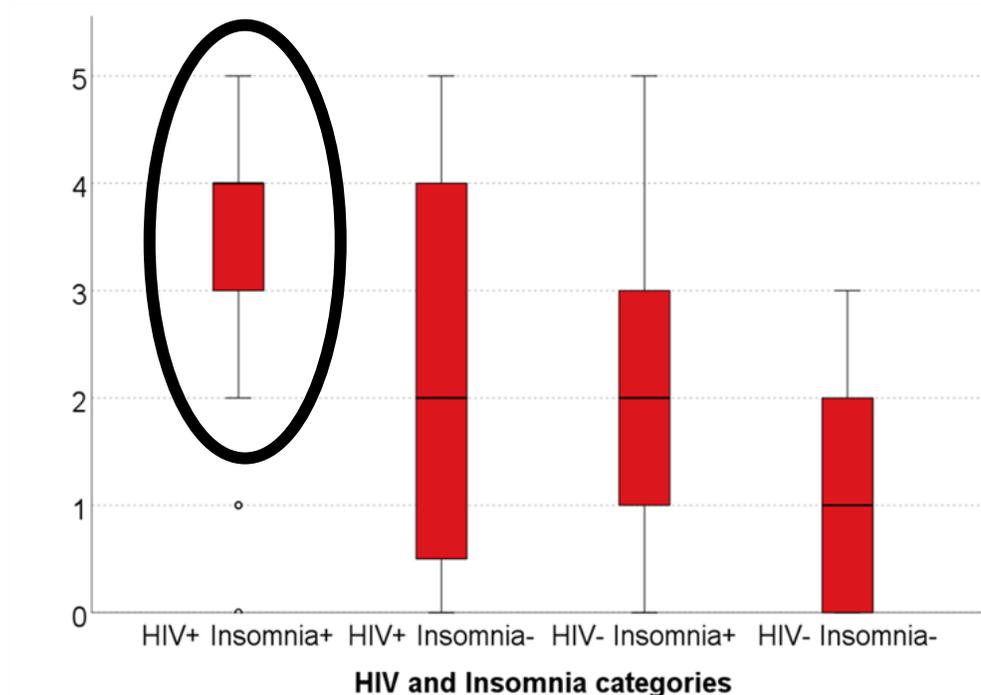
People with HIV and insomnia indeed demonstrate the lowest sleep quality (red bar)

HIPPI Findings – Bodily Pain



How much bodily pain have you had during the last week?

- 0) None
- 1) Very mild
- 2) Mild
- 3) Moderate
- 4) Severe
- 5) Very severe



Caroline Webb

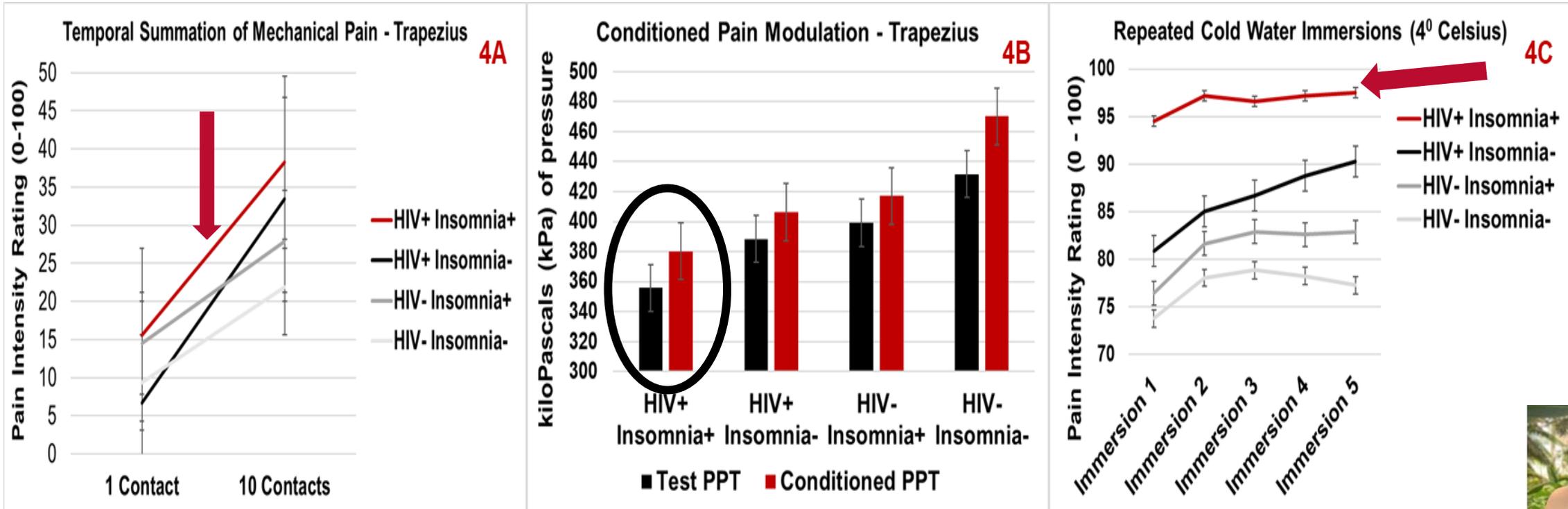
Webb, Goodin, et al.
Journal of Pain, Under Review



People with HIV and insomnia also reported the greatest severity of bodily pain during the past week (**black circle**)



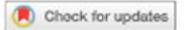
HIPPI Findings – Experimental Pain Sensitivity



People with HIV and insomnia also demonstrate the greatest degree of experimental pain sensitivity (red arrow and black circle)



Caroline Webb



Improving Sleep in People with HIV and Chronic Pain: A Pilot Study of Brief Behavioral Treatment for Insomnia

Shameka L. Cody^a, Daniel A. Kusko^b, Cesar E. Gonzalez^c, Michael A. Owens^d,
 Joanna M. Hobson^b, Shannon R. Gilstrap^b, Stephen J. Thomas^b, and Burel R. Goodin^c



Cesar Gonzalez, Ph.D.
 Assistant Professor of
 Anesthesiology at Washington
 University School of Medicine in
 St. Louis



Shameka Cody, Ph.D.
 Associate Professor Capstone
 College of Nursing at University
 of Alabama

