



# The impact of Neuroinflammation and what to do about it

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Integrated Brain Health




# Outline

- ▶ Inflammation and chronic inflammation
- ▶ Neuroinflammation
- ▶ The special case of COVID-19
- ▶ How chronic inflammation leads to symptoms
- ▶ Interventions
- ▶ Diet/Nutrition, Photobiomodulation, Neurofeedback
- ▶ Case examples

*Materials that are included in this course may include interventions and modalities that are beyond the authorized practice of mental health professionals. As a licensed professional, you are responsible for reviewing the scope of practice, including activities that are defined in law as beyond the boundaries of practice in accordance with and in compliance with your professional standards.*



# What is inflammation?

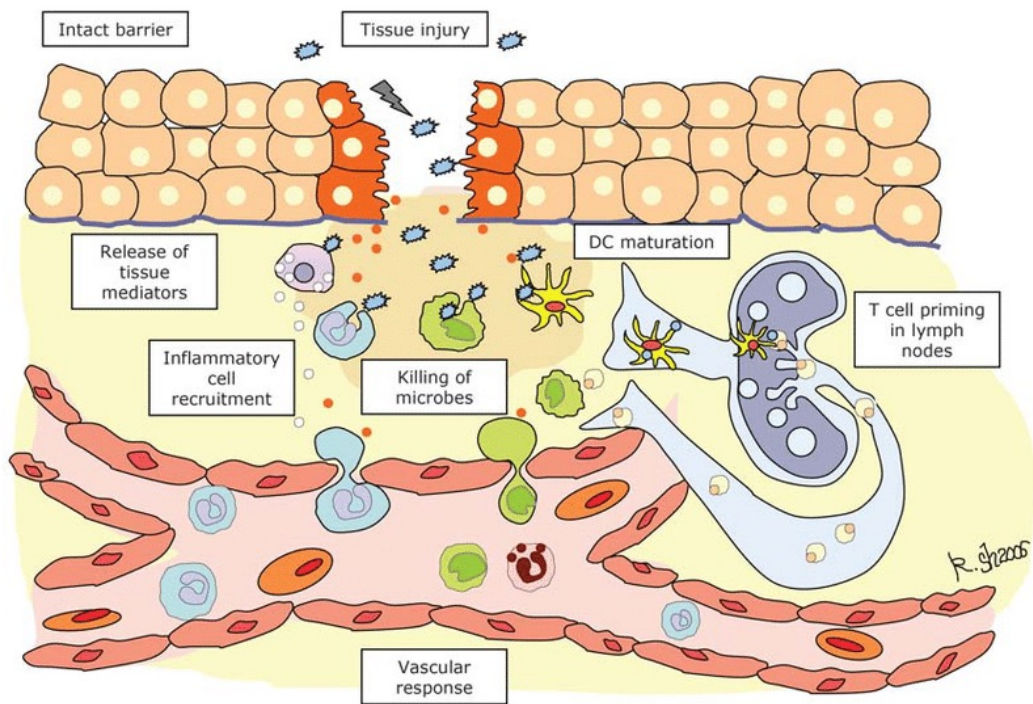
- ▶ Your body's natural response to protect itself from harm.
  - ▶ Think of cutting your finger and what happens – swelling, from blood cell accumulation and healing results.
  - ▶ Your immune system dispatches an army of white blood cells to surround and protect the area, creating redness and swelling.
  - ▶ The same is true for bacteria or viruses.
  - ▶ This would also be true to physical injuries, chemical and radiation exposure.
  - ▶ Signs of inflammation include redness, heat, swelling, pain and/or loss of function.
  - ▶ Your body then responds by feeling ill, exhaustion and fever. This occurs because your immune system is active and requires more energy to be successful.
  - ▶ There are also changes in the blood including an increased number of immune system cells.
- 



# How does your immune system respond?

- ▶ When inflammation occurs, immune system cells get activated.
- ▶ These include hormones of bradykinin and histamine leading to blood vessel dilation (more blood gets there) leading to the area turning red and feeling hot.
- ▶ These hormones irritate nerves sending pain signals to the brain (protective response).
- ▶ Immune cells can then pass out of blood vessels so that they can reach the inflamed tissue.
- ▶ Mucous membranes also release more fluid which can flush viruses away.

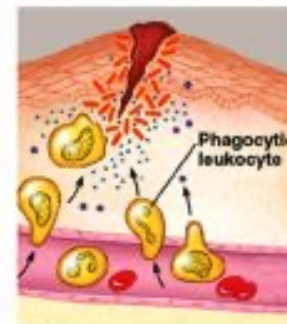




1  
Histamine & prostaglandins released



2  
Capillaries dilate  
Clotting begins



3  
Chemotactic factors attract phagocytic cells



4  
Phagocytes consume pathogens & cell debris




# The Basic Inflammatory Response

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# How does acute inflammation lead to chronic inflammation?

- ▶ Chronic inflammation happens when the immune response lingers leaving your body in a state of alert.
- ▶ Over time this will have a negative impact on your tissues and organs.
- ▶ Common symptoms of chronic inflammation include fatigue, fever, mouth sores, rashes, abdominal pain and chest pain.
- ▶ Causes may include untreated causes of acute inflammation (infection, injury), autoimmune disorder, long term exposure to chemicals or pollutants.
- ▶ Other causes may include smoking, obesity, alcohol and chronic stress.
- ▶ Foods that increase inflammation include sugar and high fructose corn syrup, refined carbohydrates, fried foods, trans fats, vegetable oils, red meat and processed meat.



## Major Causes of Chronic Inflammation

Poor diet

Advanced glycation end products (AGEs) due to elevated blood sugar

Insulin resistance

Mitochondrial dysfunction

Oxidized lipoproteins (such as low-density lipoprotein, LDL)

Lack of exercise

Inadequate sleep

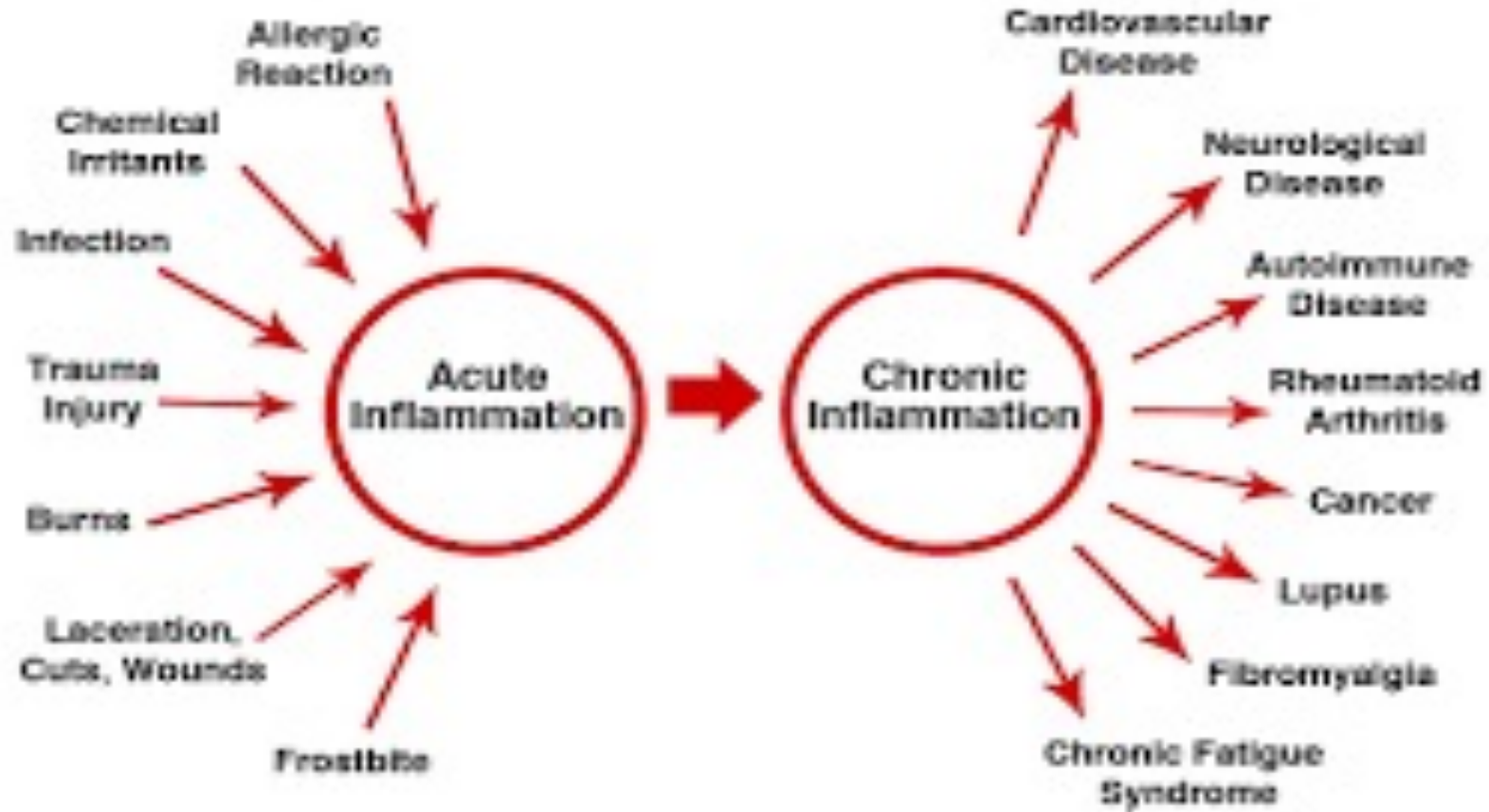
Smoking

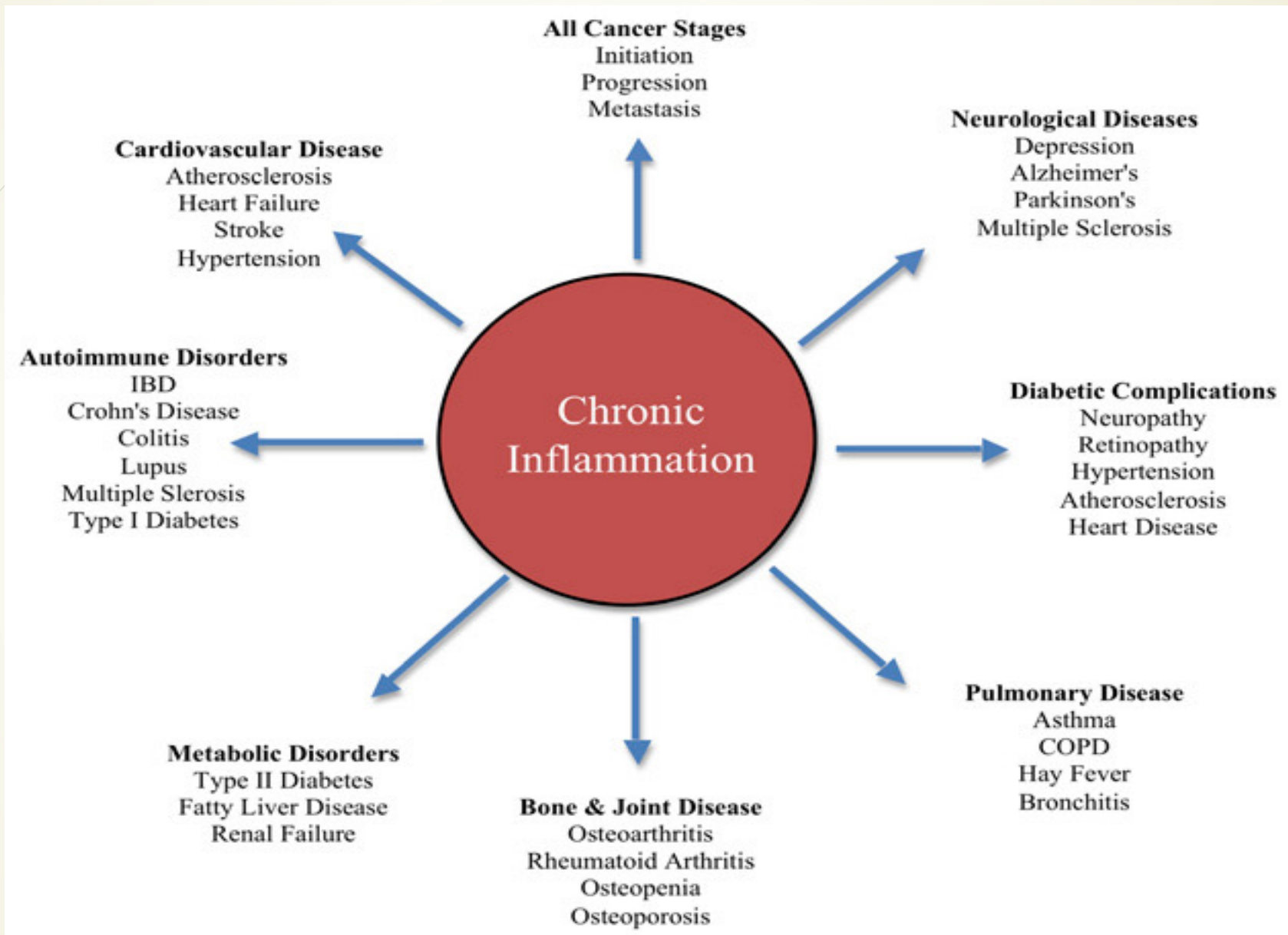
Excess stress

Environmental factors (i.e. pollution)



# Acute Vs. Chronic Inflammation










# Neuroinflammation and it's disorders

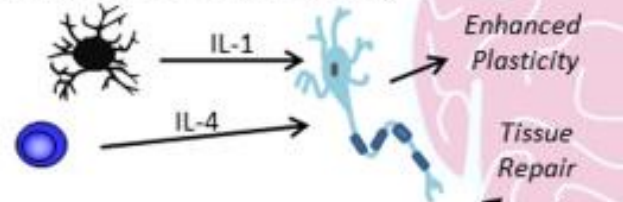
- ▶ Neuroinflammation is an inflammatory response in the brain or spinal cord.
  - ▶ This is commonly seen in traumatic injuries.
  - ▶ Chronic stress leads to neuroinflammation which increases the likelihood of increasing stress responses.
  - ▶ Aging and brain decay also kick off an immune response and inflammatory process. If this is not adressed it can worsen the effects of aging.
  - ▶ Microglia are critical in modulating neuroinflammatory responses.
  - ▶ There is an intimate relationship between the brain, spinal cord and immune system.
- 

## Positive Aspects of Neuroinflammation

**Transient (Low) Inflammation**  
*Immune to brain communication*  
*Immune surveillance*



**Neuroinflammatory (Low) Signaling**  
*Development, Memory and learning*



**Transient (Med) Inflammation**  
*Injury Induced Remodeling*



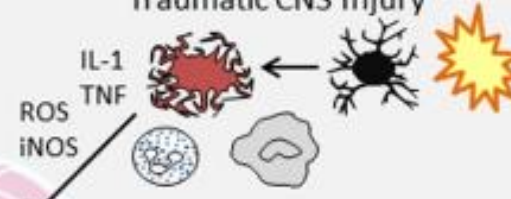
**Transient (Med) Inflammation**  
*Immune Pre-conditioning,*  
*Eufflammation*



*Reorganization of host priorities*  
*Enhanced Plasticity*  
*Tissue Repair*  
*Neuro-protection*

## Negative Aspects of Neuroinflammation

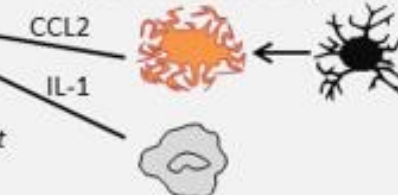
**Transient (High) Inflammation:**  
*Traumatic CNS Injury*



*Collateral Damage*

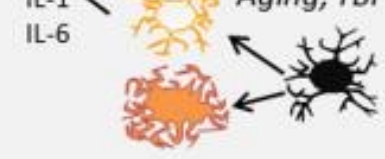
**Transient (Med) Inflammation**  
*Repeated Social Defeat Stress*

*Anxiety & Depression*  
*Cognitive Impairment*  
*Reduced Plasticity*

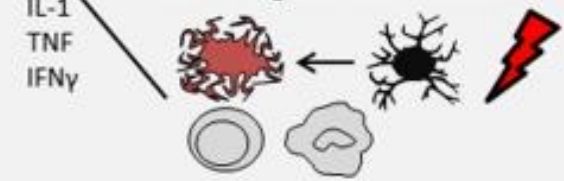


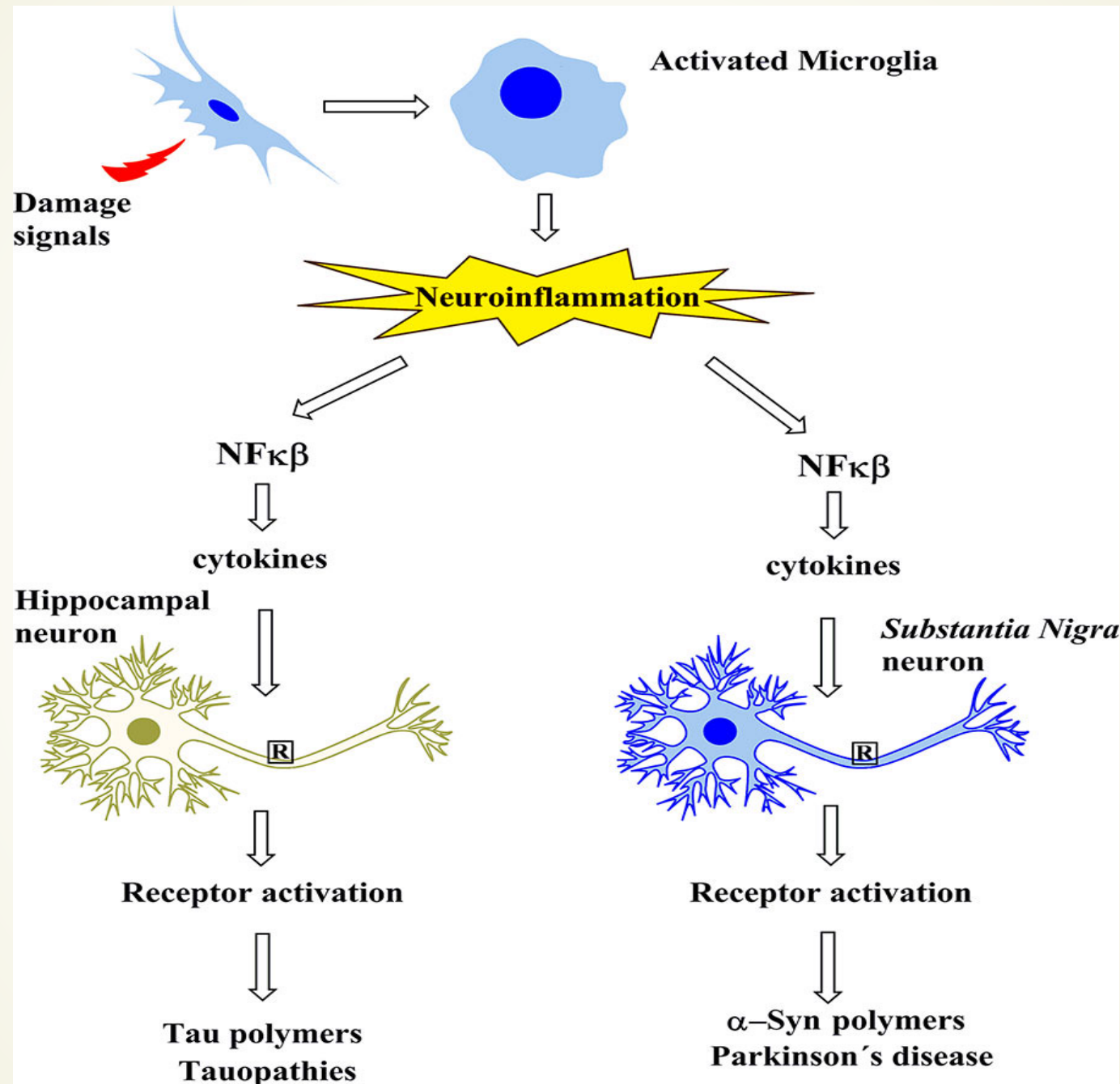
*Neuronal damage*

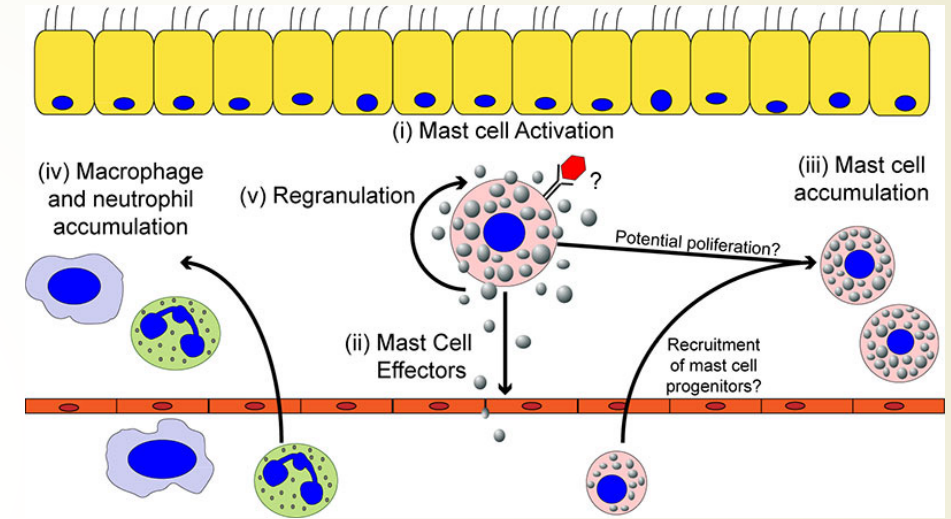
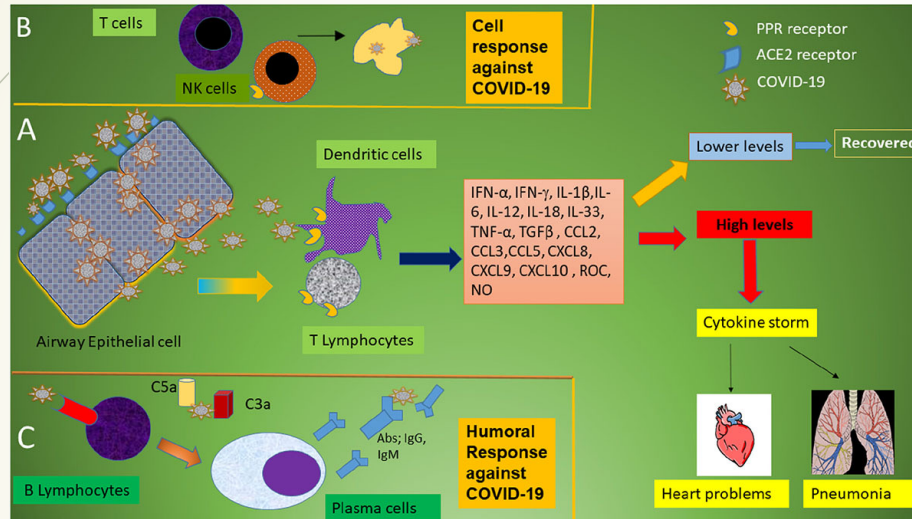
**Chronic (Low) Inflammation:**  
*Aging, TBI*



**Chronic (High) Inflammation:**  
*Neurodegenerative Disease*








# COVID-19 Inflammatory Response



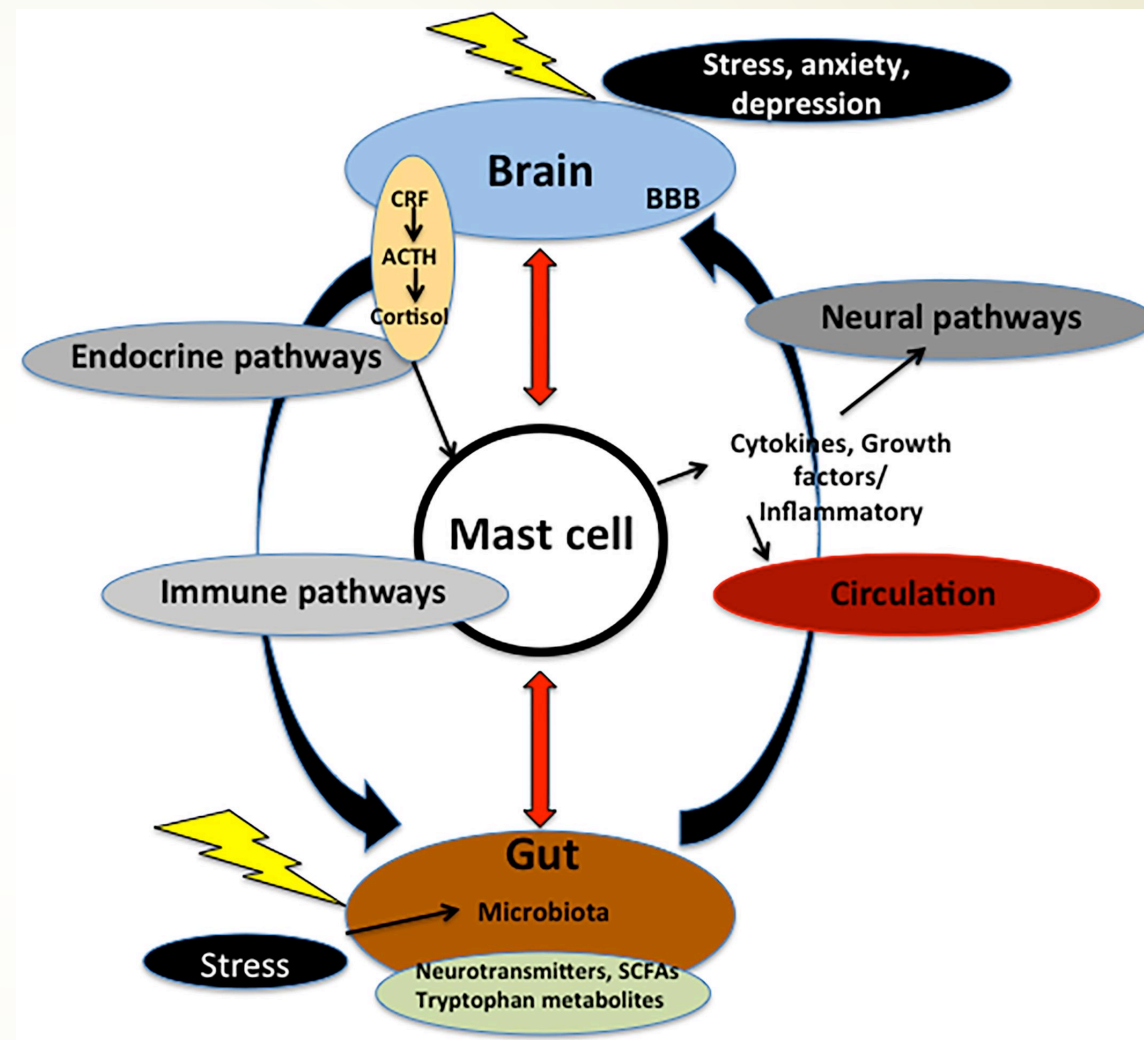


# COVID-19 Inflammatory Response

- ▶ Intensive complications in those that are older and have chronic disease states – more severe inflammatory responses.
  - ▶ Those with heightened inflammatory levels can have uncontrolled inflammation leading to a cytokine storm.
  - ▶ The COVID-19 infection, of course, leads to an increase in inflammation to attack the virus. It commonly infects the lower respiratory tract via attachment to S proteins and ACE2 receptors (in epithelial cells).
  - ▶ Organs rich in these cells are susceptible including the kidney, gut and brain.
  - ▶ This invasion makes clearing out the virus very challenging and can lead to severe or prolonged symptoms.
- 

# Mast Cell Activation Syndrome


- Mast cells respond to infection and help clear out invading agents.
- With the cytokine storm over production of mast cells can occur leading to hyperinflammation.
- It is estimated that MCAS occurs in about 15% of the population.
- This may be especially salient for “long haulers” and their prolonged recoveries.







# Anti-inflammatory intervention

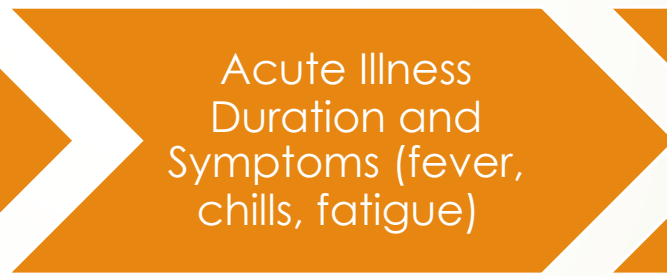
- ▶ Treat the gut with anti-inflammatory agents
  - ▶ Enhance immune system functioning.
  - ▶ Work on brain pathways.
  - ▶ Reduce stress, anxiety, depression.
  - ▶ Resolve endocrine pathways.
  - ▶ Enhance blood circulation.
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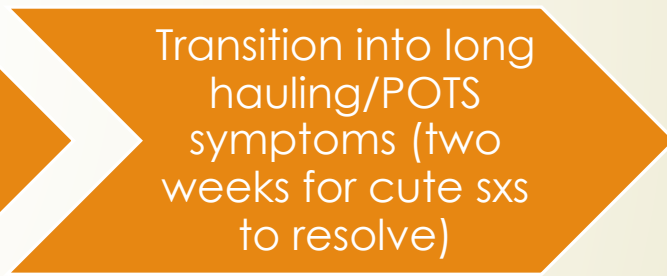
# Personal COVID-19 Timeline




Acute COVID-19  
infection  
(1/11/2021)



Acute Illness  
Duration and  
Symptoms (fever,  
chills, fatigue)



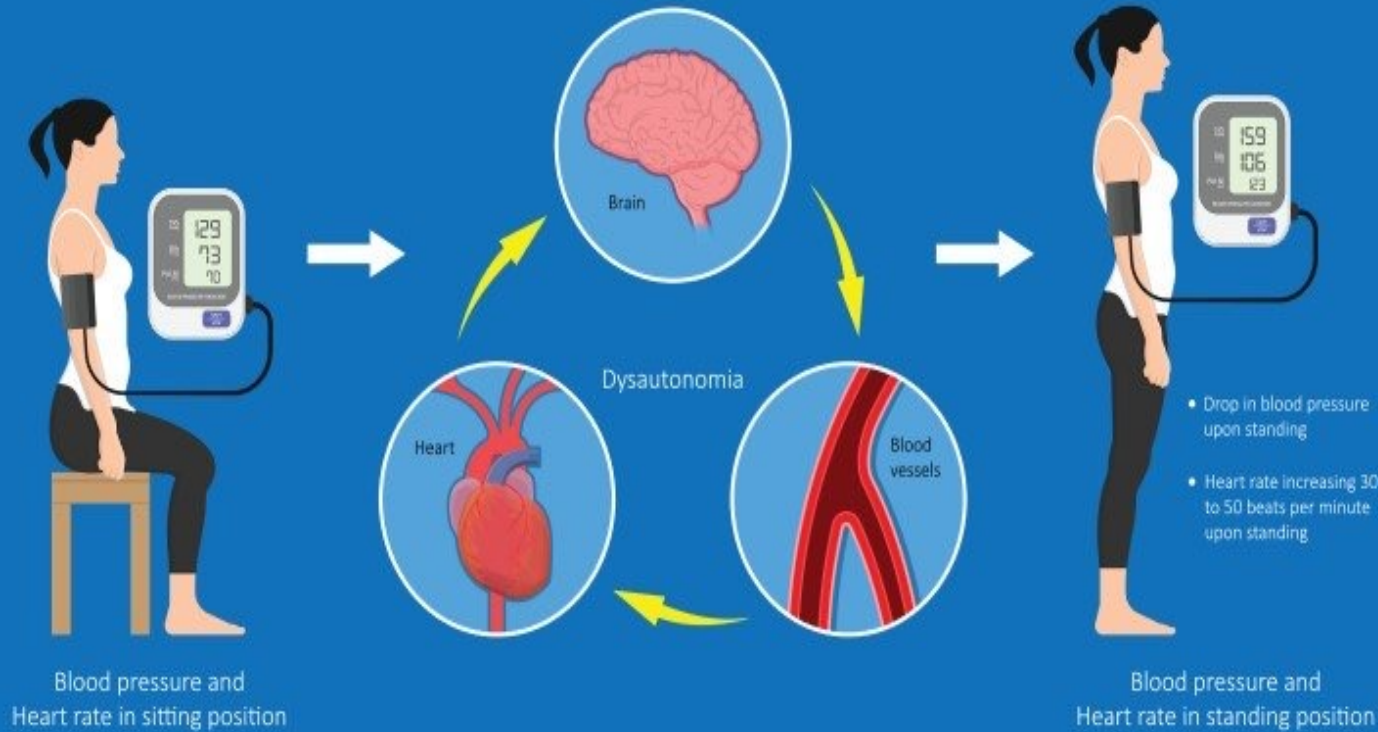
Transition into long  
hauling/POTS  
symptoms (two  
weeks for acute sxs  
to resolve)



# Developing long hauler POTS symptoms

- ▶ As the fever broke, I continued to have excessive fatigue and just felt unwell.
- ▶ I started getting light headedness and dizzy spells upon standing.
- ▶ Resting heart rate shot up to 85 (was 55).
- ▶ Upon standing and traversing a flight of stairs my heart rate would go up to above 130 bpm.
- ▶ Had one episode of passing out upon standing.
- ▶ Started becoming very concerned with distress and anxiety symptoms.

## Postural Orthostatic Tachycardia Syndrome (POTS)



### Symptoms of POTS

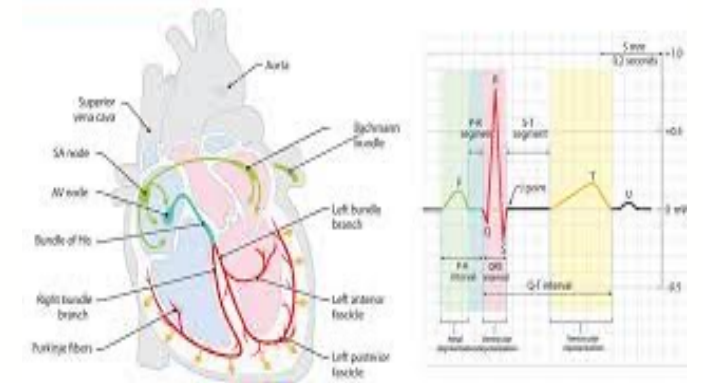
- Dizziness or light-headedness
- Shaking and sweating
- Weakness and fatigue
- Shortness of breath
- Chest pain
- Fainting
- Heart palpitations
- Headaches
- Poor sleep

# Medical tests

- Routine physical exam was normal.
- Blood pressure was a little high but not excessive.
- EKG was negative.
- Echocardiogram was normal.

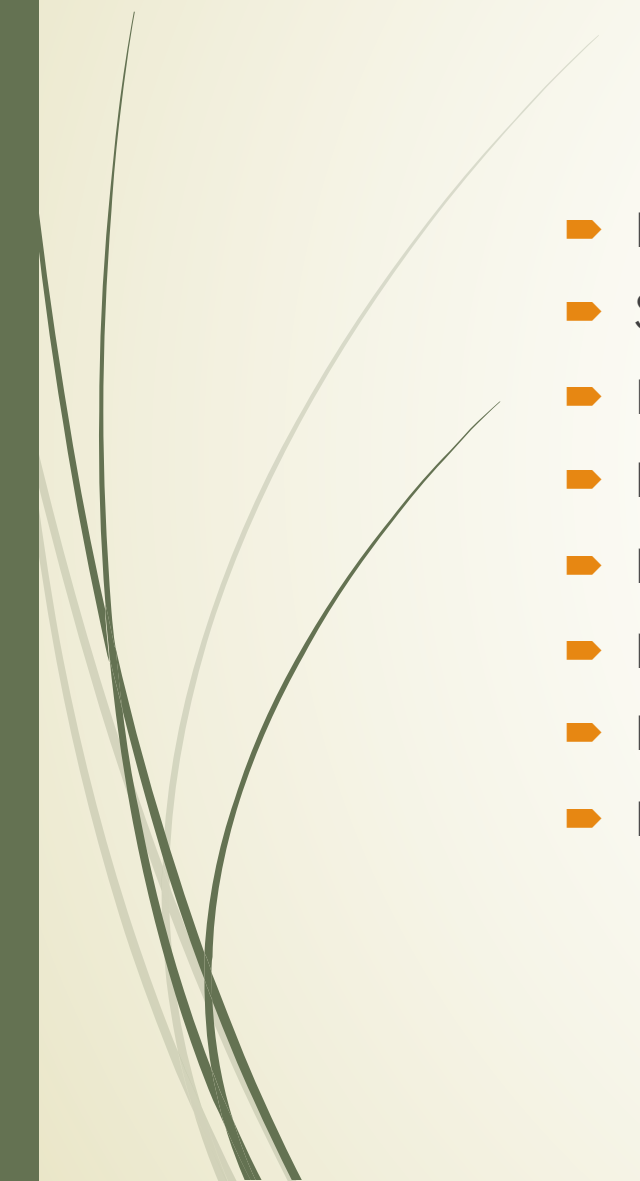


Electrocardiogram





# Interventions (self-designed program)

- ▶ FB group for long haulers with lots of good info.
  - ▶ Sleep at least 7 hours per night.
  - ▶ Rest when needed.
  - ▶ Hydration (at least 80 ounces of water and electrolytes per day).
  - ▶ No caffeine.
  - ▶ No alcohol.
  - ▶ Low sugar, anti-inflammatory diet.
  - ▶ Low stress environment.
- 



# Supplements, vitamins

- Vitamin C
- Vitamin D3
- Zinc
- Quercetin
- N-Acetyl Cysteine
- Nicotinamide Adenine Dinucleotide+
- ATP Fuel

## Supplement Facts

Serving Size 5 Capsules Servings Per Container 30

Amount Per Serving	% Daily Value**	
<b>Vitamin E</b> (as d-alpha tocopheryl acid succinate)	17 mg	110%
<b>Calcium</b> (from Mitochondrial Pro Regulator™ Blend)	137 mg	11%
<b>Phosphorus</b> (from Mitochondrial Pro Regulator™ Blend)	37 mg	3%
<b>Magnesium</b> (from Mitochondrial Pro Regulator™ Blend)	41 mg	10%
<b>NT Factor® Proprietary Blend:</b> NT Factor Lipids® (Pat.No. 8,877,239) , Fructo-oligosaccharides, Rice Bran Extract, Opti MSM®, Bromelain, Sulfur, Pantethine, Inositol, L-Arginine, L-Glycine, Taurine, Alpha Lipoic Acid, Garlic, Spirulina, Beet Root Fiber, <i>Bifidobacterium bifidum</i> , Leeks Stem powder, <i>Lactobacillus acidophilus</i> , Blackstrap Molasses, Boron.	2,000 mg	†
<b>Mitochondrial Pro Regulator™</b> Opti MSM®, Calcium (as calcium citrate, dicalcium phosphate, and calcium pyruvate), Phosphorus (as dicalcium phosphate), Magnesium (as magnesium malate)	432 mg	†
<b>Krebs Cycle Glucose Absorb™</b> Alpha ketoglutaric acid, L-Tyrosine	180mg	†
<b>RN Fatty Acid Metabolizer™</b> Carnipure® L-Carnitine L-tartrate, Pantethine (a Coenzyme A Precursor)	141mg	†
<b>Krebs Energy Foundation™</b> Coenzyme Q10 and stabilized NaDH	35mg	†

\*\* Percent Daily Values are based on a 2,000 calorie diet.