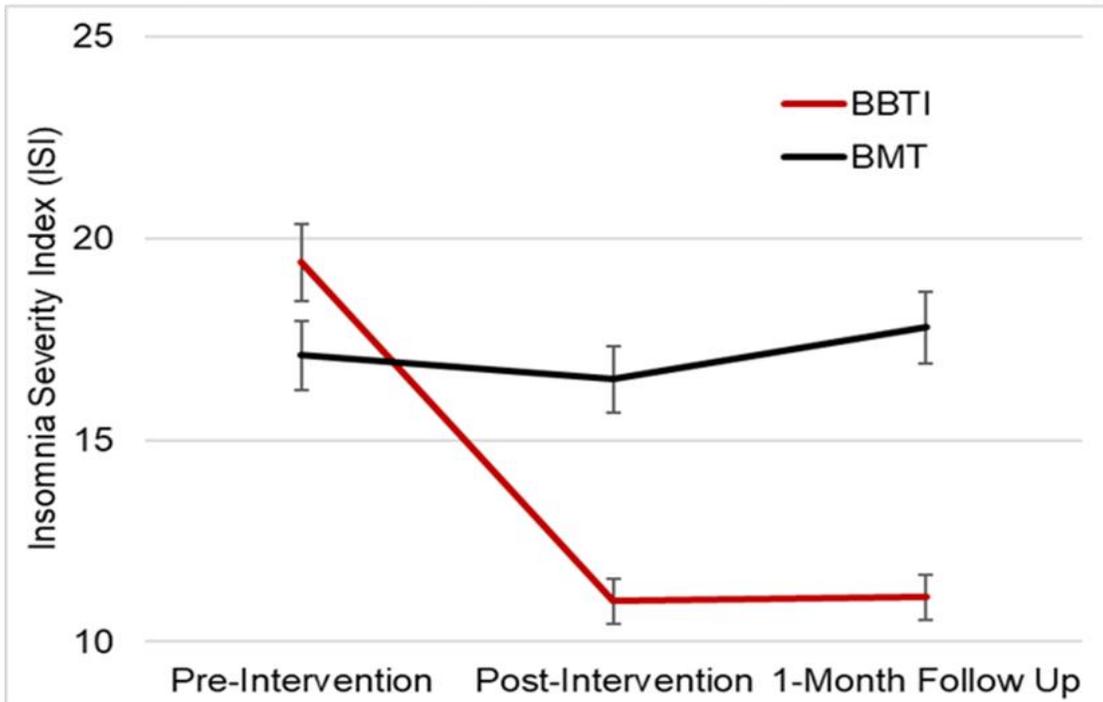
Guidelines for Scoring/Interpretation:

Add the scores for all seven items (questions 1 + 2 + 3 + 4 + 5 + 6 + 7) = _____ your total score

Total score categories:

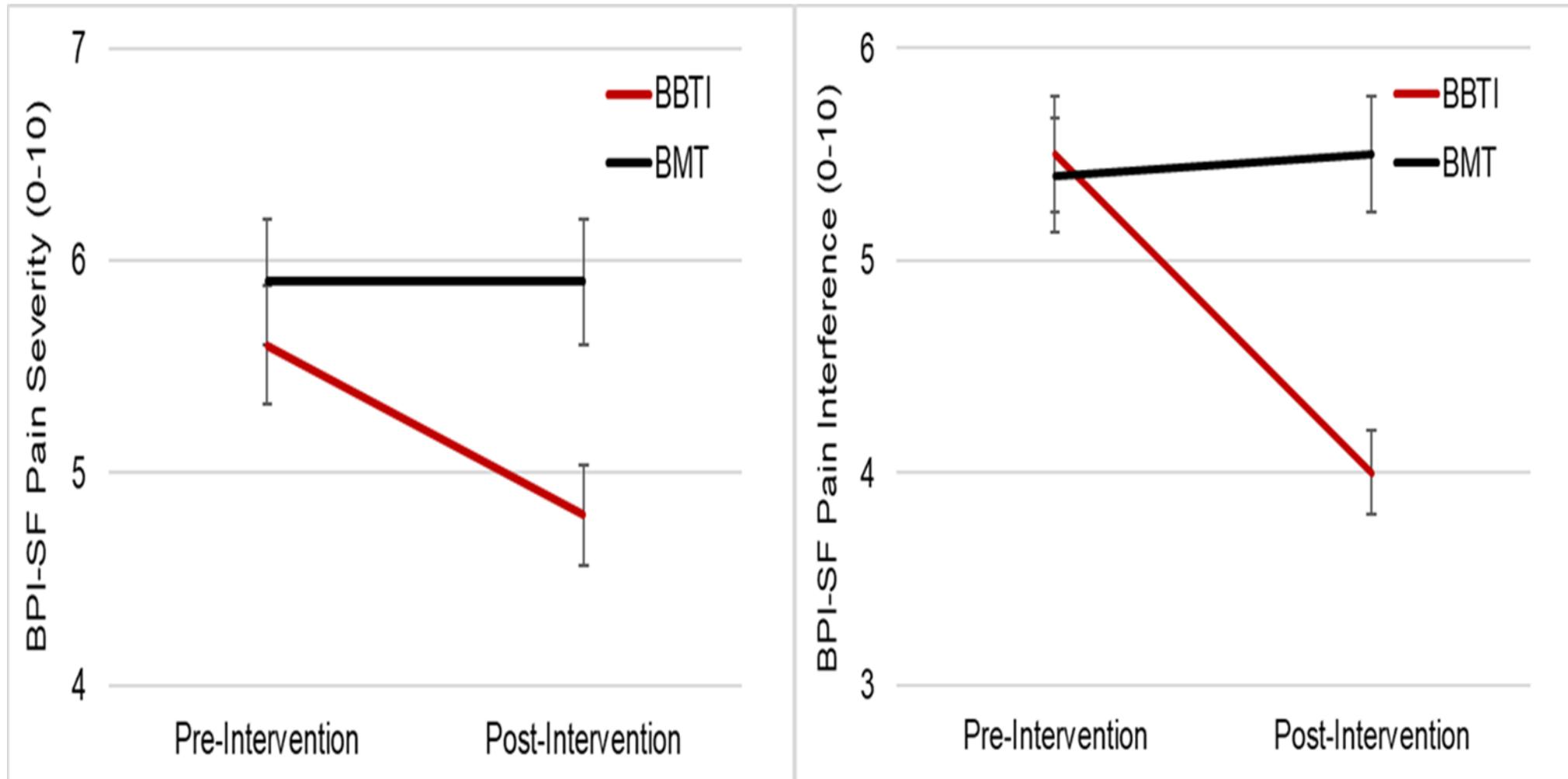
- 0-7 = No clinically significant insomnia
- 8-14 = Subthreshold insomnia
- 15-21 = Clinical insomnia (moderate severity)
- 22-28 = Clinical insomnia (severe)