† Daily Value not established.

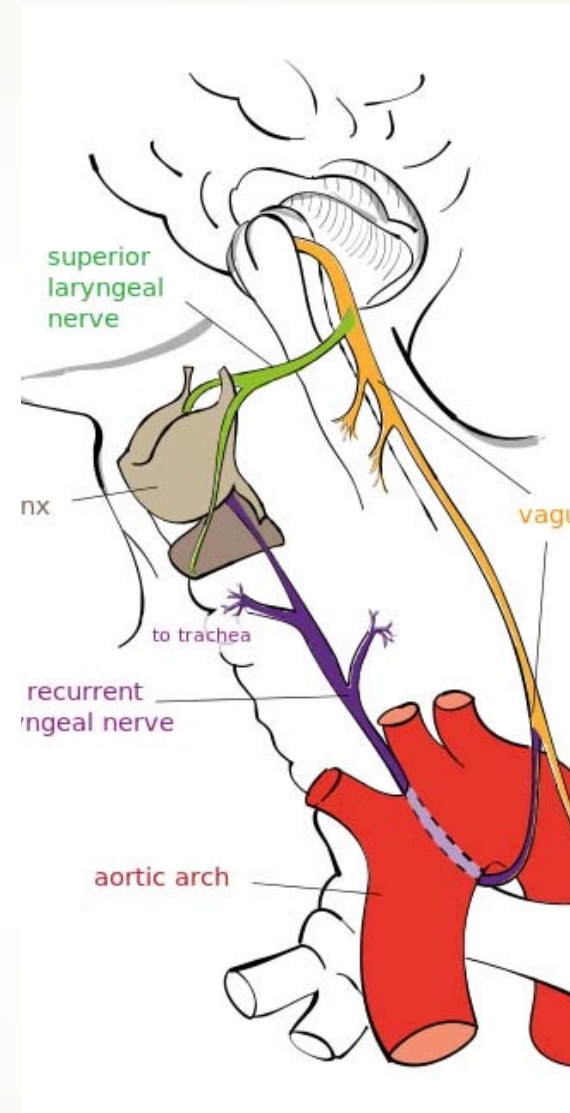
## Biofeedback/Heart Rate Variability/Photobiomodulation

- ▶ HRV Elite heart rate variability
- ▶ Polar 10 heart rate monitor
- ▶ Vielight gamma photobiomodulation
- ▶ Infrared light stimulation shown to decrease inflammation and enhance brain cell growth at the level of the mitochondria



# Vagus nerve infrared stimulation

- ▶ Infrared light stimulation targeted towards the vagal nerve and lower brain centers
- ▶ Nasal stimulator targets limbic system functions
- ▶ Headset at base of neck and top of head to target deeper centers near the hypothalamus, brain stem and vagus





# Exercise: the final frontier

- ▶ About 3 weeks into my illness I started trying to walk for exercise.
- ▶ Guided by MD and PT and cautioned to take it slow and stop if my heart rate gets too high or too low.
- ▶ High heart rate at start with dramatic decreases in heart rate while exerting myself over time and up hills.
- ▶ Heart rate ranging from 135 to 55 (90-100 typical).





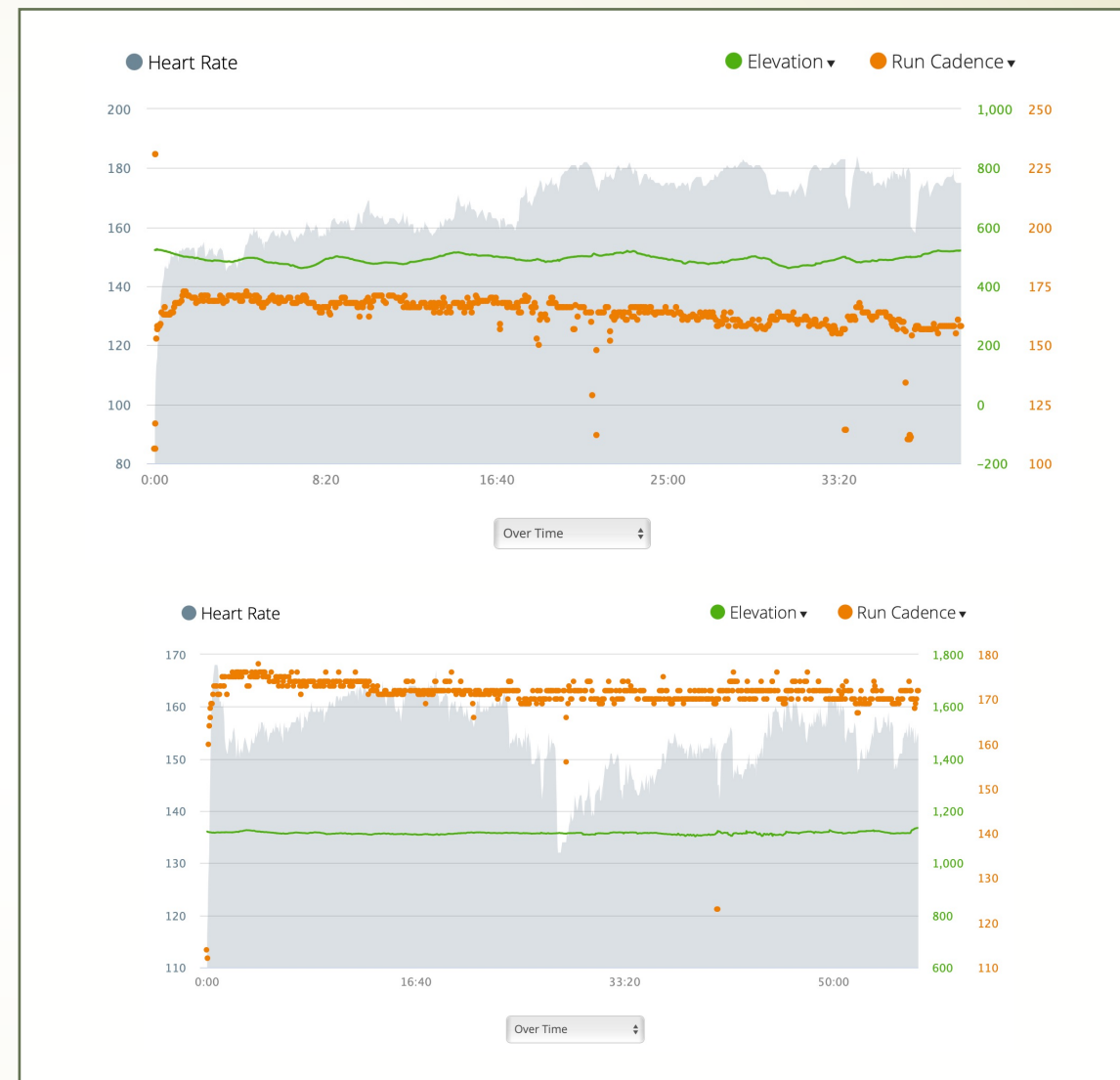
# Walking



- ▶ Over the next 3 weeks walked daily no matter how I felt...
- ▶ Walked at slower paces over shorter distances.
- ▶ Only increased distance when heart rate did not drop dramatically.
- ▶ Over time was able to get over 1, 2 and 3 miles.
- ▶ Elevated heart rates but over time rapid changes diminished somewhat but not completely.
- ▶ After 3 weeks of walking and 6 weeks since illness I was able to resume jogging.

# Running (praise the lord!)

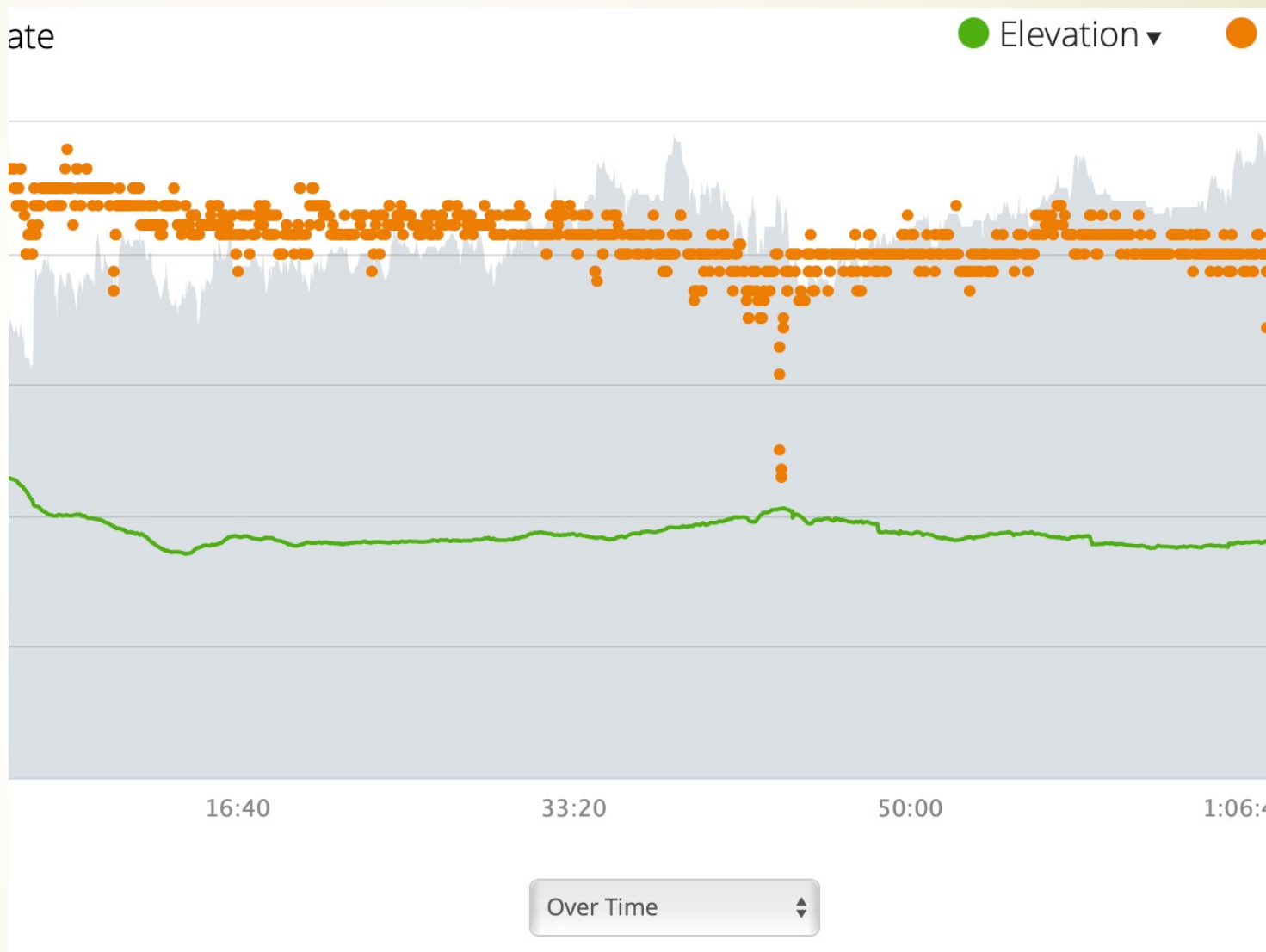
- ▶ Six weeks in able to run over 4 miles again but with increasing excessive heart rate.
- ▶ Heart rate increasing as trying to keep it at moderate ranges (zones 2-3).
- ▶ Dramatic rises and dips in heart rate.
- ▶ Continued to run shorter distances and slower paces to gradually build up tolerance.
- ▶ This occurred for up to 9 weeks after illness beginning.





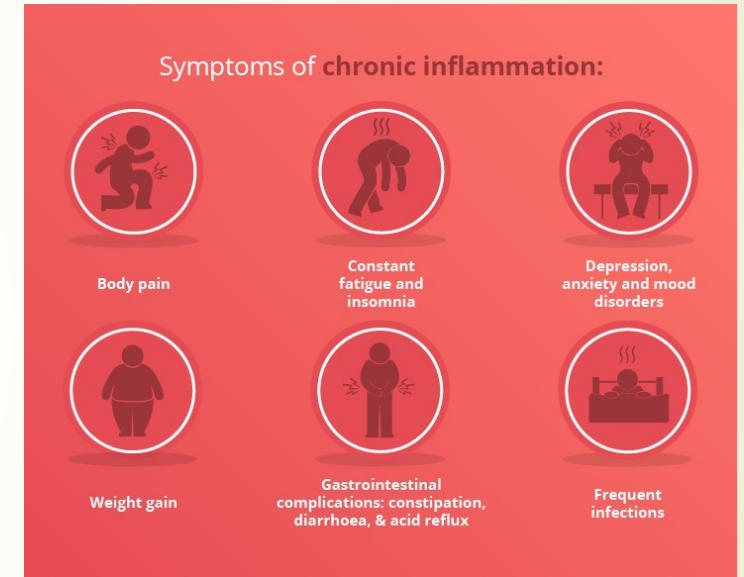
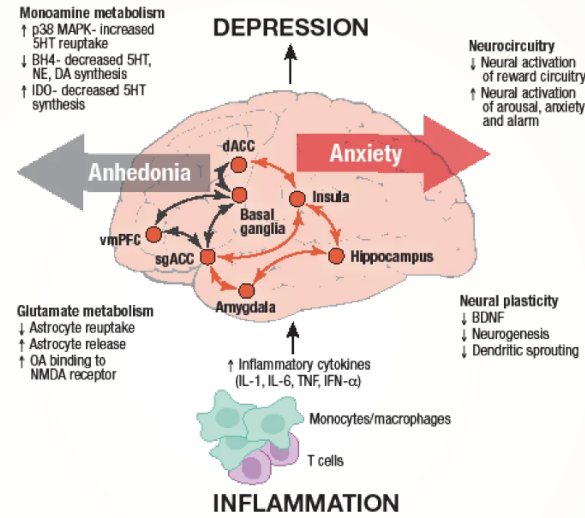
# Return to normal running

- First fever 1/11/2021
- Running with normal heart rate and no dramatic fluctuations (matching to cadence).
- This occurred for the first time with a longer run (8 miles) on 3/20/2021.
- Continued training and ran an ultramarathon on 5/29/2021.



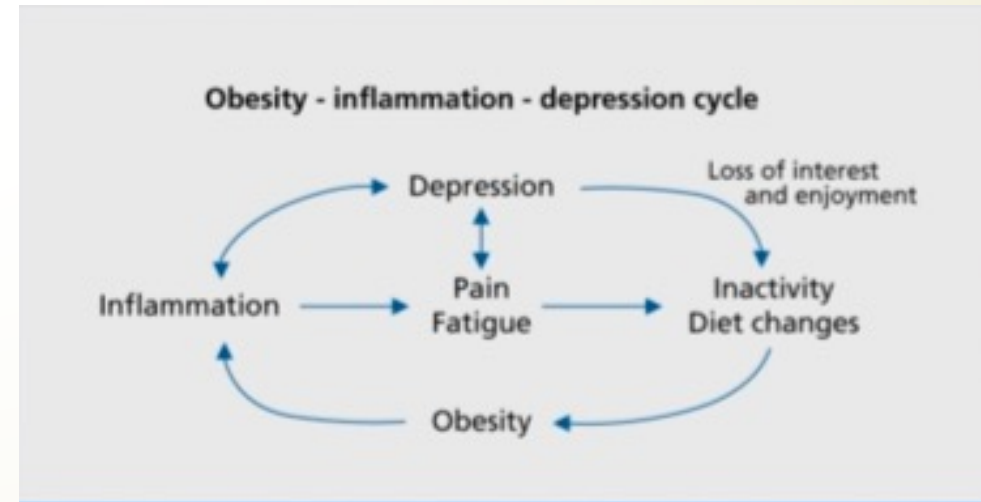
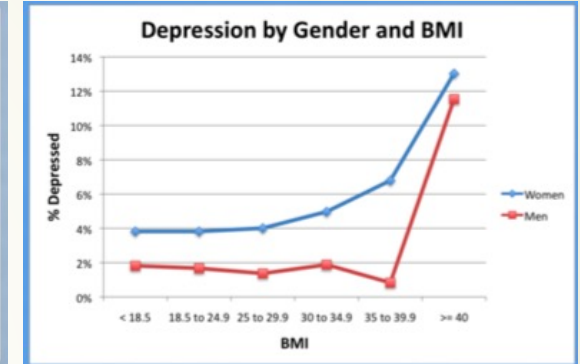
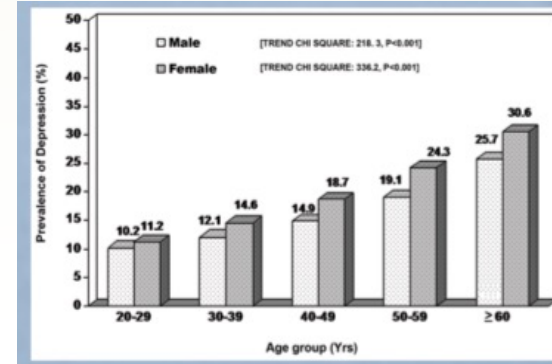
# Chronic inflammation and neuropsychological disorders

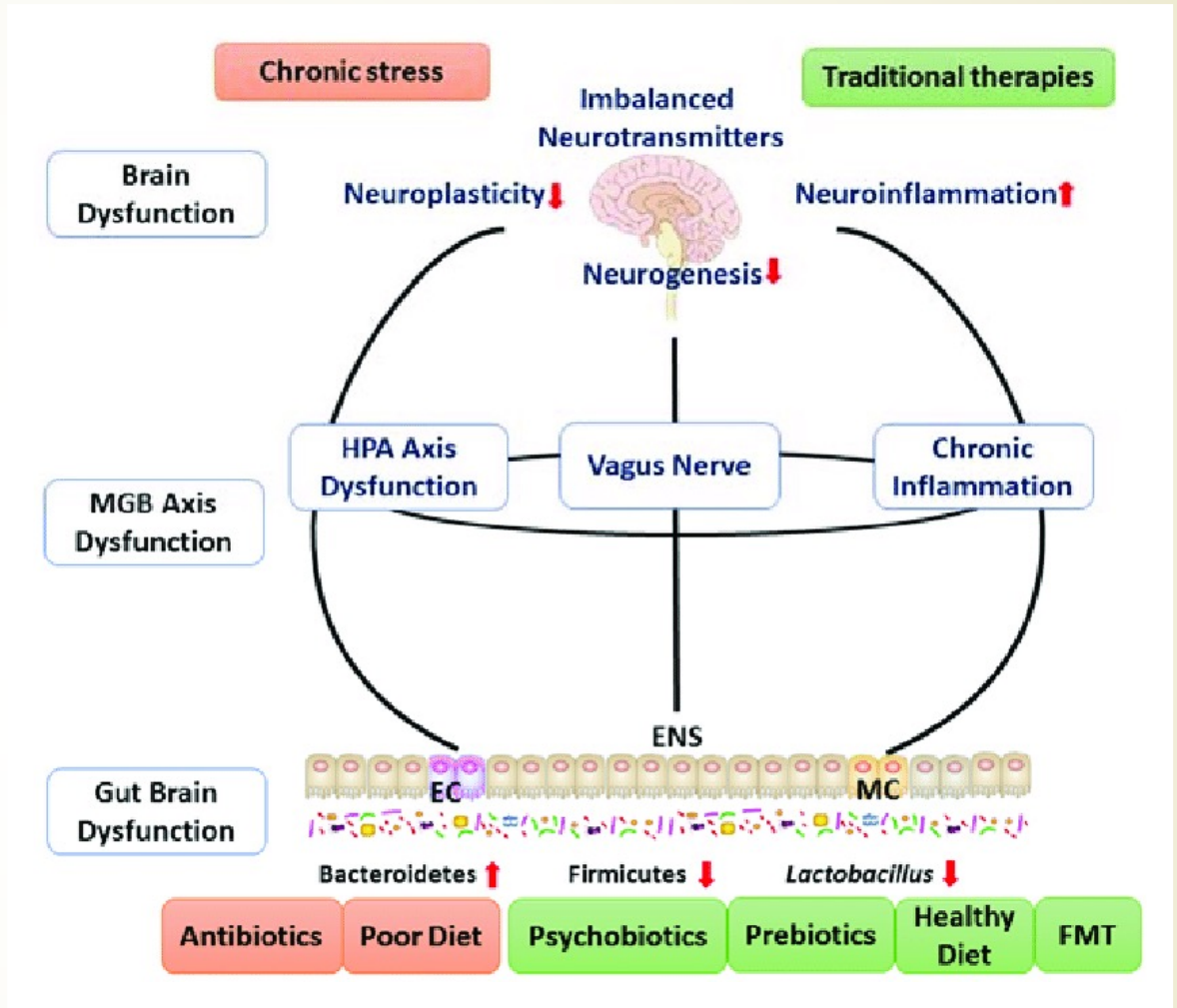
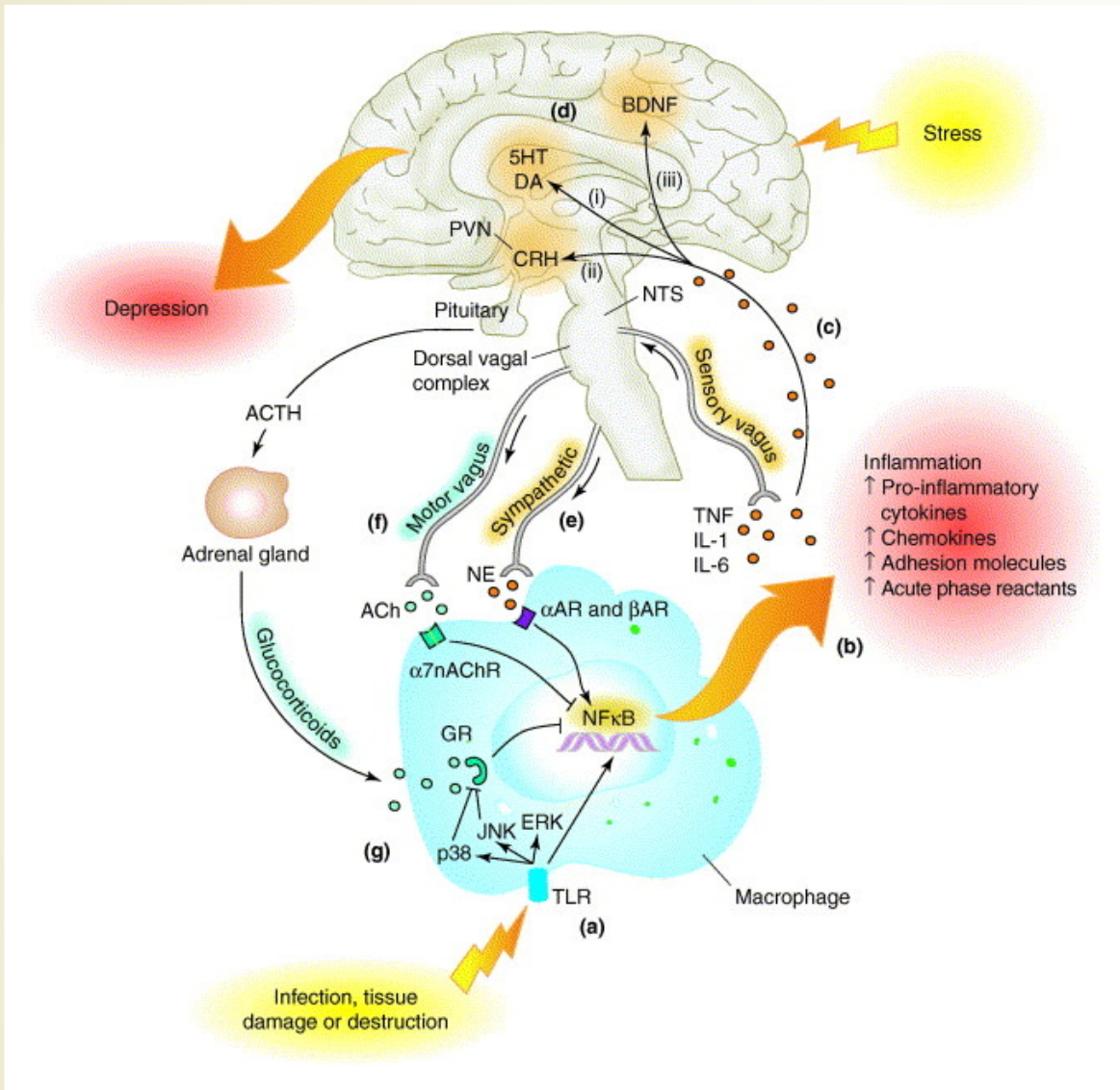
- Depression
- Anxiety
- Memory Disorders
- Cognitive Disorders
- Dementia
- Traumatic Brain Injury



# Depression

- Rates of depression increase with age.
- Risk of becoming overweight and obese increase dramatically with age.
- Aging and obesity are both associated with chronic inflammation.
- This is associated with inactivity, dietary changes, loss of interest, pain and fatigue.

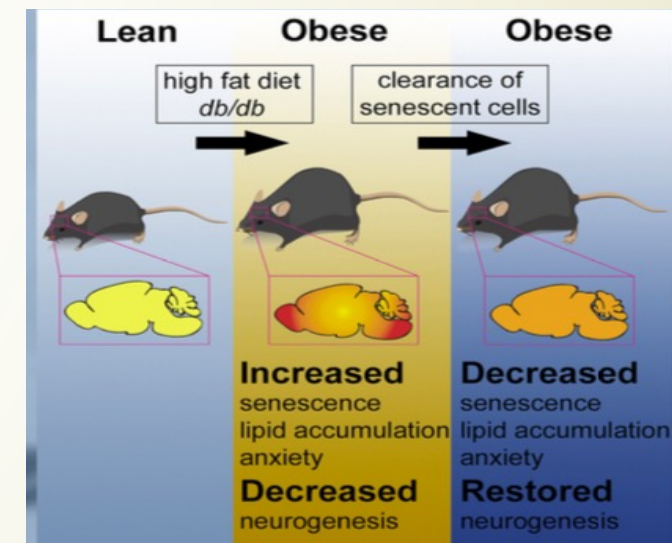
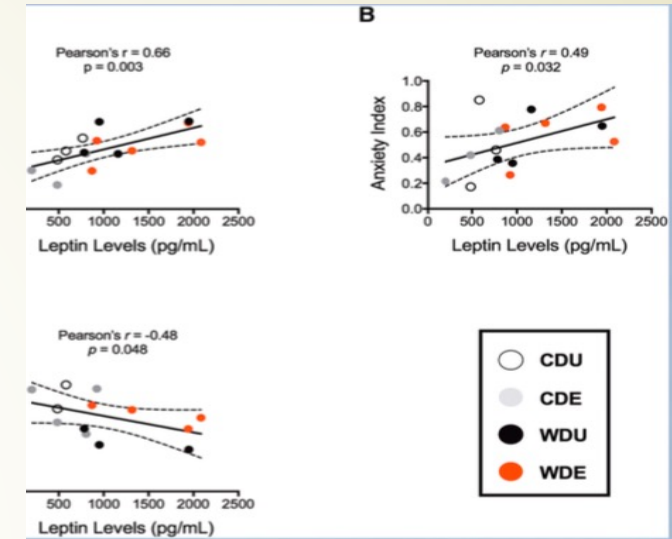
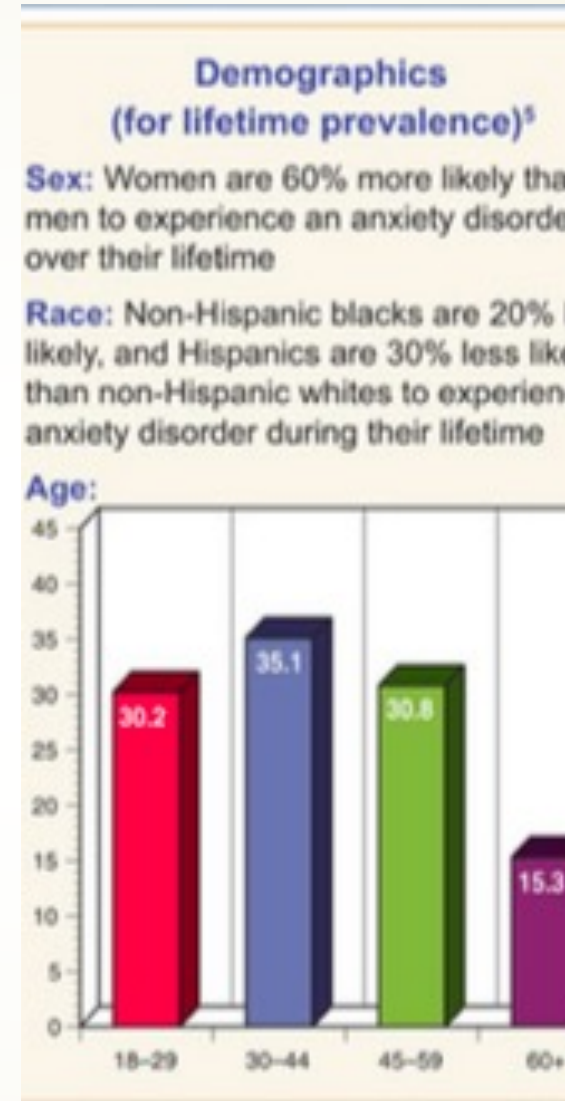






# Anxiety

- Anxiety is common over all ages but especially 30-60.
- It is more common in women.
- High fat diet (saturated fat, trans fats) leads to anxiety in animal models.
- Removal of fat inducing cells relieves anxiety.





# Anxiety

- Often related to multiple health concerns and habits.
- Related to physical organ dysfunction often related to dietary and lifestyle choices.
- Chronic inflammation is a constant in all of these conditions.

## POSSIBLE ROOT CAUSES OF ANXIETY

@corylrodriguez

@ellenvoramd



Blood sugar roller coaster



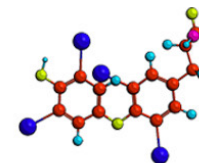
Caffeine sensitivity



Sleep deprivation



Constant stressful situations



Hormonal imbalance and thyroid problems



Gut dysfunction



Chronic inflammation



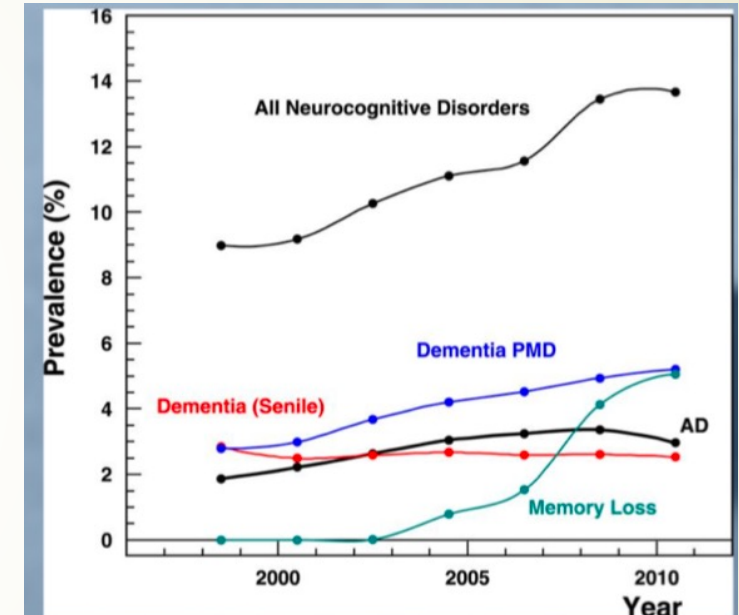
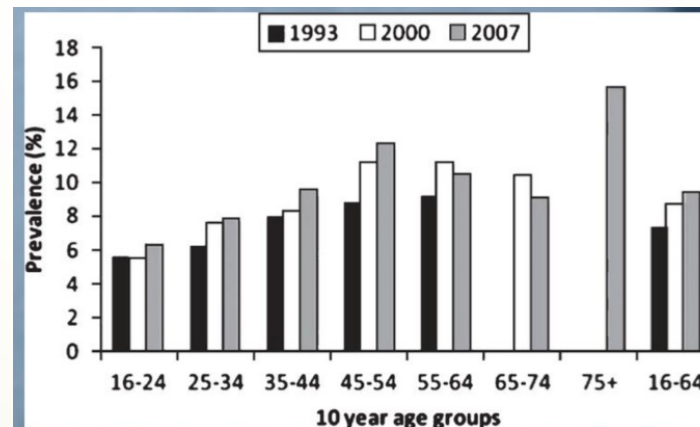
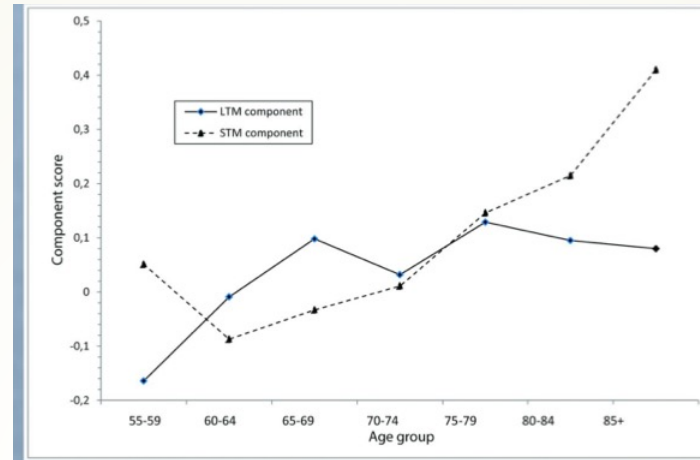
Food sensitivities



Micronutrient deficiencies

# Memory Disorders

- Memory problems increase with age.
- Long term memory gets especially worse around the age of 75.
- Memory disorders have been increasing in prevalence at every age group over the last two decades.
- This is especially true for memory loss and multi infarct dementia.



# BMI and Dementia

- As BMI continues to rise with age so does the risk of dementia.
- At higher BMI levels the prevalence almost doubles.
- In fact, if you stabilize someone's BMI (dietary intervention) their risk of dementia stabilizes.
- If you lower their BMI their risk of dementia also goes down substantially.



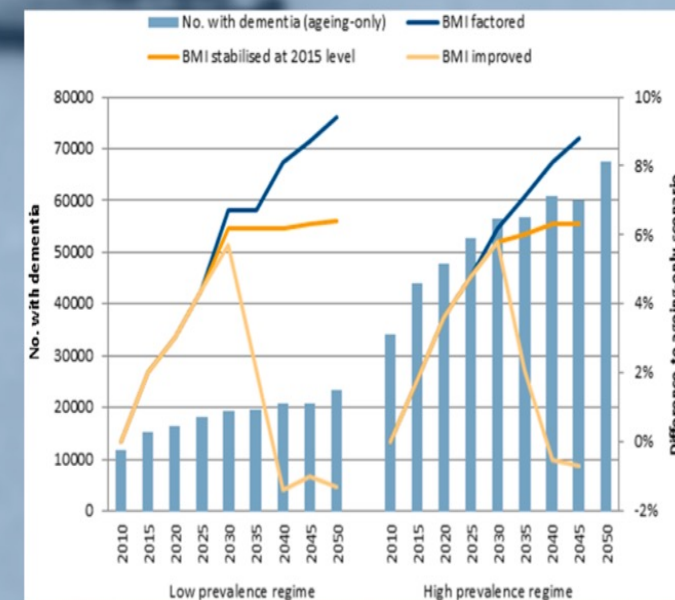
## Rising Midlife Obesity Will Worsen Future Prevalence of Dementia

Binod Nepal, Laurie J. Brown, Kaarin J. Anstey

Published: September 3, 2014 • <https://doi.org/10.1371/journal.pone.0099305>

Age	Low prevalence regime [3,11]		High prevalence regime [1]	
	Male	Female	Male	Female
65-69	1.6	1.0	3.0	4.5
70-74	2.9	3.1	6.2	4.3
75-79	5.6	6.0	10.7	10.6
80-84	11.0	12.6	16.9	16.0
85-89	12.8	20.2	25.1	21.0
90+	22.1	30.8	43.0	41.0

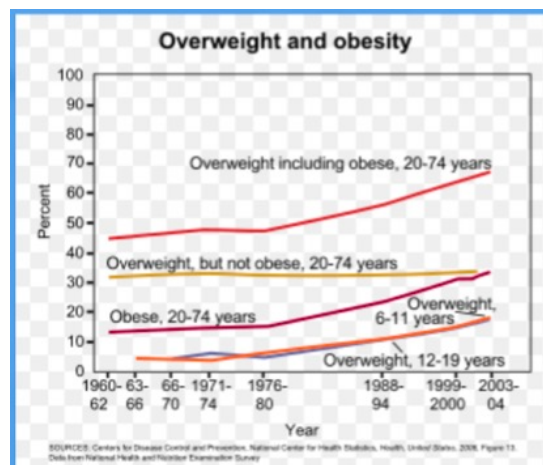
doi:10.1371/journal.pone.0099305.t001



# BMI (Body Mass Index)

- BMI is simply a number based on your height and weight.
- That number is then used to tell you if you have a healthy weight for your height or if you are overweight or obese.
- It is very easy to calculate and there are even online calculators for this.
- A BMI of 25 or higher means you are overweight and 30 or above obese.
- Over the last 50 years the rates of overweight and obese people have risen dramatically. It is now at 70% of the US population.