	BBTI – 10	BMT – 10	Total – 20
Race	Black – 8 (80%) White – 1 (10%) Multiracial – 1 (10%)	Black – 8 (80%) White – 2 (20%) Multiracial - 0	Black – 16 (80%) White – 3 (15%) Multiracial – 1 (5%)
Sex	Man – 4 (40%) Woman – 6 (60%) Transwoman - 0	Man – 5 (50%) Woman – 4 (40%) Transwoman – 1 (10%)	Man – 9 (45%) Woman – 10 (50%) Transwoman – 1 (5%)
Age	Range – 39-64 Mean – 53 Median – 51.5	Range – 31-62 Mean – 48.6 Median – 46.5	Range – 31-64 Mean – 50.8 Median – 47.5
Household Income	0 - 9,000 – 4 (40%) 10,000 - 14,999 – 4 (40%) 15,000 - 19,999 - 0 20,000 - 24,999 – 1 (10%) 50,000 - 74,999 – 1 (10%) 75,000 - 99,999 - 0	0 - 9,000 – 3 (30%) 10,000 - 14,999 – 3 (30%) 15,000 - 19,999 – 1 (10%) 20,000 - 24,999 – 1 (10%) 50,000 - 74,999 - 0 75,000 - 99,999 – 1 (10%)	0 - 9,000 – 7 (35%) 10,000 - 14,999 – 7 (35%) 15,000 - 19,999 – 1 (5%) 20,000 - 24,999 – 2 (10%) 50,000 - 74,999 – 1 (5%) 75,000 - 99,999 – 1 (5%)



Brief Behavioral Treatment for Insomnia (BBTI) decreased insomnia severity while Brief Mindfulness Training (BMT) did not; the improvement due to BBTI remained 1 month after treatment ended

HIPPI Findings – Results



BBTI improved pain (decreased severity and interference) while BMT did not

PRESENT-HIP HOP Study

Healthy Behaviors for Insomnia Prevention in People with HIV and Ongoing Pain (the HIP HOP study)

Project Number
1R01MD021001-01

Contact PI/Project Leader
GOODIN, BUREL R.

Awardee Organization



Dr. Rachel
Presti

Figure 1: Conceptual model depicting the putative pathway of BBTI (vs. BMT) treatment effects on biomarkers of biological aging (via effects on sleep and pain) with consideration for social environmental influences on treatment response; **note:** BBTI = Brief Behavioral Treatment for Insomnia, BMT = Brief Mindfulness Training

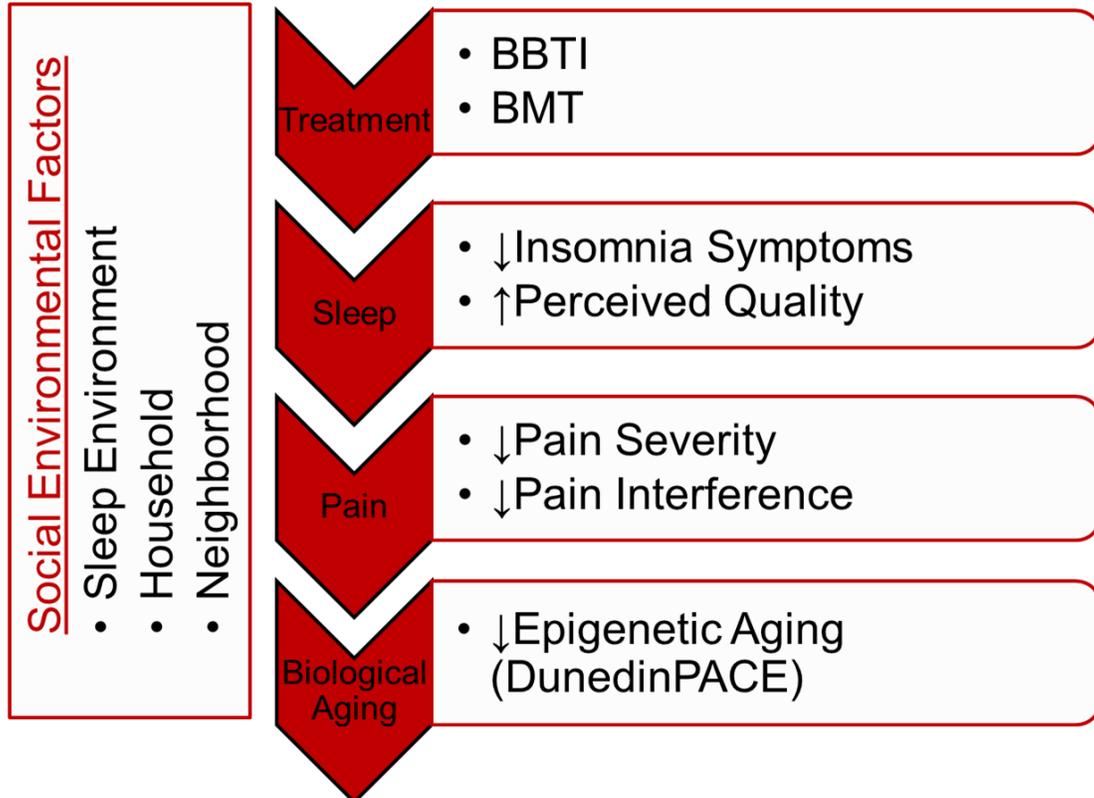
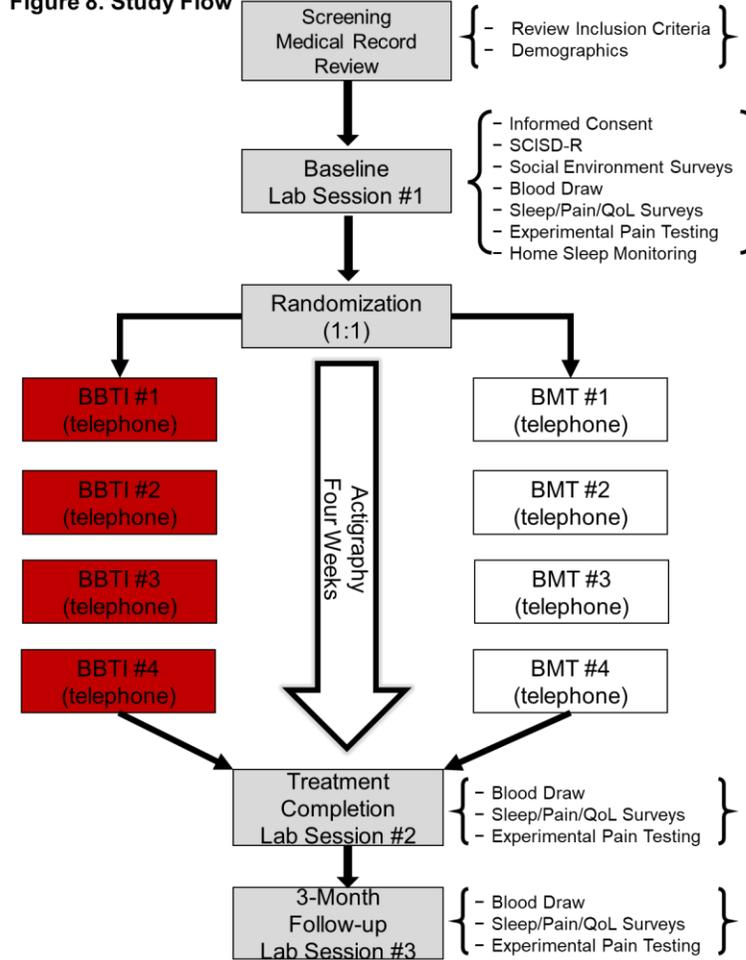


Figure 8. Study Flow



Note: SCISD-R = Structured Clinical Interview for Sleep Disorders – Revised; QoL = Quality of Life; BBTI = Brief Behavioral Treatment for Insomnia; BMT = Brief Mindfulness Training.



PHYSICAL ACTIVITY

PHYSICAL ACTIVITY & MUSCULOSKELETAL PAIN RISKS

A Study Using All of Us Research Program Data

14,754 PARTICIPANTS

Median Age: 51.3 Years
72% Female

≥ 6 Months Fitbit & EHR Data
Before First Pain Diagnosis



PA MEASURES ANALYZED



Daily Steps



Light Activity



Moderate Activity



Vigorous Activity

PAIN CONDITIONS STUDIED



Neck Pain



Low Back Pain



Hip Pain



Knee Pain

KEY FINDINGS

Higher Daily Steps

↓ Low Back Pain
HR 0.89



↓ Neck Pain
HR 0.69



↑ Moderate Activity

↓ Low Back Pain
HR 0.82



↓ Hip Pain
HR 0.87



↑ Vigorous Activity

↓ Neck Pain
HR 0.53



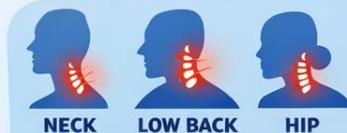
↓ Low Back Pain
HR 0.72
HR 0.93



No Association with Knee Pain

Higher Physical Activity Linked to
Reduced Risk of Developing

Neck, Low-Back, & Hip Pain



NECK

LOW BACK

HIP



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

The Journal of Pain

journal homepage: www.jpain.org

USASP
US Association for
the Study of Pain

Original Reports

Association of activity with the risk of developing musculoskeletal pain in the All of Us research program



Salim Yakdan, MD, MSCI^{a,*}, Braeden Benedict, MS^a, Pranay Singh, BS^a,
Madelyn R. Frumkin, PhD^b, Burel R. Goodin, PhD^c, Brian Neuman, MD^d,
Abby L. Cheng, MD, MPHS^e, Jing Wang, PhD^f, Michael P. Kelly, MD^g,
Wilson Z. Ray, MD, MBA^a, Jacob K. Greenberg, MD, MSCI^a



Dr. Jacob
Greenberg

Higher physical activity was associated with reduced risk of neck, low-back, and hip pain.

No association was found between physical activity and the risk of developing knee pain.

Largest study using Fitbit and electronic health record data for musculoskeletal pain prediction



Dr. Taylor Taylor

Check for updates

OPEN ACCESS

EDITED BY
 Cristiano Maria Verrelli,
 University of Rome Tor Vergata, Italy

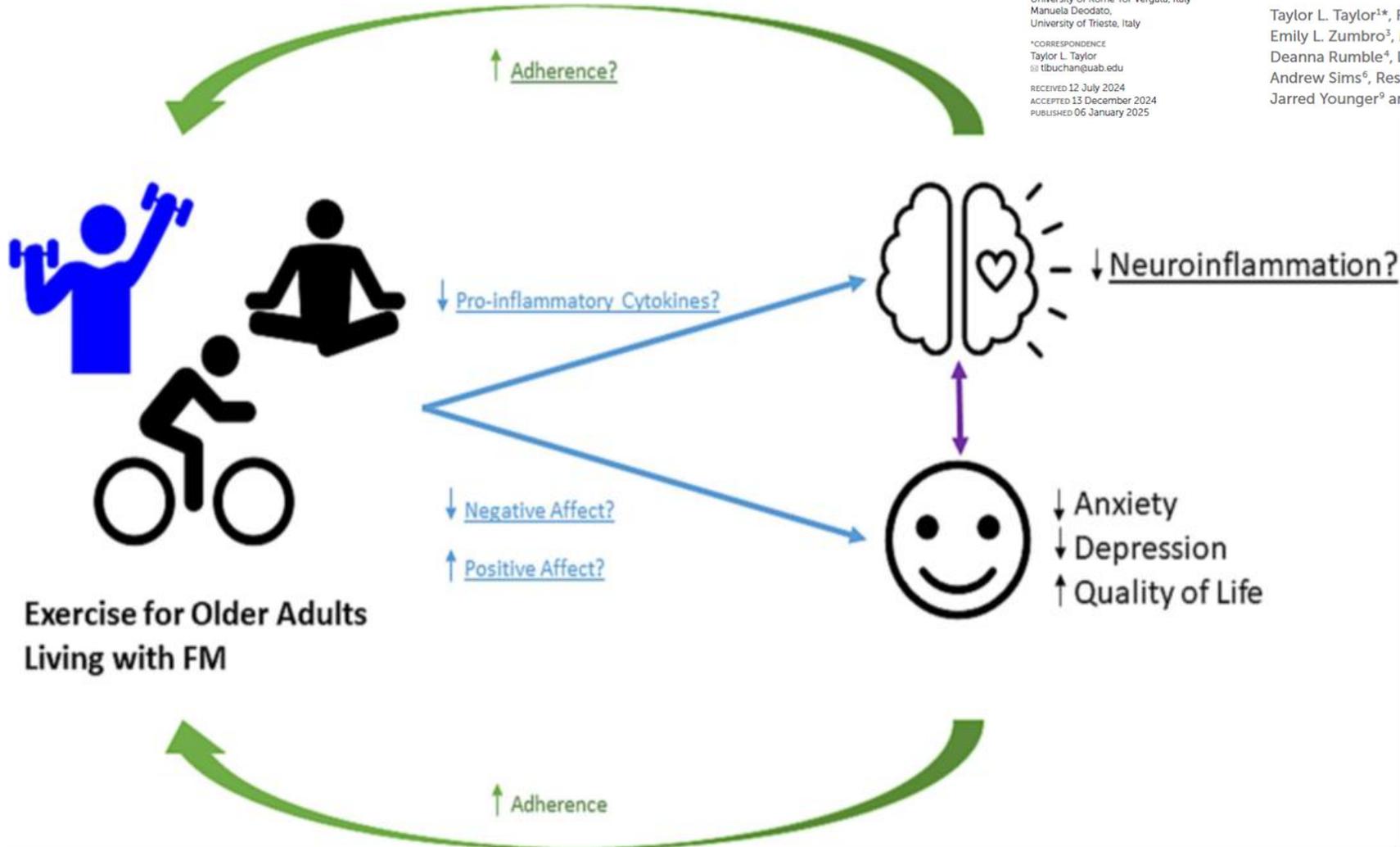
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The potential impact of exercise on affect and neuroinflammation in older adults living with fibromyalgia: a scoping review