BMI of Adults Ages 20 and Older	
BMI	Classification
18.5 to 24.9	Normal weight
25 to 29.9	Overweight
30+	Obesity (including extreme obesity)
40+	Extreme obesity

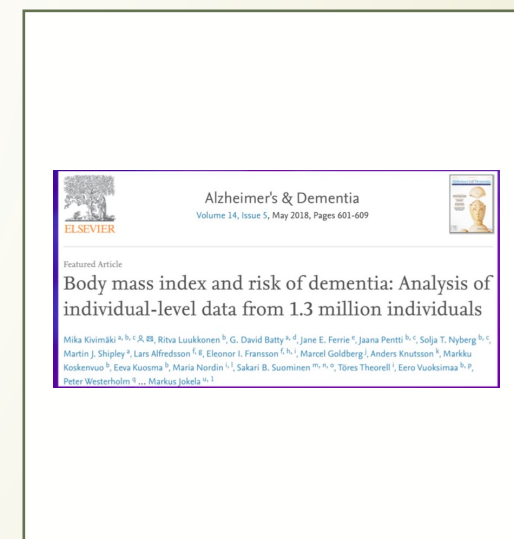
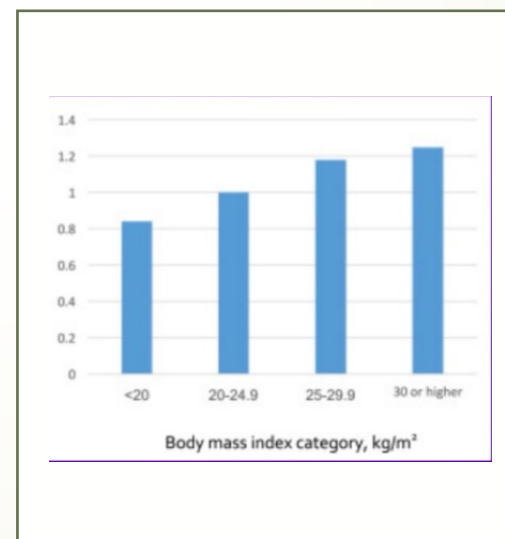
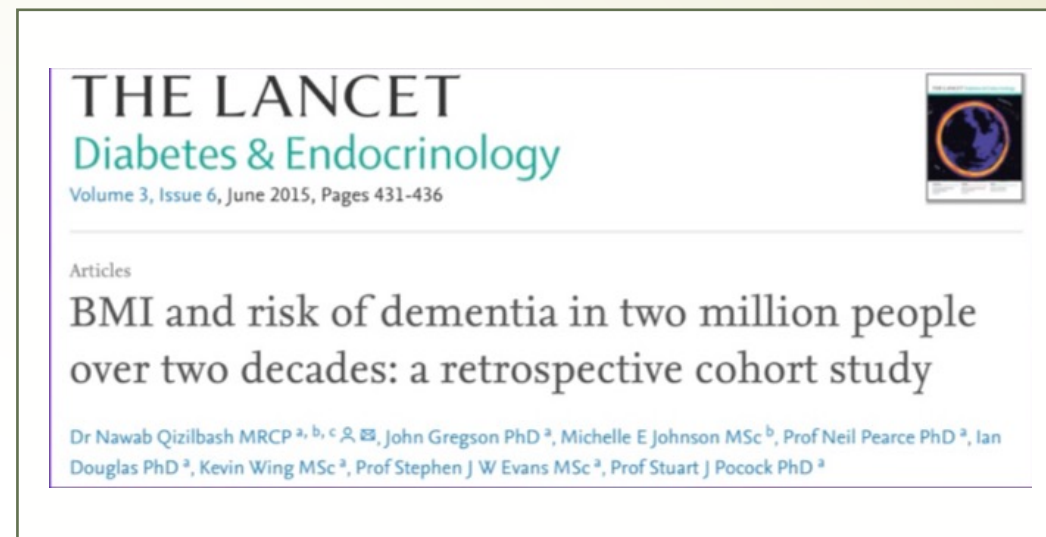


WEIGHT	lbs	kgs																																																			
		90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290																															
HEIGHT	ft/in	cm	Underweight	Healthy	Overweight	Obese	Extremely Obese																																														
4'8"	142.2	142.2	20	22	25	27	29	31	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80																					
4'9"	144.7	144.7	19	22	24	26	28	30	32	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81																				
4'10"	147.3	147.3	19	21	23	25	27	29	31	33	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80																				
4'11"	149.8	149.8	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80																			
4'12"	152.4	152.4	18	20	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81																		
5'1"	154.9	154.9	17	19	21	23	25	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80																		
5'2"	157.4	157.4	16	18	20	22	24	26	27	29	31	33	35	37	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80																	
5'3"	160.0	160.0	16	18	19	21	23	25	27	28	30	32	34	35	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81																
5'4"	162.5	162.5	15	17	19	21	22	24	26	27	29	31	33	34	36	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81															
5'5"	165.1	165.1	15	17	18	20	22	23	25	27	28	30	32	33	35	37	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80															
5'6"	167.6	167.6	15	16	18	19	21	23	24	26	27	29	31	32	34	36	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81														
5'7"	170.1	170.1	14	16	17	19	20	22	24	25	27	28	30	31	33	34	36	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81													
5'8"	172.7	172.7	14	15	17	18	20	21	23	24	26	27	29	30	32	33	35	37	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80													
5'9"	175.2	175.2	13	15	16	18	19	21	22	24	25	27	28	30	31	33	34	35	37	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80												
5'10"	177.8	177.8	13	14	16	17	19	20	22	23	24	26	27	29	30	32	33	34	36	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81											
5'11"	180.3	180.3	13	14	15	17	18	20	21	22	24	25	27	28	29	31	32	33	35	36	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81										
5'12"	182.8	182.8	12	14	15	16	18	19	20	22	23	24	26	27	28	30	31	33	34	35	37	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81									
6'1"	185.4	185.4	12	13	15	16	17	18	20	21	22	24	25	26	28	29	30	32	33	34	36	37	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80									
6'2"	187.9	187.9	12	13	14	15	17	18	19	21	22	23	24	26	27	28	30	31	32	33	35	36	37	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81								
6'3"	190.5	190.5	11	13	14	15	16	18	19	20	21	23	24	25	26	28	29	30	31	33	34	35	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80								
6'4"	193.0	193.0	11	12	13	15	16	17	18	19	21	22	23	24	26	27	28	29	30	32	33	34	35	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80							
6'5"	195.5	195.5	11	12	13	14	15	17	18	19	20	21	23	24	25	26	27	28	30	31	32	33	34	35	37	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81					
6'6"	198.1	198.1	10	12	13	14	15	16	17	18	20	21	22	23	24	25	27	28	29	30	31	32	33	34	35	37	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81				
6'7"	200.6	200.6	10	11	12	14	15	16	17	18	19	20	21	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81			
6'8"	203.2	203.2	10	11	12	13	14	15	16	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81		
6'9"	205.7	205.7	10	11	12	13	14	15	16	17	18	19	20	21	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81		
6'10"	208.2	208.2	9	10	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81	
6'11"	210.8	210.8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39	41	43	45	47	49	51	53	55	57	59	61	63	65	67	69	71	73	75	77	79	81



# Dementia and memory disorders

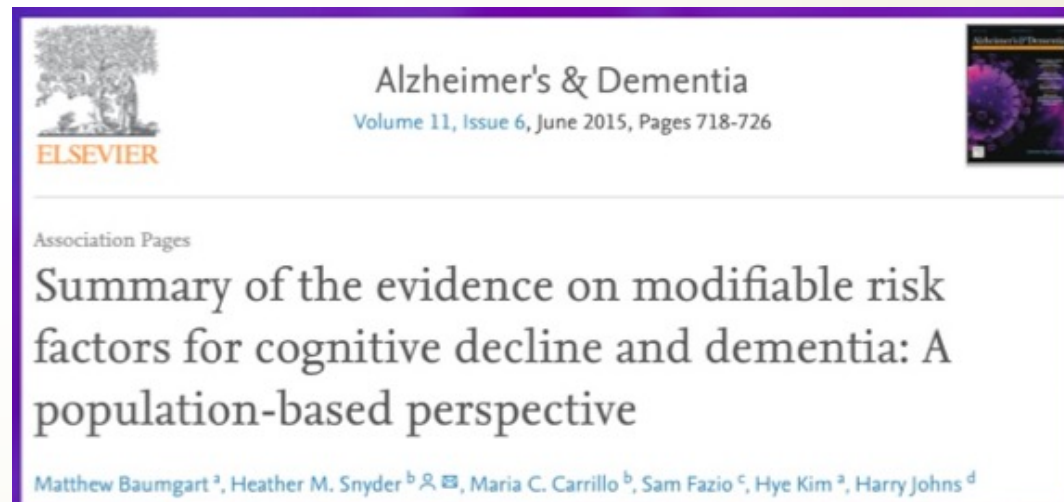
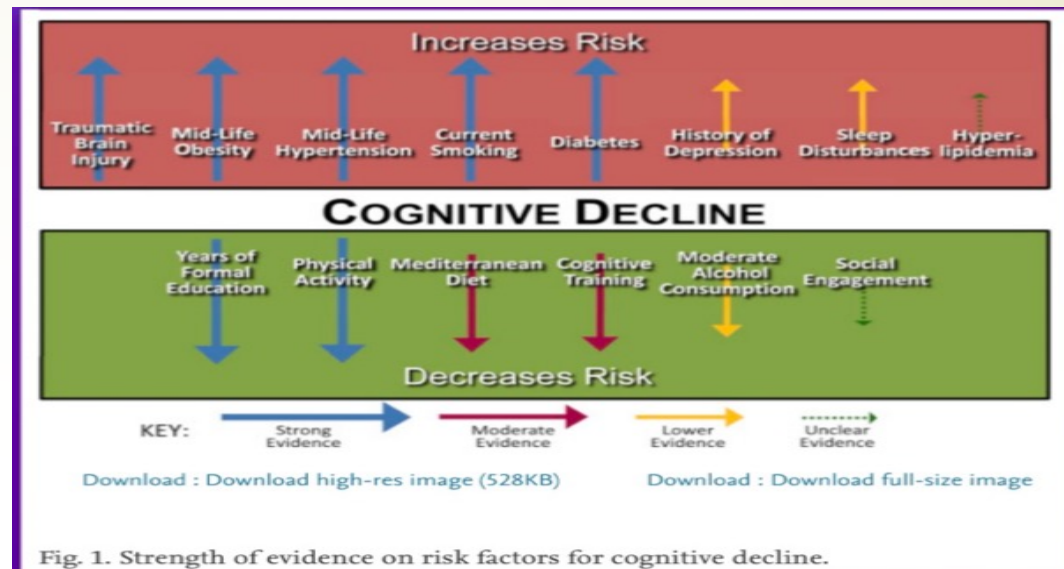
- Both low (<20) and high (>25) BMI is associated with dementia risk.
- Over 50% are related to poor diet, nutrition and chronic inflammation.
- Dietary intervention has been showed to lead to a 53% reduction in risk, thicker cortical regions, higher glucose metabolism and less beta amyloid proteins.
- Vitamins B (1,3 and 12), E and fatty acids are all critical in this process.





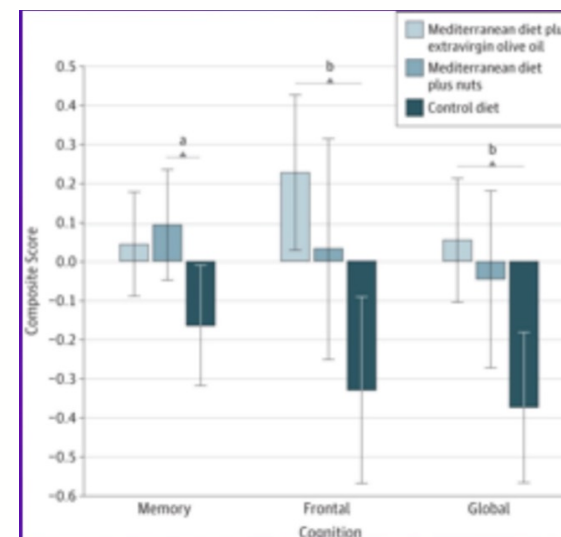
# Dementia Risk

- ▶ TBI, Obesity, Hypertension, Smoking, Diabetes, Depression, Sleep problems and Hyperlipidemia all increase your risk for dementia.
- ▶ Years of formal education, physical activity, Mediterranean diet, cognitive training, moderate alcohol consumption and social engagement all decrease your risk.



# Mediterranean diet

- Avoid sugar, refined grains (carbs), trans fats, vegetable oils, processed meat.
- Focus on vegetables, nuts, seeds, legumes, herbs, spices, fish, seafood, extra virgin olive oil, some dairy and red meat infrequently.
- Drink mainly water.



## Mediterranean Diet and Age-Related Cognitive Decline

### A Randomized Clinical Trial

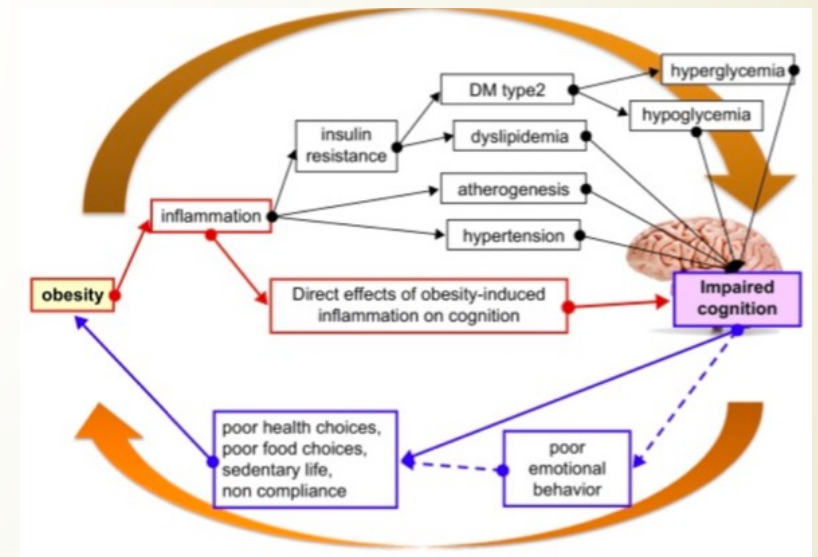
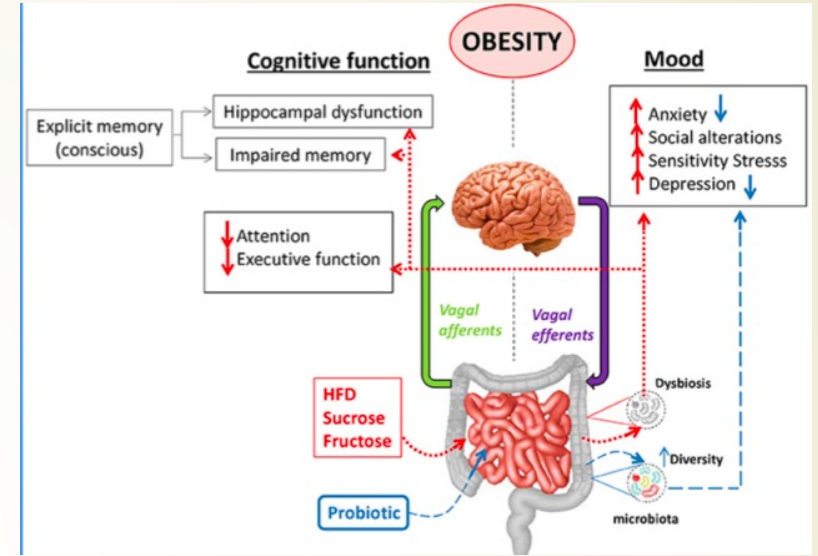
Cinta Valls-Pedret, MSc<sup>1,2</sup>; Aleix Sala-Vila, DPharm, PhD<sup>1,2</sup>; Mercè Serra-Mir, RD<sup>1,2</sup>; et al

» [Author Affiliations](#) | [Article Information](#)

*JAMA Intern Med.* 2015;175(7):1094-1103. doi:10.1001/jamainternmed.2015.1668

# Neurocognitive Disorders

- ▶ Obesity and chronic inflammation are associated with a whole list of cognitive and emotional disorders.
- ▶ Cognition is often impaired in the presence of other inflammatory conditions like diabetes, hypertension, and hyperlipidemia.
- ▶ Aspects of emotional regulation, social skills, attention and executive functions, and memory skills can be adversely impacted by these factors.





# Traumatic Brain Injury



- ▶ Following a brain injury there is a biochemical cascade within the brain.
- ▶ It is this cascade that leads to the secondary impact of TBI.
- ▶ There is an impact to neuronal cell membranes as a result of the stretching of nerve fibers (axonal shearing).
- ▶ This leads to cellular and biochemical changes.
- ▶ These biochemical changes interfere with the normal regulation of the flow of potassium and calcium ions and prompt the release of excitatory neurotransmitters that lead to more dysfunction and greater disequilibrium.
- ▶ The brain then rapidly depletes its energy stores and is forced into a hypermetabolic state leading to oxidative stress and inflammation.



# TBI Intervention

- It stands to reason that the only major way to impact these processes is to alter this biochemical cascade and normalize these processes.
- This means the introduction of stabilizing forces that can alter our internal biochemistry – good nutrition.
- This would include anti-inflammatory agents, anti-oxidants, vitamins, minerals and balancing of macronutrients (fats, carbs, proteins).
- These are the energy producers of the human body and can dramatically change someone from the inside.
- Positive outcomes were associated with anti-oxidants, bcaa's and polyunsaturated fats (healthy fats).



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**Neuroscience**  
Journal of Neuroscience Research homepage  
**research**

REVIEW

## **Nutritional interventions to improve neurophysiological impairments following traumatic brain injury: A systematic review**

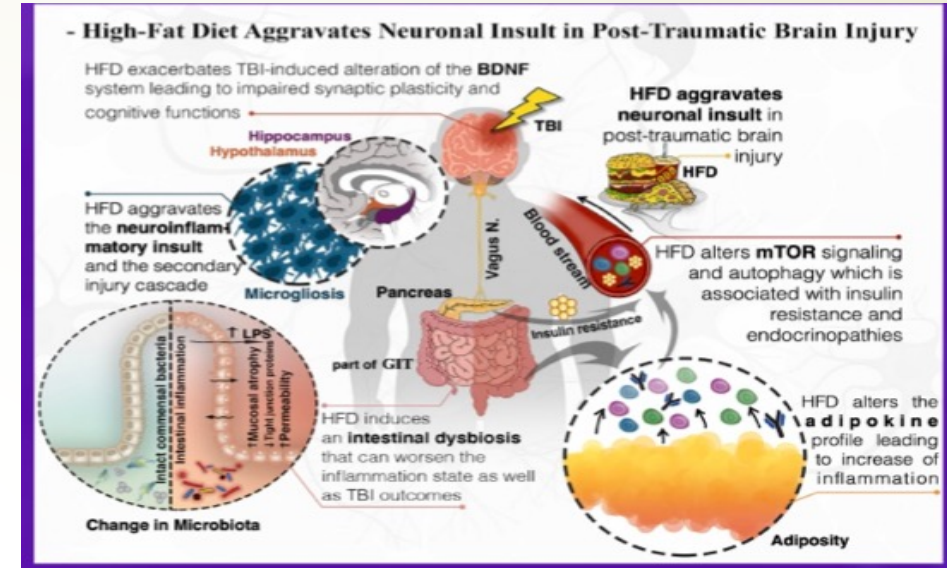
Joshua P. McGeown ✉, Patria A. Hume, Alice Theadom, Kenneth L. Quarrie, Robert Borotkanics

First published: 26 October 2020 | <https://doi.org/10.1002/jnr.24746>



# Inflammatory agents impair recovery from TBI

- Inflammatory foods, especially high fat diet impairs function in TBI.
- This would include sugary and high fructose corn syrup, trans fats, vegetable oils, refined or simple carbohydrates, processed meat and excessive alcohol.
- Saturated and trans fats are the worst culprit, while monosaturated and polyunsaturated fats are health and anti-inflammatory.



Published by THE LANCET

Volume 57, July 2020, 102829

Review

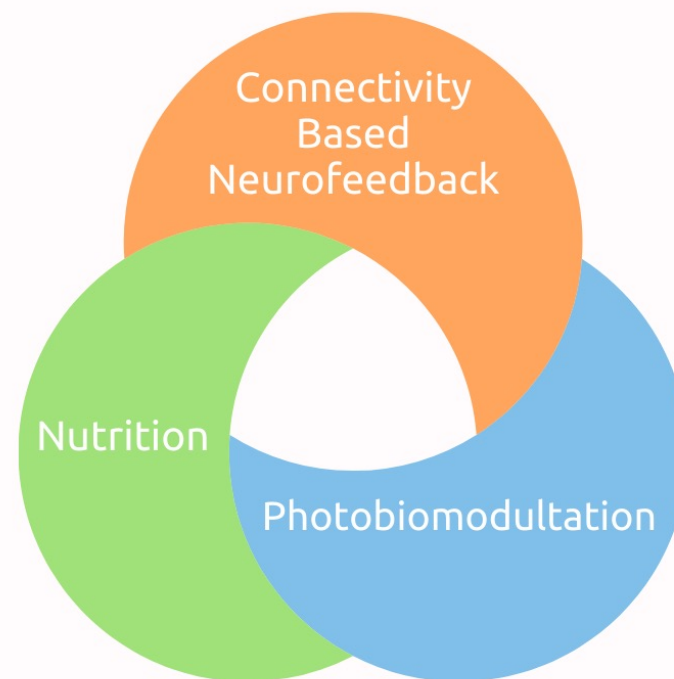
## Western diet aggravates neuronal insult in post-traumatic brain injury: Proposed pathways for interplay

Abdullah Shaito <sup>a</sup>, Hiba Hasan <sup>b, 1</sup>, Karl John Habashy <sup>c, 1</sup>, Walaa Fakh <sup>d, 1</sup>, Samar Abdelhady <sup>e</sup>, Fatimah Ahmad <sup>f</sup>, Kazem Zibara <sup>g</sup>, Ali H. Eid <sup>d, h</sup>, Ahmed F. El-Yazbi <sup>d, i, j, k</sup>, Firas H. Kobeissy <sup>f, l, m</sup>

# Head On Program

- Multivariate 4 channel coherence neurofeedback training (QEEG/Connectivity driven)
- Photobiomodulation/ Vielight Gamma
- Nutritional/Health coaching program
- All can be integrated into your practice and/or done remotely

## Head On! Program



*Tackling Brain Development, Recovery and Optimization*

# Head On!

- Originally created as a concussion program.
- Later thought of as interventions that can help with memory decline and dementia.
- We now believe these can all help just about anyone either in isolation or together.
- Effects appear to be additive.



# HEAD ON! PROGRAM

CASE STUDY: 85-YEAR-OLD FEMALE

## COMPLAINT OF MEMORY ISSUES

Major neurocognitive disorder likely due to Alzheimer's disease.

## ASSESSED MENTAL ACUITY

Participated in a battery of neuropsychological tests.

## ASSESSED BRAIN ACTIVITY AND CONNECTIVITY

Conducted a qEEG.

## EEG-GUIDED BRAIN MAPPING RESULTS

Poor connectivity among a number of brain regions, especially Brodmann's area 40 (multifunctional region that plays a role in language and memory).

## TREATMENT PLAN

Neurofeedback and photobiomodulation.

*After 2 months of Treatment:*  
Anecdotal improvement of short-term memory. Neuropsychological tests revealed improvements in auditory and facial recognition, as well as in a number of executive function measures.



# Nutrition/Health Plan

- Focused on learning habits of health including diet/food, hydration, sleep, social support, energy level, movement/fitness, and many others.
- Four pillars of intervention including health coaching, learning healthy habits, nutrition, and social support.







# Nutritional Intervention

- ▶ Anti-inflammatory, nutrition dense program designed for weight loss and enhanced body and brain functioning.
- ▶ Low sugar content meant to stabilize blood sugars.
- ▶ Learn to eat multiple times per day (6) in smaller amounts.
- ▶ Fat burning, mild ketosis which alleviates oxidative stress.
- ▶ Hydration to nourish organs, the brain and remove toxins.
- ▶ 26 essential vitamins and minerals to feed the body and brain.
- ▶ Protein, vegetables and health fatty acids to fight inflammation and enhance functioning.
- ▶ Specific anti-inflammatory agents and probiotics built in.
- ▶ Weight loss, gain, fitness or direct treatment of chronic inflammation.

# Nutritional breakdown

Water soluble vitamins	Fat soluble vitamins	Macrominerals	Trace Minerals	Probiotics/Anti-Inflammatory Agents
C, B1, B2, B3, B5, B6 and B12	A, D, E and K	Calcium, Phosphorus, Magnesium, Potassium and Sulfur	Iron, Manganese, Copper, Zinc, Iodine, Selenium	Selenium, Molybdenum, Chromium, Manganese
Blood flow, heart, energy metabolism, digestion, blood cells and brain functioning.	Immune system, organs, bones, blood and oxygen flow throughout the body.	Bones, muscles, blood pressure and metabolism.	Blood and oxygen flow, cholesterol, immune system, thyroid and reducing inflammation.	Anti-inflammatory, gut health.

## Healing Effects of Weight Loss

**Migraines**  
57% resolved

**Dyslipidemia  
Hypercholesterolemia**  
63% resolved

**Non-Alcoholic Fatty  
Liver Disease**  
90% improved  
steatosis  
37% resolution of  
inflammation  
20% resolution of  
fibrosis

**Metabolic Syndrome**  
80% resolved

**Type II  
Diabetes Mellitus**  
83% resolved

**Polycystic  
Ovarian Syndrome**  
79% resolution of hirsutism  
100% resolution of  
menstrual dysfunction

**Venous Stasis Disease**  
95% resolved

**Quality of Life**  
Improved in  
95% of patients

Adapted from the Bariatric Journal: Cleveland Clinic Foundation



**Depression**  
55% resolved

**Obstructive  
Sleep Apnea**  
74-98% resolved

**Asthma**  
82% improved  
or resolved

**Cardiovascular  
Disease**  
82% risk reduction

**Hypertension**  
52-92% resolved

**GERD**  
72-98% resolved

**Stress Urinary  
Incontinence**  
44-88% resolved

**Degenerative  
Joint Disease**  
41-76% resolved

**Gout**  
77% resolved

**Mortality**  
89% reduction in  
5-year mortality



Average weight loss on the Optimal Weight 5 & 1 Plan<sup>®</sup> is 12 pounds. Client testimonial: "I lost 12 pounds in 12 weeks on the Optimal Weight 5 & 1 Plan."



# Longevity and healing

- ▶ Insulin signaling
- ▶ Sir1/Sir2 activated by calorie restriction and may extend life by 30%
- ▶ IGF-1 (insulin growth factor) may prevent disease and extend life
- ▶ Decreased T3 and oxidative stress
- ▶ Decreased inflammation
- ▶ DNA and metabolic repair
- ▶ Avoids beta amyloid buildup
- ▶ Increased neurotrophins and other proteins (exercise)
- ▶ Decreasing blood pressure prevents brain aging



# Exercise and movement

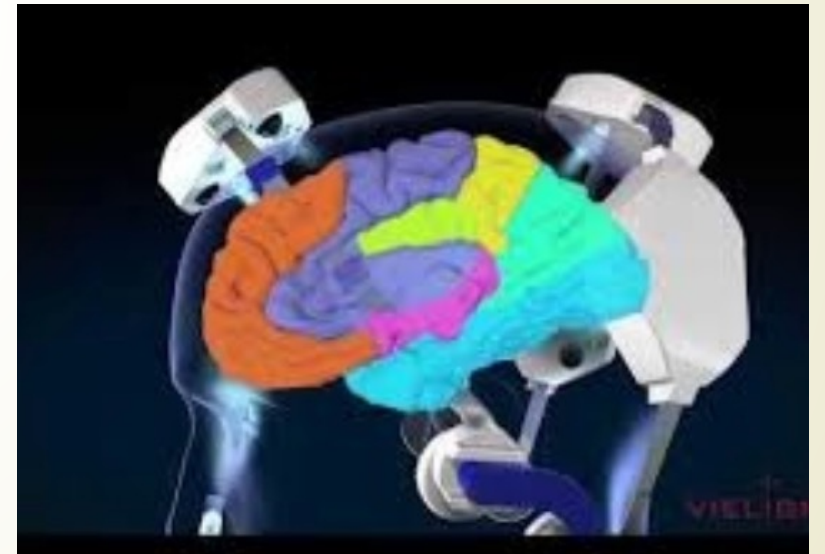
- Maintain a healthy weight.
- Heart disease risk reduced.
- Manage blood sugars.
- Improved mood and mental well-being.
- Helps cognitive functioning.
- Strengthens bones and muscles.
- Reduced cancer risk.
- Improved sexual health.
- You may live longer.
- Required for your bodies and organs to function!



# Photobiomodulation

- ▶ Infrared light stimulation to enhance brain activity.
- ▶ Visible light gamma.
- ▶ Diodes over midline frontal, midline and left and right parietal regions as well as use of a nasal stimulator.
- ▶ Stimulates at 810 nm, the frequency shown to penetrate the skull and physiologically augment brain cells and mitochondria functioning.

## Cranial and Nasal applications



# Cellular impacts

- Direct evidence that infrared light at 810 nm penetrates the skull and is excitatory at the level of the cellular membrane and mitochondria.
- This produces an increase in ATP or the energy of cells and brain cells.

BBA Clin. 2016 Dec; 6: 113-124.

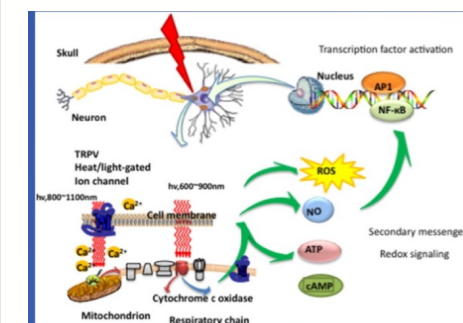
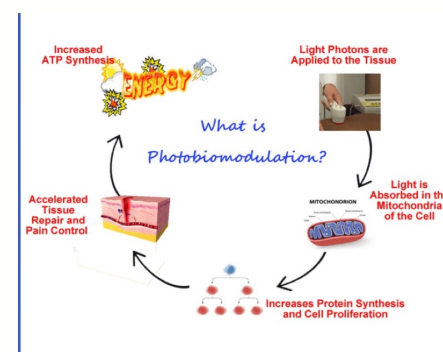
Published online 2016 Oct 1. doi: 10.1016/j.bbacli.2016.09.002

PMCID: PMC5066074

PMID: 27752476

Shining light on the head: Photobiomodulation for brain disorders

Michael R. Hamblin





# Evidence of brain changes

- 20 subjects underwent sham and active stimulation with crossover to each group.
- Enhancements in brain activation and not just in gamma.
- They also showed greater global efficiency or speed of connectivity processing.

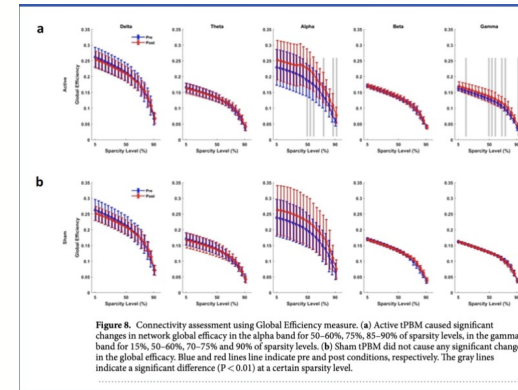


Figure 8. Connectivity assessment using Global Efficiency measure. (a) Active tPBM caused significant changes in network global efficiency in the alpha band for 50-60%, 75%, 85-90% of sparsity levels, in the gamma band for 15%, 50-60%, 70-75% and 90% of sparsity levels. (b) Sham tPBM did not cause any significant change in the global efficiency. Blue and red lines indicate pre and post conditions, respectively. The gray lines indicate a significant difference ( $P < 0.01$ ) at a certain sparsity level.

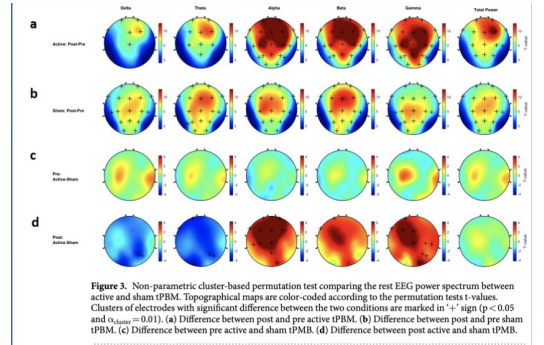


Figure 3. Non-parametric cluster-based permutation test comparing the rest EEG power spectrum between active and sham tPBM. Topographical maps are color-coded according to the permutation test  $t$ -values. Clusters of electrodes with significant difference between the two conditions are marked in '+' sign ( $p < 0.05$  and  $\alpha_{cluster} = 0.01$ ). (a) Difference between post and pre active tPBM. (b) Difference between post and pre sham tPBM. (c) Difference between pre active and sham tPBM. (d) Difference between post active and sham tPBM.

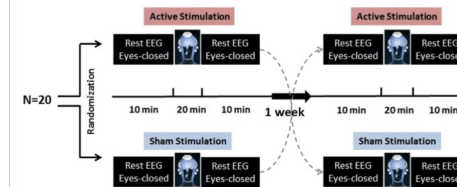


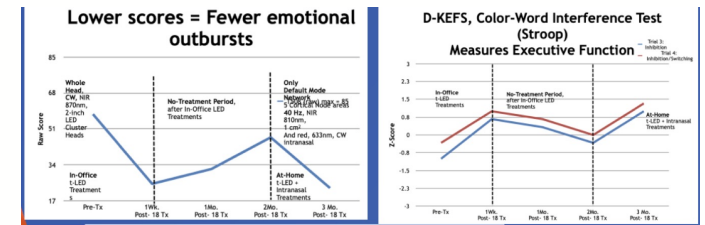
Figure 1. Schematic diagram of study design. Twenty healthy participants randomized to receive either active or sham tPBM with a minimum 1-week washout period between the two visits. 10 minutes eye-closed rest EEG recorded pre and post of each intervention.

Zomorodi, R., Loheswaran, G., Pushparaj, A., & Lim, L. (2019). Pulsed near infrared transcranial and intranasal photobiomodulation significantly modulates neural oscillations: a pilot exploratory study. *Scientific reports*, 9(1), 1-11.