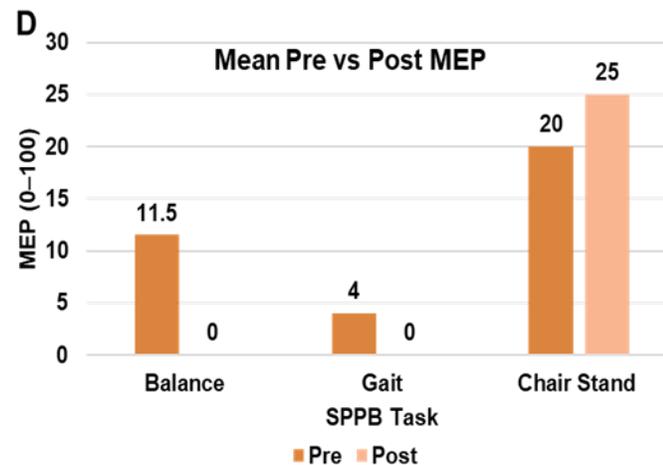
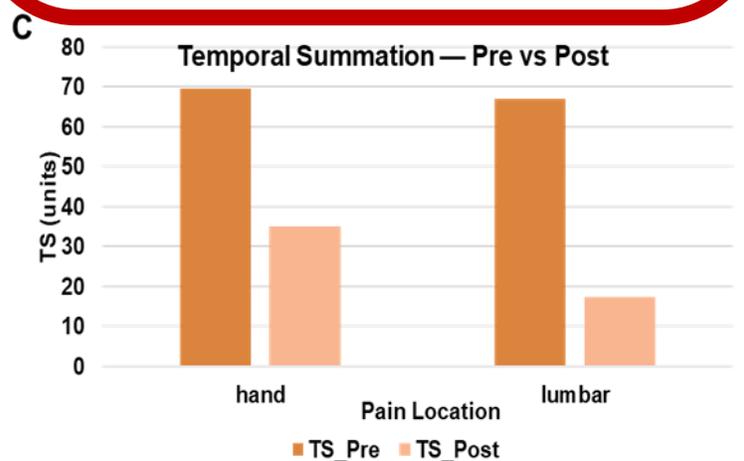
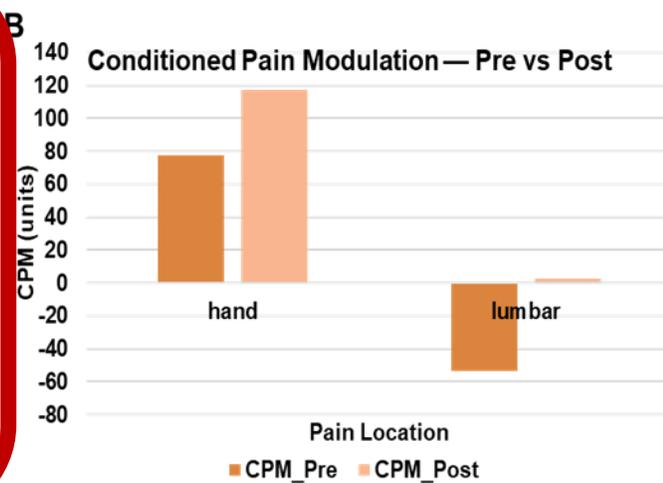
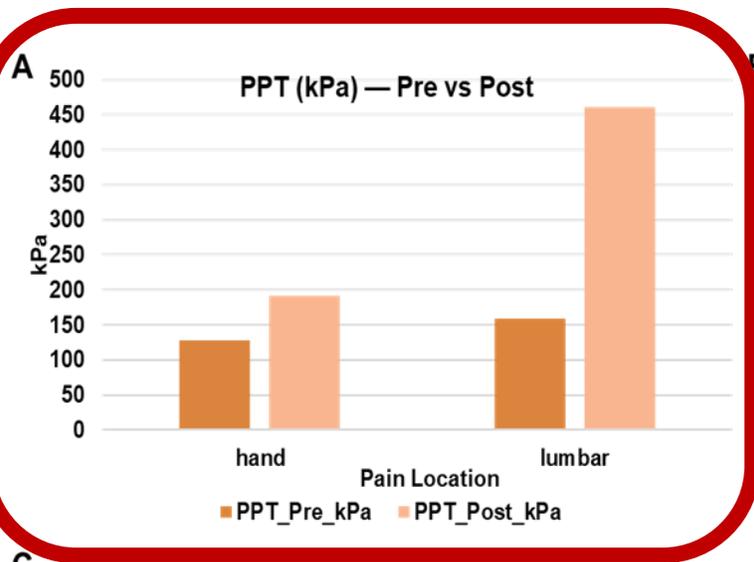
Taylor L. Taylor^{1*}, Fitzgerald Dodds², McKenna Tharpe², Emily L. Zumbro³, Michael Hanks², Raymond Jones³, Deanna Rumble⁴, Lisa Antoine⁵, Kristen Allen-Watts³, Andrew Sims⁶, Reshu Chandra⁷, Burel R. Goodin⁸, Jarred Younger⁹ and Thomas W. Buford^{3,10}



Exercise Improves Pain and Function in Veterans Living with Fibromyalgia (FM)



Dr. Taylor Taylor



Pain sensitivity improved: Lumbar PPT increased by ~191% post-intervention.

Pain modulation enhanced: CPM improved at both hand and lumbar sites.

Temporal summation reduced: Significant decrease in pain wind-up after exercise.

Functional gains achieved: Movement-evoked pain eliminated for balance and gait tasks; chair stand performance improved.

Lifestyle medicine impact: Exercise is a feasible, mechanism-driven strategy for chronic pain management.

Data shown for n = 5 participants. Data collection still in progress.