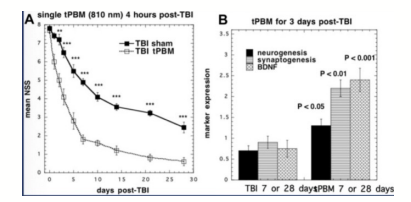
# Traumatic brain injury case studies

Transcranial Near-infrared Photobiomodulation to Improve Cognition in Two, Retired Professional Football Players Possibly Developing CTE  
 Poster, International Brain Injury Association (IBIA) Meeting, Toronto, March 2019  
 M.A. Naeser<sup>1,2</sup>, P.I. Martin<sup>1,2</sup>, M.D. Ho<sup>1</sup>, M.H. Krengel<sup>1,2</sup>, Y. Bogdanova<sup>1,3</sup>, J.A. Knight<sup>1</sup>, A.E. Fedoruk<sup>1</sup>, M.R. Hamblin<sup>4</sup>, B.B. Koo<sup>2</sup>

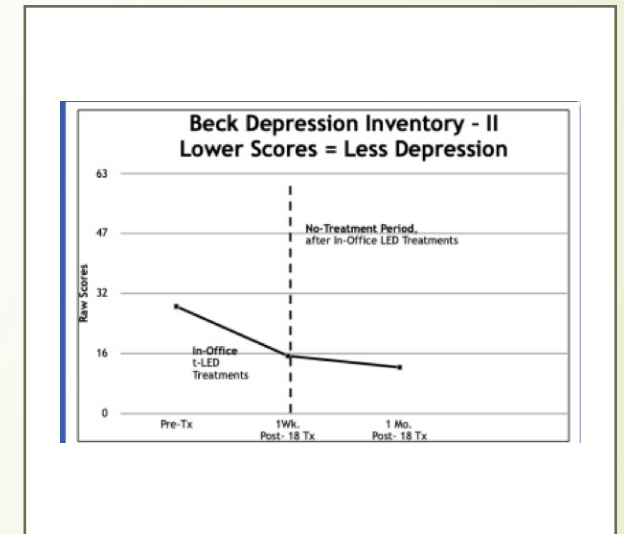
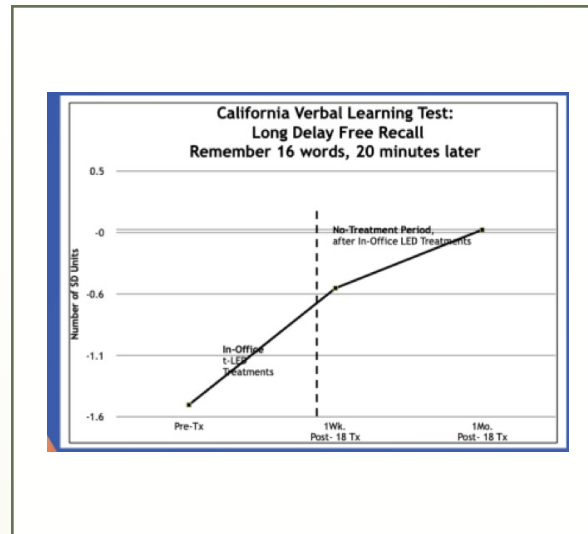
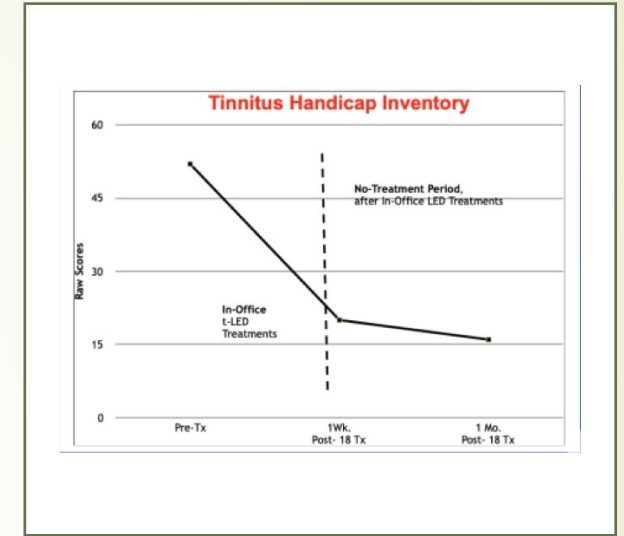
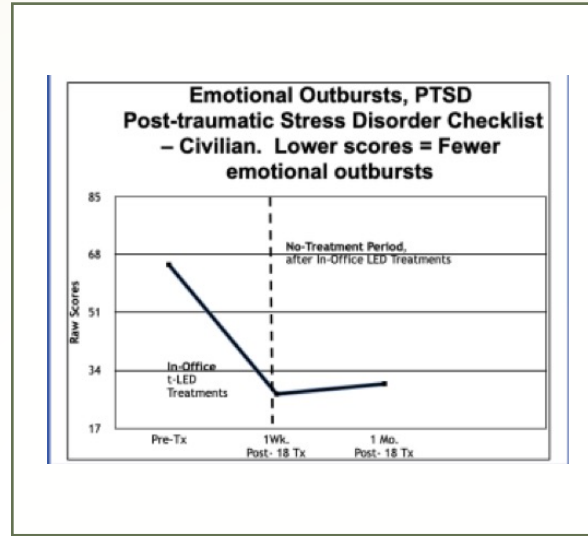


**Resting-state functional-connectivity MRI**

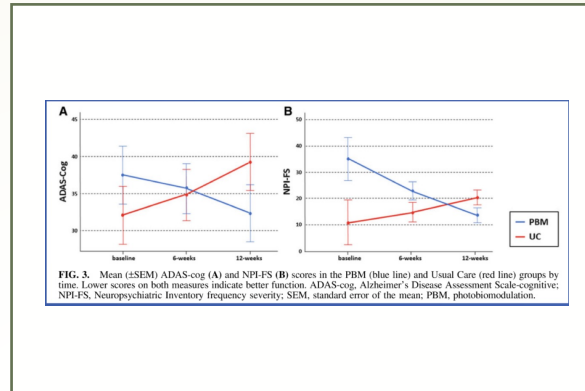
Before LED Tx.	1 wk After In-Office LED	1 mo After In-Office LED	3 mo After In-Office LED	After 3 mo In-Home LED
1127 (10)	1243 (11)	1693 (16)	1268 (12)	1443 (13)



... continued



# Dementia studies

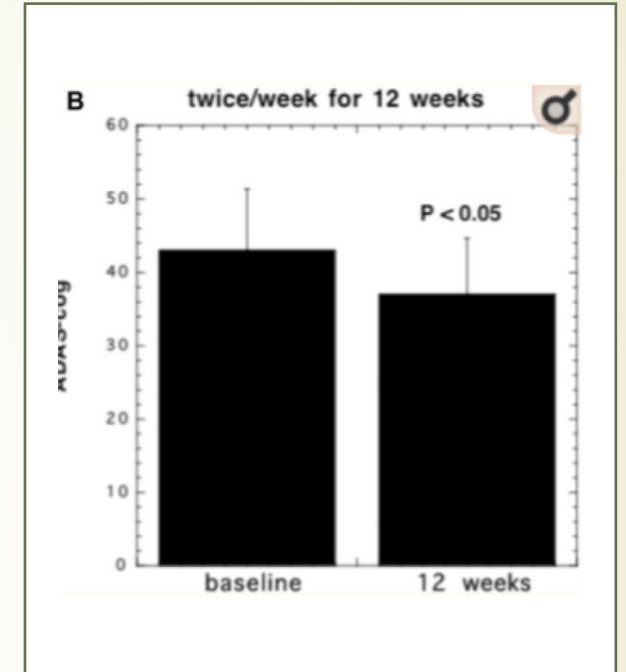


Photobiomodulation, Photomedicine, and Laser Surgery  
 Volume XX, Number XX, 2019  
 © Mary Ann Liebert, Inc.  
 pp. 1-8  
 DOI: 10.1089/photob.2018.4555

**Original Research**

### Effects of Home Photobiomodulation Treatments on Cognitive and Behavioral Function, Cerebral Perfusion, and Resting-State Functional Connectivity in Patients with Dementia: A Pilot Trial

Linda L. Chao, PhD<sup>1-3</sup>



**Fig. 5**  
 (PBM for Alzheimer's disease. (A) Nineteen patients were randomized to receive real or sham (PBM (810 nm LED, 24.6 J/cm<sup>2</sup> at 41 mW/cm<sup>2</sup>). (B) Significant decline in ADAS-cog (improved cognitive performance) in real but not sham (unpublished data).

DEMOGRAPHICS AND BASELINE CHARACTERISTICS OF EACH PATIENT

Patient no.	Baseline MMSE score	Baseline ADAS-cog score	Age at entry	Gender	Dementia diagnosis (years)	Diagnosis from physician	Years of education	Prescribed dementia medication
1	10	58	77	Female	2	Dementia	7	No
2	10	58	90	Male	2	Dementia	10+	Donepezil
3	21	26.33	76	Male	0.5	Dementia. Memory changes noted by wife 1 year earlier.	16	No
4	22	20.67	72	Male	3.5	Dementia. Very gradual decline, works part-time.	10	Donepezil
5	24	14.33	73	Male	8	Dementia. Diagnosis by one physician, AD. Failed re-registration exam.	18	Donepezil
Mean (SD)	17.4 (6.84)	35.47 (21.00)	77.6 (7.23)		3.2 (2.89)			12.2 (4.6)

Photomed Laser Surg. 2017 Aug 1; 35(8): 432-441. PMID: PMC5568598  
 Published online 2017 Aug 1. doi: 10.1089/pho.2016.4227 PMID: 28186867

**Significant Improvement in Cognition in Mild to Moderately Severe Dementia Cases Treated with Transcranial Plus Intranasal Photobiomodulation: Case Series Report**

Anita E. Saltmarche, RN, MHS<sup>1</sup>, Margaret A. Naeser, PhD<sup>2,3</sup>, Kai Fai Ho, PhD<sup>4</sup>, Michael R. Hamblin, PhD<sup>5,6</sup> and Lew Lim, PhD, DNM, MBA<sup>7</sup>

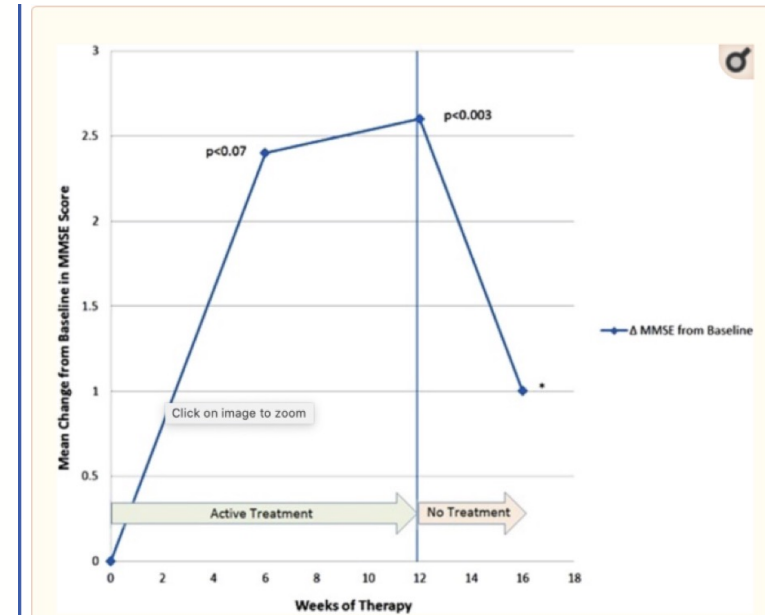


FIG. 2.

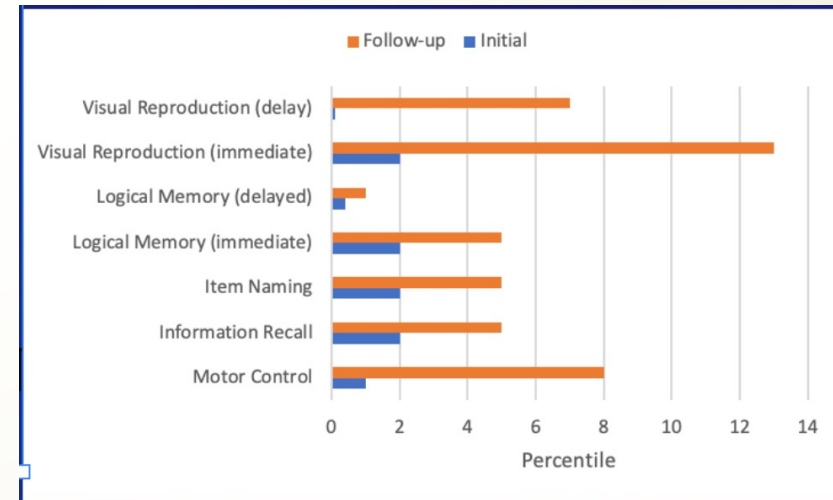
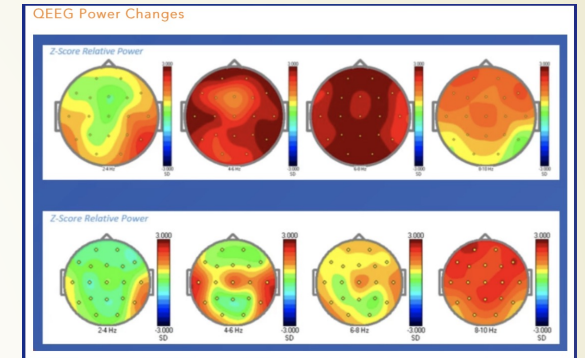
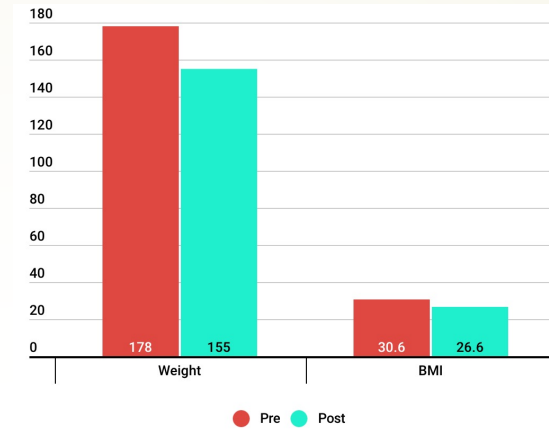
Mean change from baseline in MMSE scores. Higher numbers indicate better cognition on this test. \*The *p* value for week 16 is omitted due to missing data from a patient who dropped out during the "4-Week, No-Treatment Period." MMSE, Mini-Mental State Exam.

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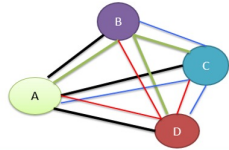
# Case Review

- ▶ The patient was a 74-year-old female who presented for evaluation related to memory problems.
- ▶ Most likely has Alzheimer's disease.
- ▶ Two-month follow-up period.
- ▶ Lost 22 lbs with a 4 pt drop in BMI (almost healthy).
- ▶ Improvements in memory, naming and motor control.
- ▶ Dramatic reductions in theta from the front to back of the brain.



## QPS: Averaging coherences

- A method of combining averaged *psync* values.
- 4 channels of EEG
- Each pair has a running *psync* calculation
- For each channel, the 3 pairs of *psync* values are computed, averaged and this is used as the output reward value
- If a raw channel is in artifact condition, the channel is not used in the averaging calculation



$$\begin{aligned} A &= (AB + AC + AD)/3 \\ B &= (BA + BC + BD)/3 \\ C &= (CA + CB + CD)/3 \\ D &= (DA + DB + DC)/3 \\ \text{QPS Ave} &= (A + B + C + D)/4 \end{aligned}$$

### TECHNOLOGY REPORT ARTICLE

Front. Neurosci., 11 October 2018 | <https://doi.org/10.3389/fnins.2018.00729>

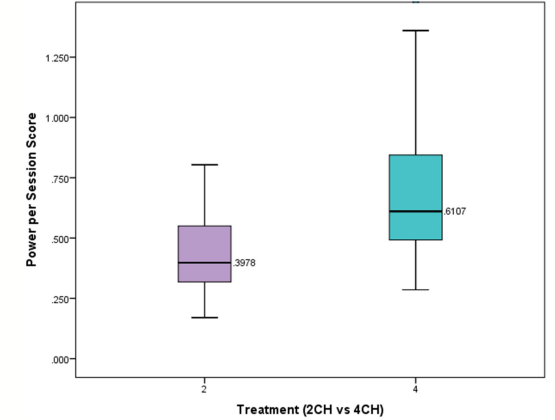
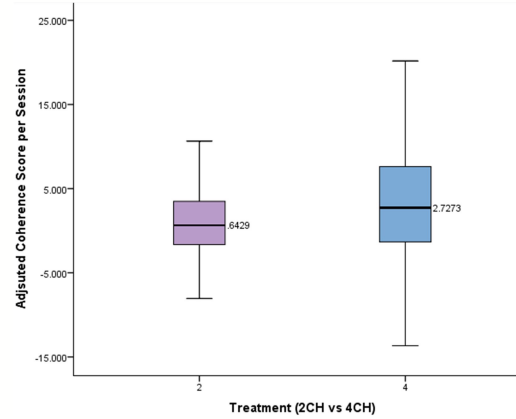
## Four Channel Multivariate Coherence Training: Development and Evidence in Support of a New Form of Neurofeedback

Robert Coben<sup>1\*</sup>, Morgan Middlebrooks<sup>2</sup>, Howard Lightstone<sup>1</sup> and Madeline Corbett<sup>1</sup>

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<sup>2</sup>TEG Software, LLC, Conwayville, FL, United States

<sup>3</sup>Department of Psychological Science, University of Arkansas, Fayetteville, AR, United States



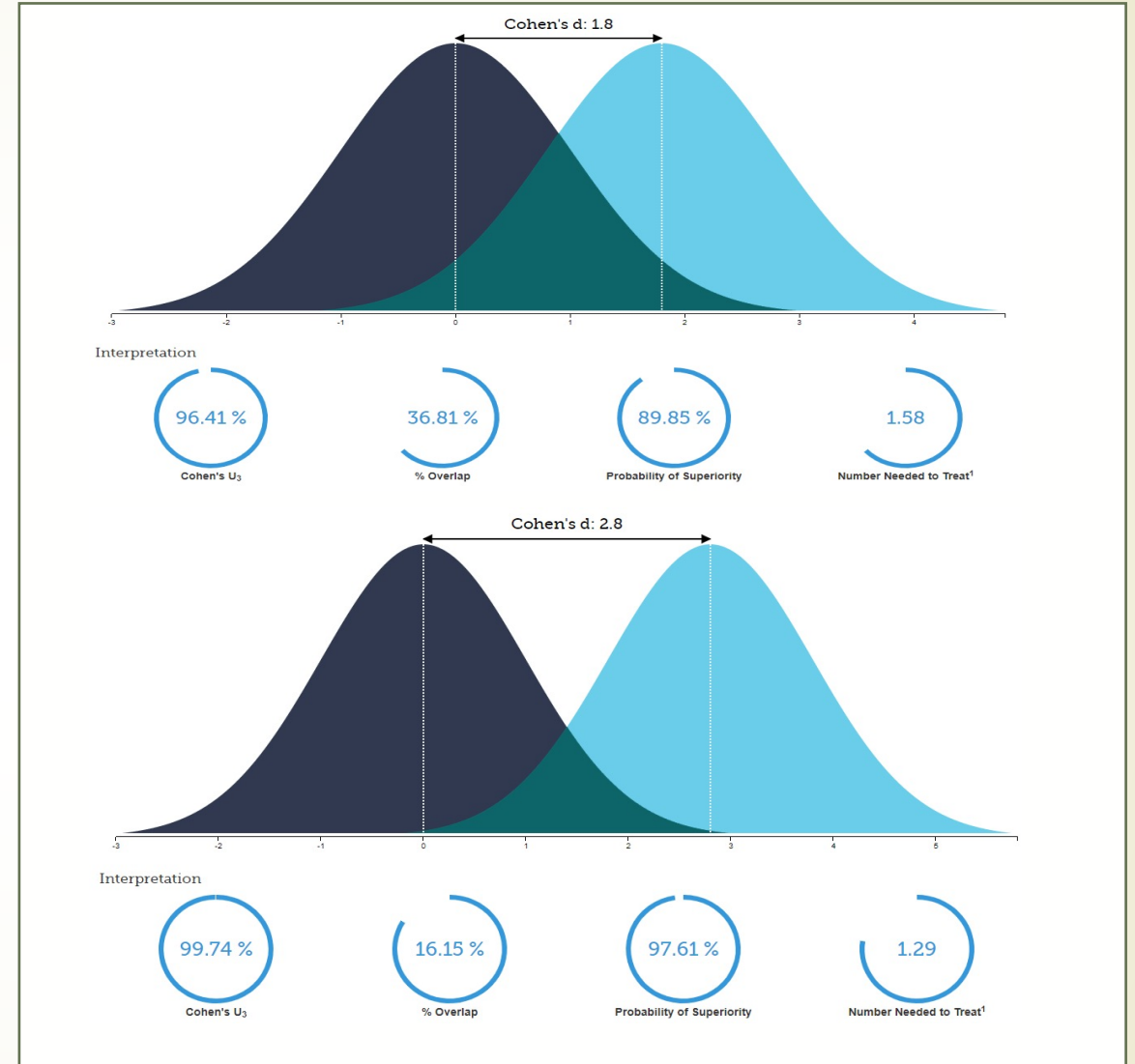
# 4-Channel Multivariate Coherence Neurofeedback