MINDFULNESS

Mindfulness Meditation and Pain



Dr. Fadel Zeidan would likely say that mindfulness meditation:

- Dampens pain intensity and unpleasantness
- Engages specific brain networks tied to cognitive and emotional control
 - E.g., activation of limbic system structures like anterior cingulate cortex
- Decouples pain perception from self-referential and evaluative processes
 - E.g., deactivation of thalamus and somatosensory cortex
- Operates through neural mechanisms distinct from placebo

Mindfulness Meditation & Pain: Key Findings from Fadel Zeidan, PhD

Neural Mechanisms

Zeidan et al, *Journal of Neuroscience*, 2011

- Thalamic deactivation of pain signals
- Increased activity in OFC, ACC, Insula

Non-Opioid Pain Relief

Zeidan et al. *Journal of Neuroscience*, 2016

- Mindfulness works under opioid blockade
- Pain relief independent of opioids

Individual Differences

Zeidan et al., *PAIN*, 2018

- Greater mindfulness, lower pain
- Altered salience & control networks

Mindfulness vs. Placebo

Zeidan et al, *Biological Psychiatry*, 2024

Mindfulness	Placebo

Conceptual Takeaway

“Mindfulness reshapes how the brain constructs pain, separating sensation from self-referential evaluation.”



ELSEVIER

Contents lists available at ScienceDirect

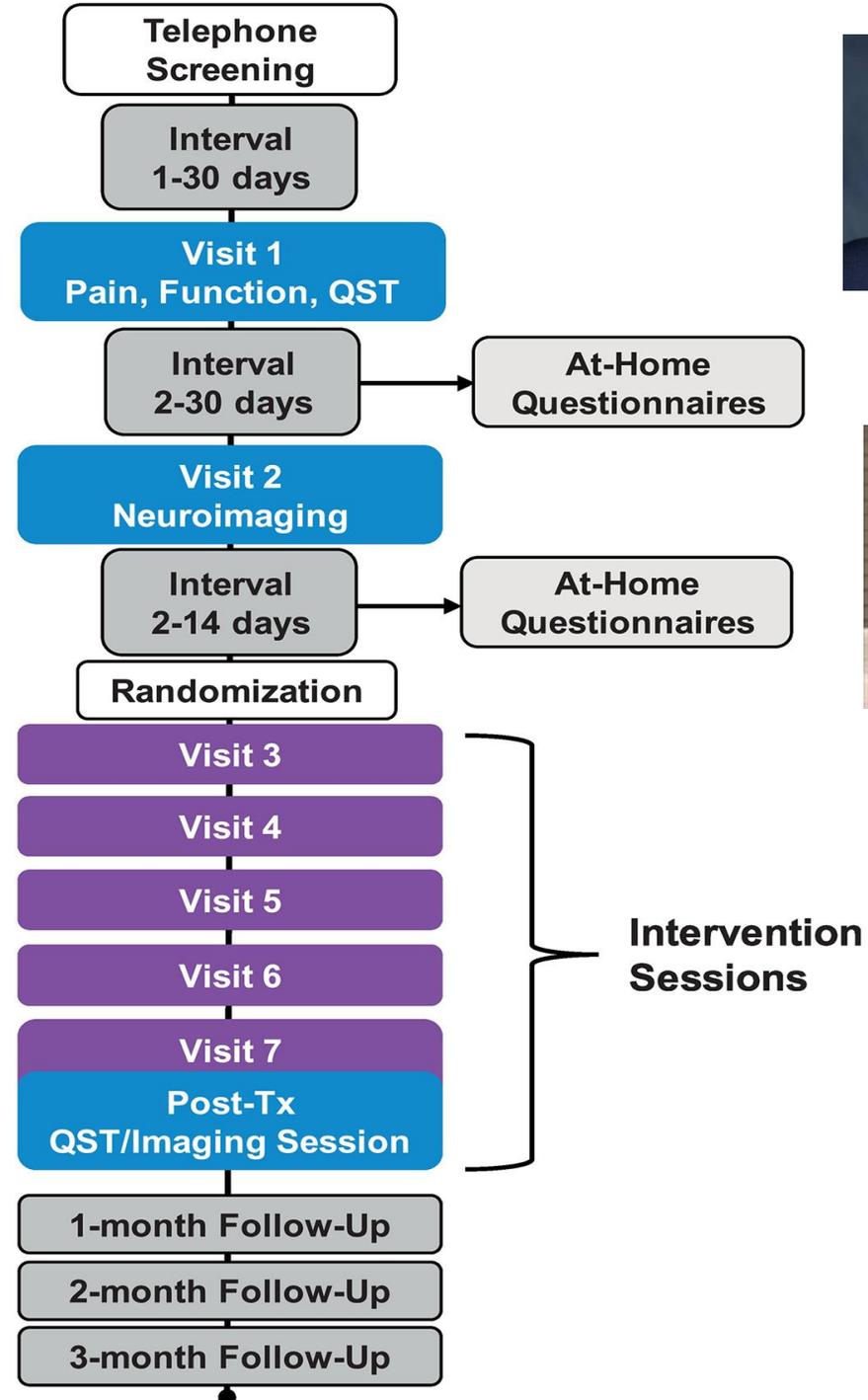
Contemporary Clinical Trials

journal homepage: www.elsevier.com/locate/conclintrial



Pain relief for osteoarthritis through combined treatment (PROACT): Protocol for a randomized controlled trial of mindfulness meditation combined with transcranial direct current stimulation in non-Hispanic black and white adults with knee osteoarthritis

Roger B. Fillingim^{a,b,*}, Adam J. Woods^c, Hyochol Ahn^d, Samuel S. Wu^e, David T. Redden^f, Song Lai^g, Hrishikesh Deshpande^h, Georg Deutsch^h, Kimberly T. Sibilleⁱ, Roland Staud^j, Fadel Zeidan^k, Burel R. Goodin^l



Dr. Roger Fillingim



Dr. Fadel Zeidan

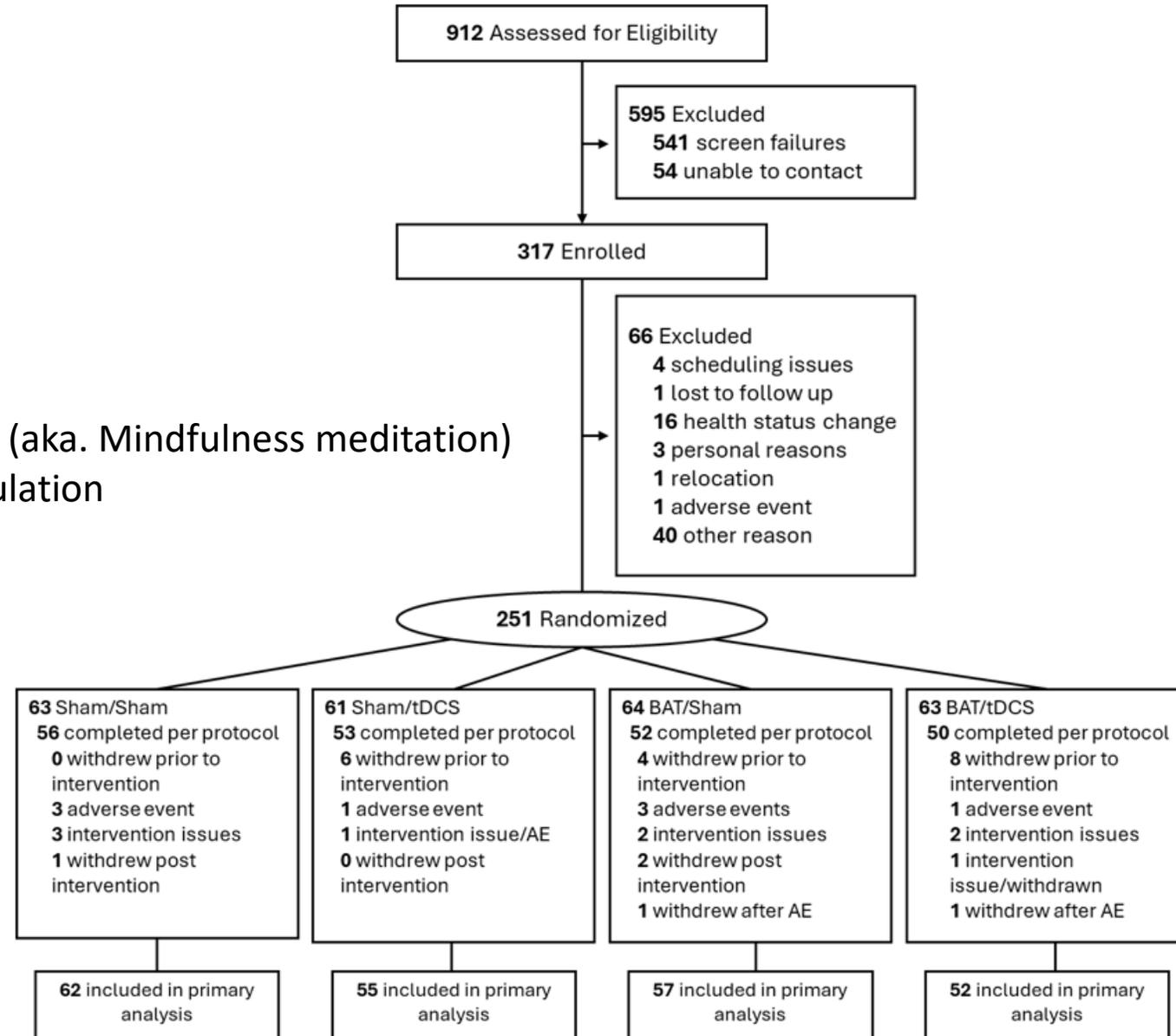
Figure 1. Recruitment, Randomization and Patient Flow Diagram for Pain Relief for Osteoarthritis Through Combined Treatment (PROACT) Trial

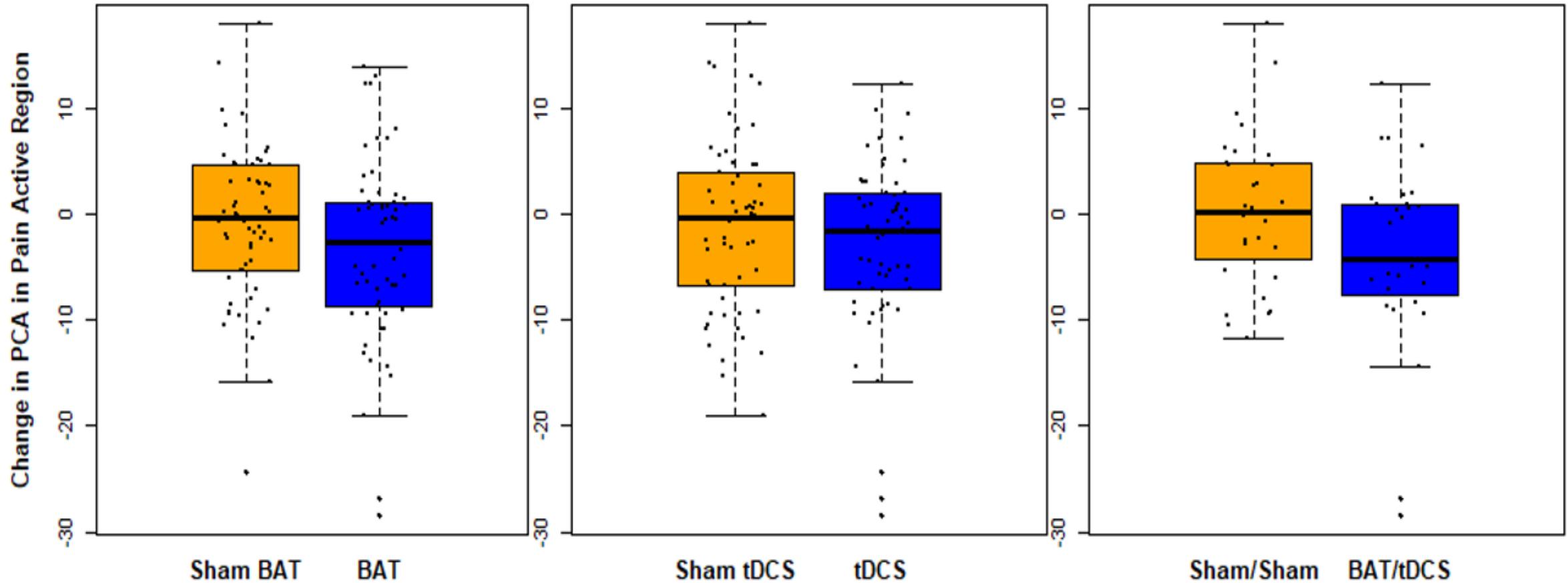


Note:

BAT = Breathing and Attention Training (aka. Mindfulness meditation)

tDCS = transcranial direct current stimulation



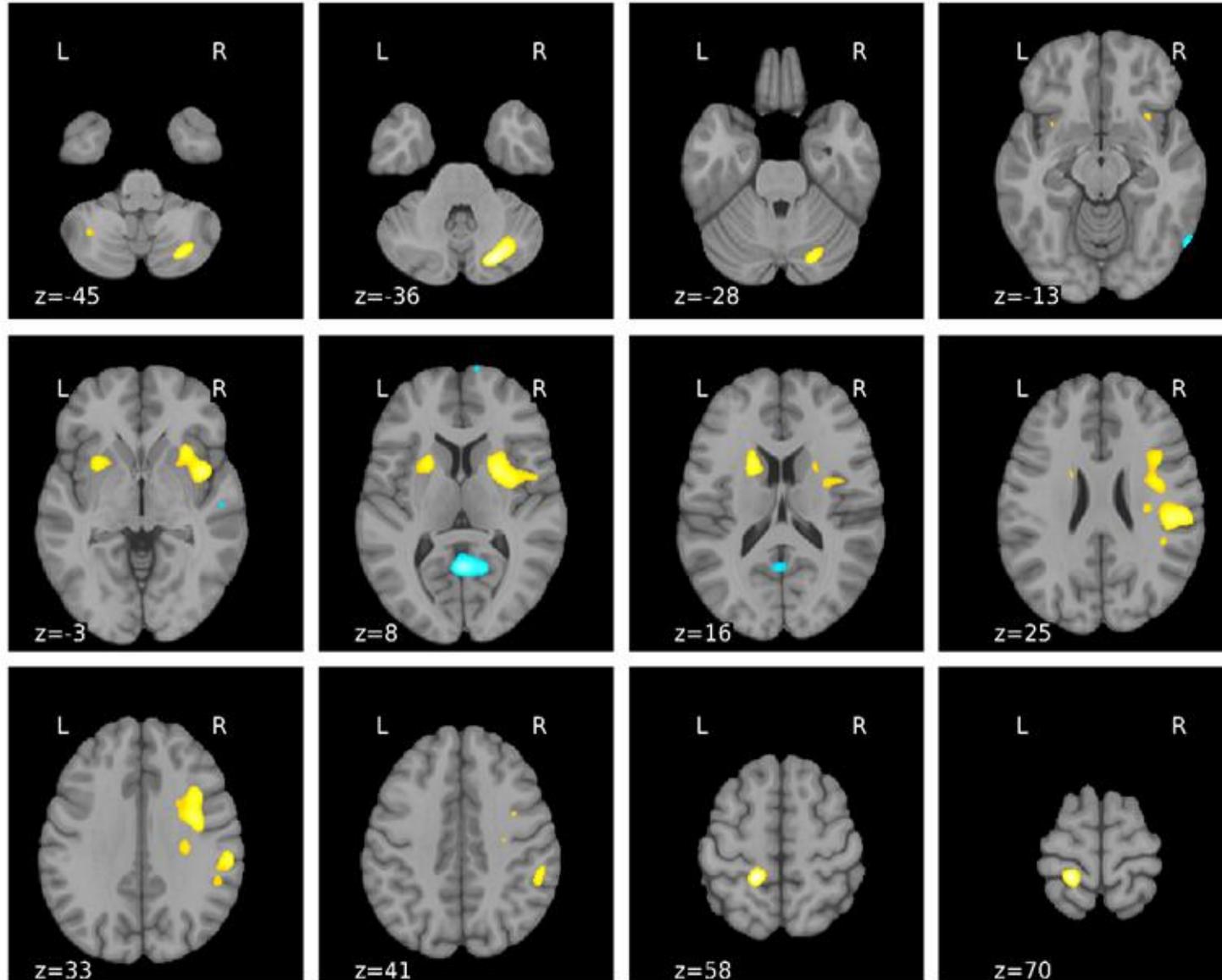


Findings suggest that the combination of active mindfulness meditation (BAT) and active tDCS provokes the greatest changes in pain-salient brain networks. **Whether these changes are clinically meaningful remains to be determined.**

Note: PCA = principal components analysis...used for pCASL (cerebral blood flow)

Axial slices of the brain indicating change in pain activated regions of interest (yellow) and deactivated regions of interest (blue) after intervention.

PROACT



Activation (in yellow) appears to be focused on anterior cingulate cortex and insula

Deactivation (in blue) is thalamus



DeseretNews

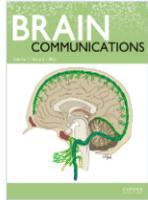
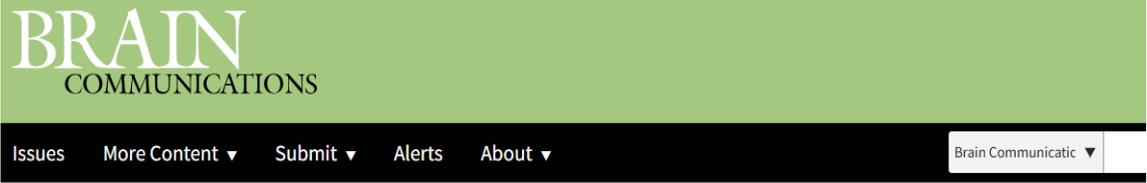
HEALTH FAMILY

How you can slow the speed at which your brain ages

Study shows which factors are risks and which are protective

KEY POINTS

- The difference between chronological age and life's effect on the brain is called a brain age gap.
- Chronic pain and stress contribute to accelerated brain aging.
- Protective factors can counteract negative impacts of pain and socioenvironmental risks.



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JOURNAL ARTICLE

More than chronic pain: behavioural and psychosocial protective factors predict lower brain age in adults with/at risk of knee osteoarthritis over two years

Jared J Tanner, Angela Mickle, Udell Holmes, III, Brittany Addison, Kenia Rangel, Cynthia Garvan, Roland Staud, Song Lai, David Redden, Burel R Goodin, Catherine C Price, Roger B Fillingim, Kimberly T Sibille

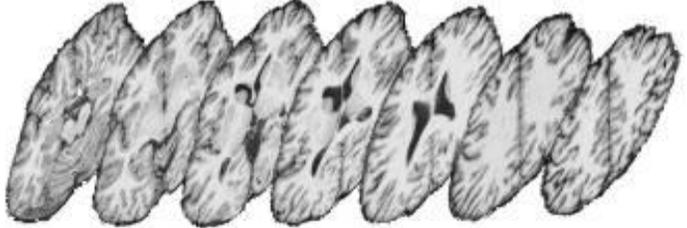
We found that quality sleep, social support, maintaining a healthy waistline, avoiding tobacco use among other healthy habits are linked to slower brain aging

Study participants with the most protective behavioral/psychosocial factors had brains that appeared up to eight years younger than their peers with the least protective factors.

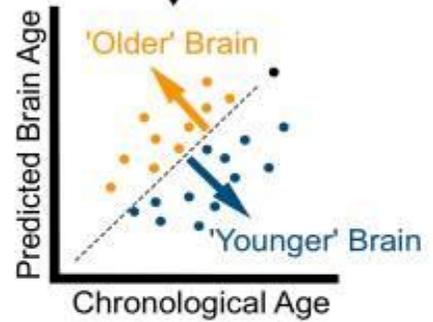
MRI scans and machine learning analysis revealed that lifestyle factors appear to buffer the burden of chronic pain and measurably influence brain age.



Structural MRI



DeepBrainNet



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Brain Age Gap



Acknowledgements





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