# Efficacy studies in support of 4 channel MVCNF (N = 591)

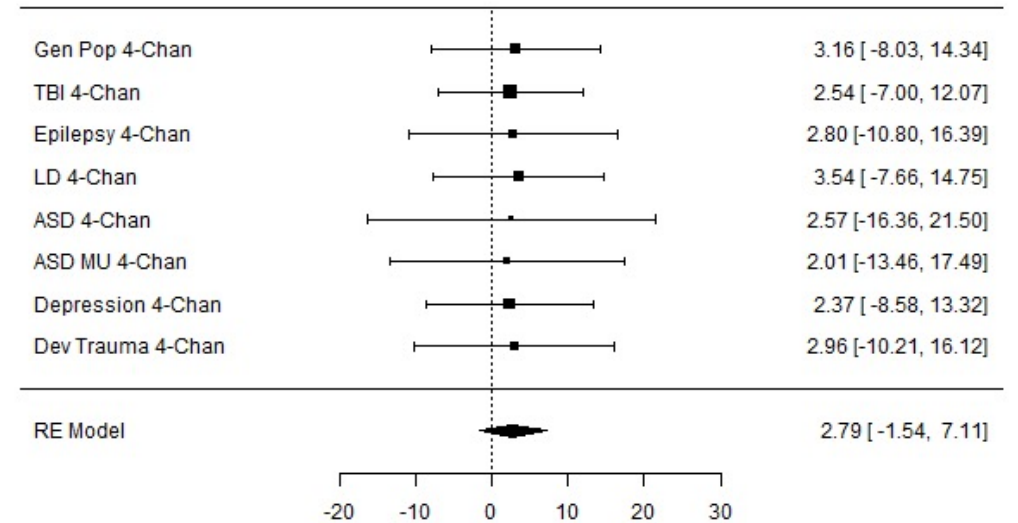
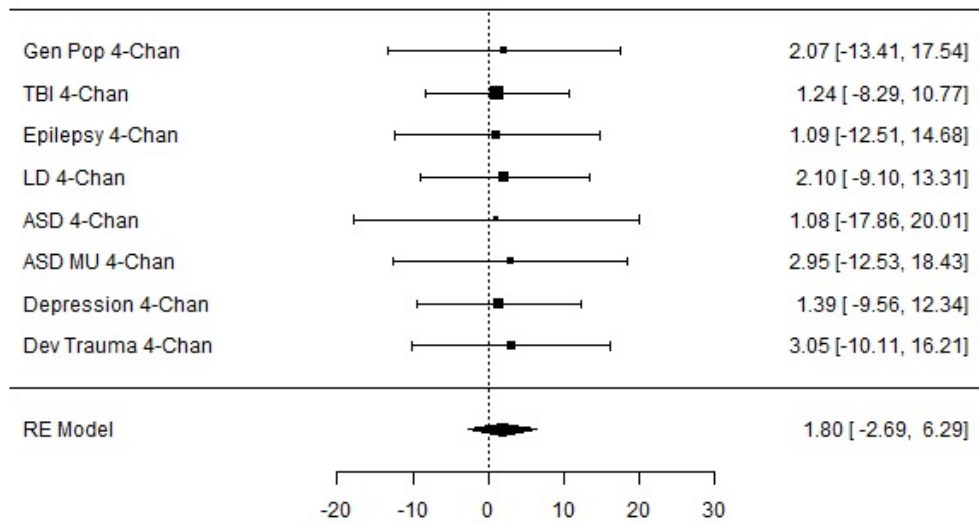
Population	Sample	Design	Findings 1	Findings 2
General Population	N = 174	MVCNF v 2 Ch CNF	MVCNF > 2 Ch CNF	Enhanced coherence and reduced power
Traumatic Brain Injury	N = 20	Compared time since injury in 3 groups	Improvements in symptoms and NP testing	Changes associated with increases in coherence
Epilepsy	N = 52	MVCNF v 2 Ch CNF	MVCNF > 2 Ch CNF	81% reduction in seizures
Learning Disabilities	N = 63	MVCNF v 2 ch CNF v resource room	MVCNF > 2 ChCNF > RR	1.6 year increase in reading
Autism	N = 110	MVCNF v 2 Ch CNF	MVCNF > 2 Ch CNF	98% success rate
Autism MND	N = 78	MVCNF v 2 Ch CNF v Bipolar	MVCNF > 2 ChCNF > Bipolar	Mu suppression with coherence changes
Depression	N = 54	MVCNF Psychotherapy v WLC	MVCNF > both groups	94% success rate, crossover and 2 yr f/u
Developmental Trauma	N = 40	MVCNF v. Psychotherapy	Exp > controls on clinical ratings	Δ in power, sources and connectivity

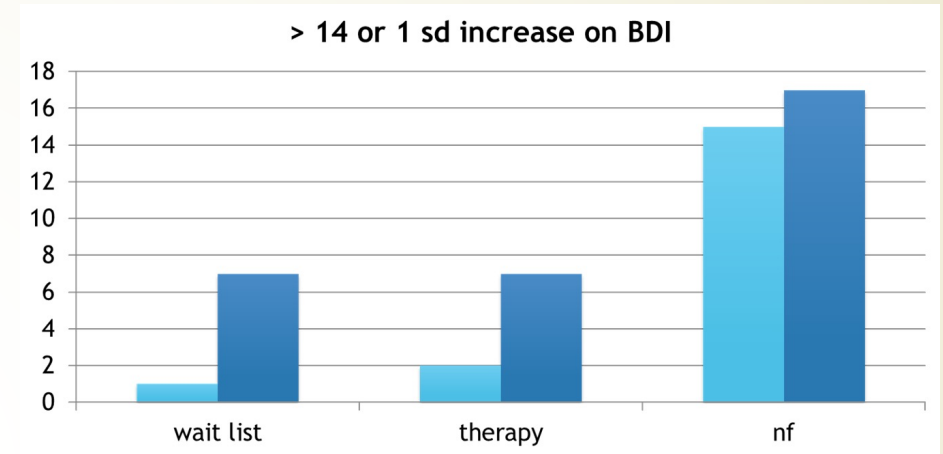
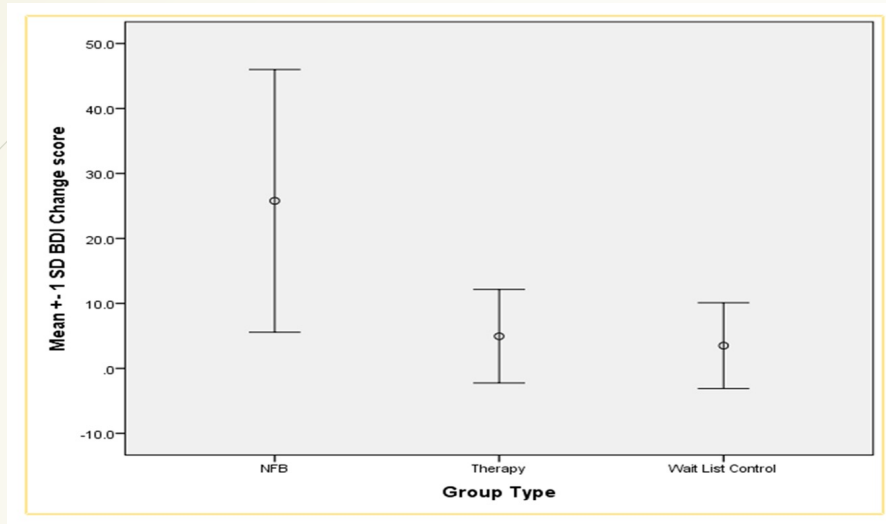
# Meta-Analysis

- Clinical changes (ratings, cognitive or other testing): Cohen's  $d = 1.8$
- Measured connectivity changes: Cohen's  $d = 2.8$
- Anything about 0.6 is a significant effect size.



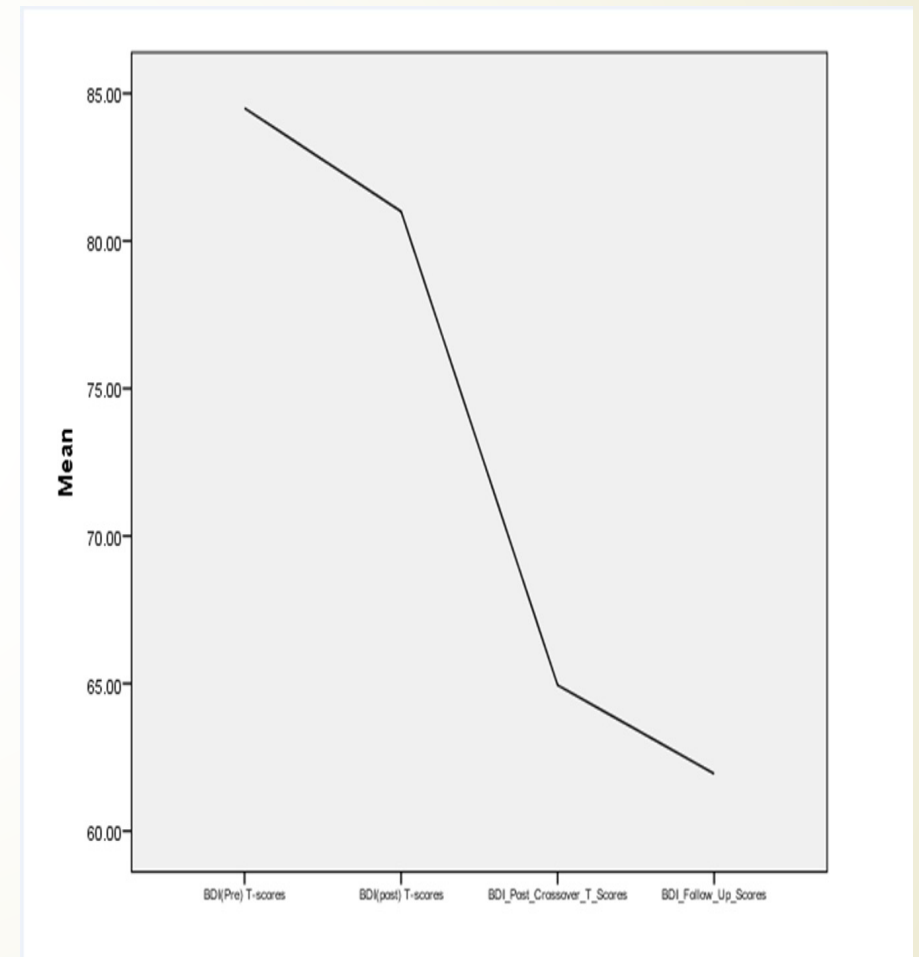
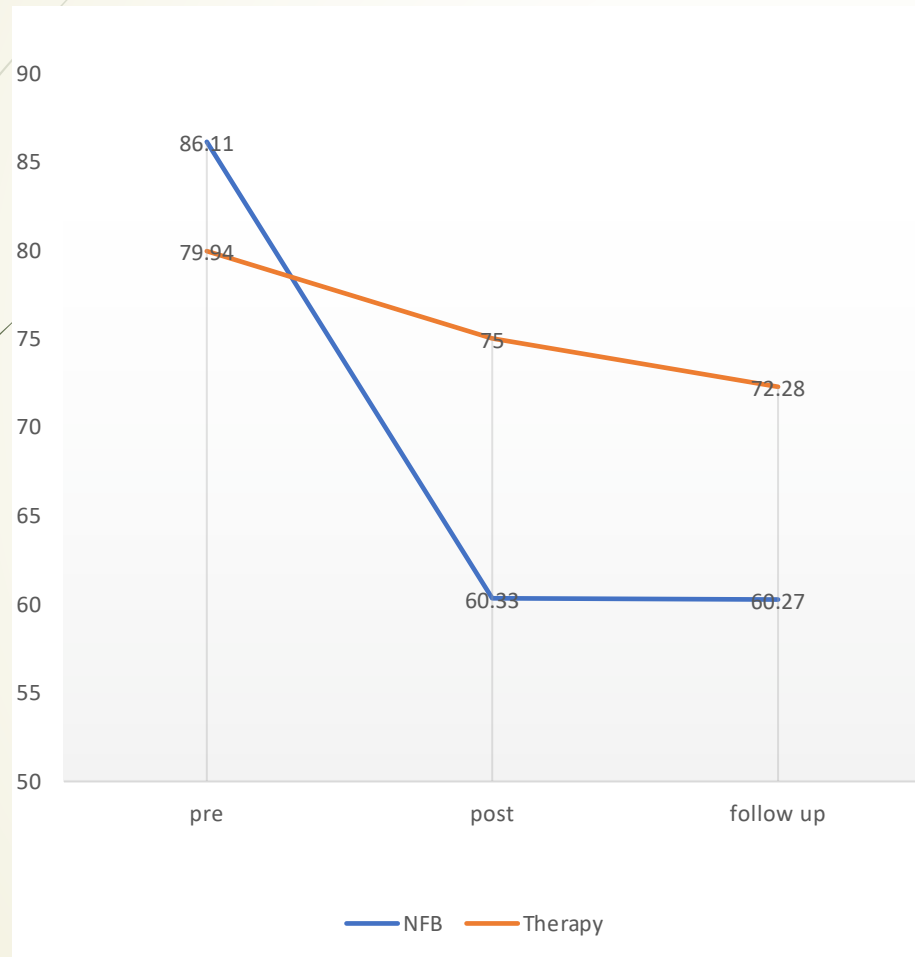






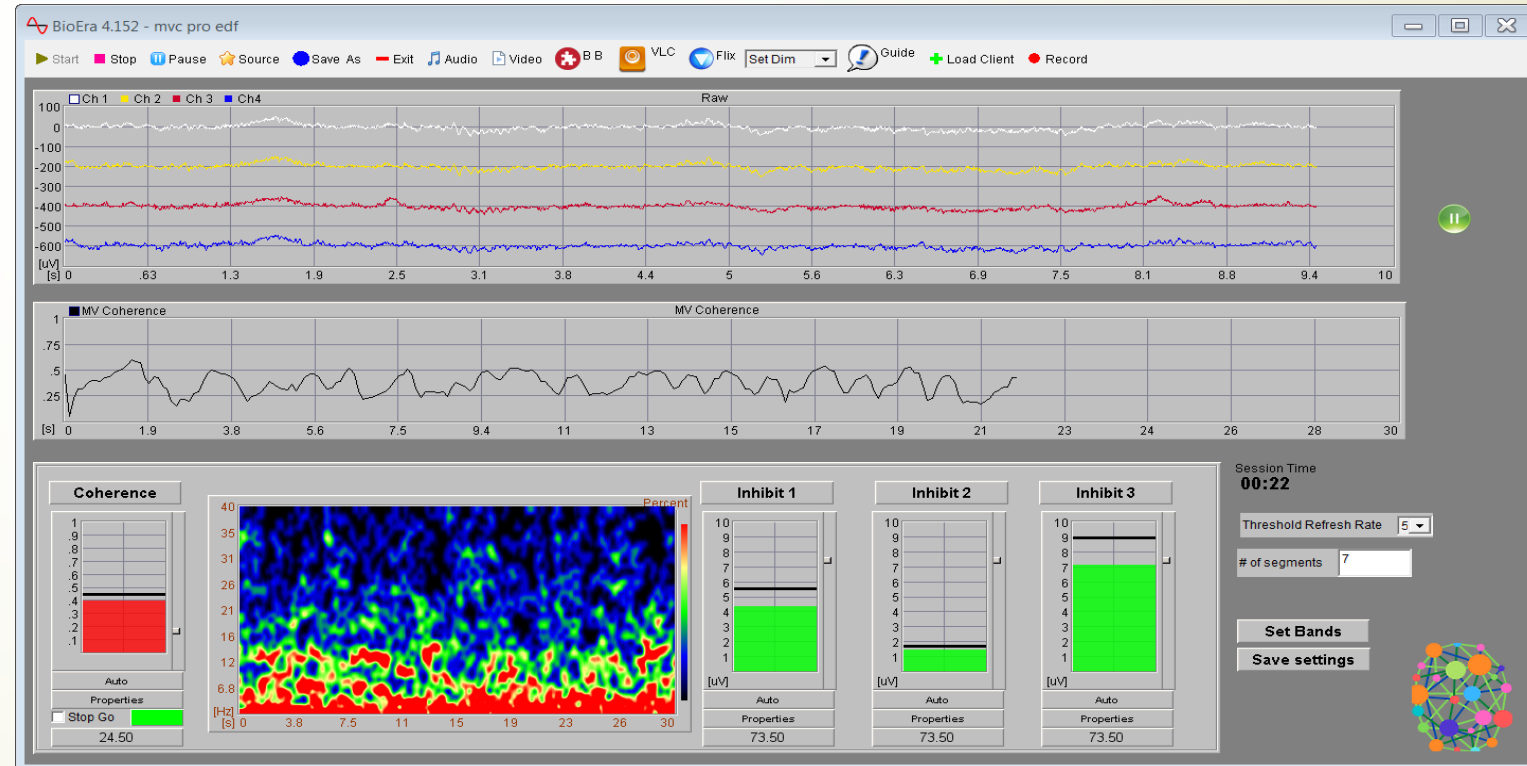
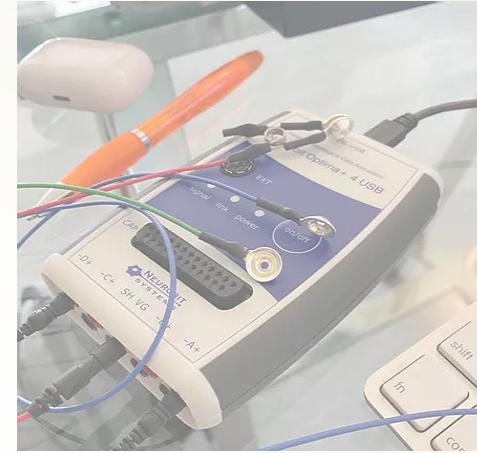
Depression study with 2 year follow-up.

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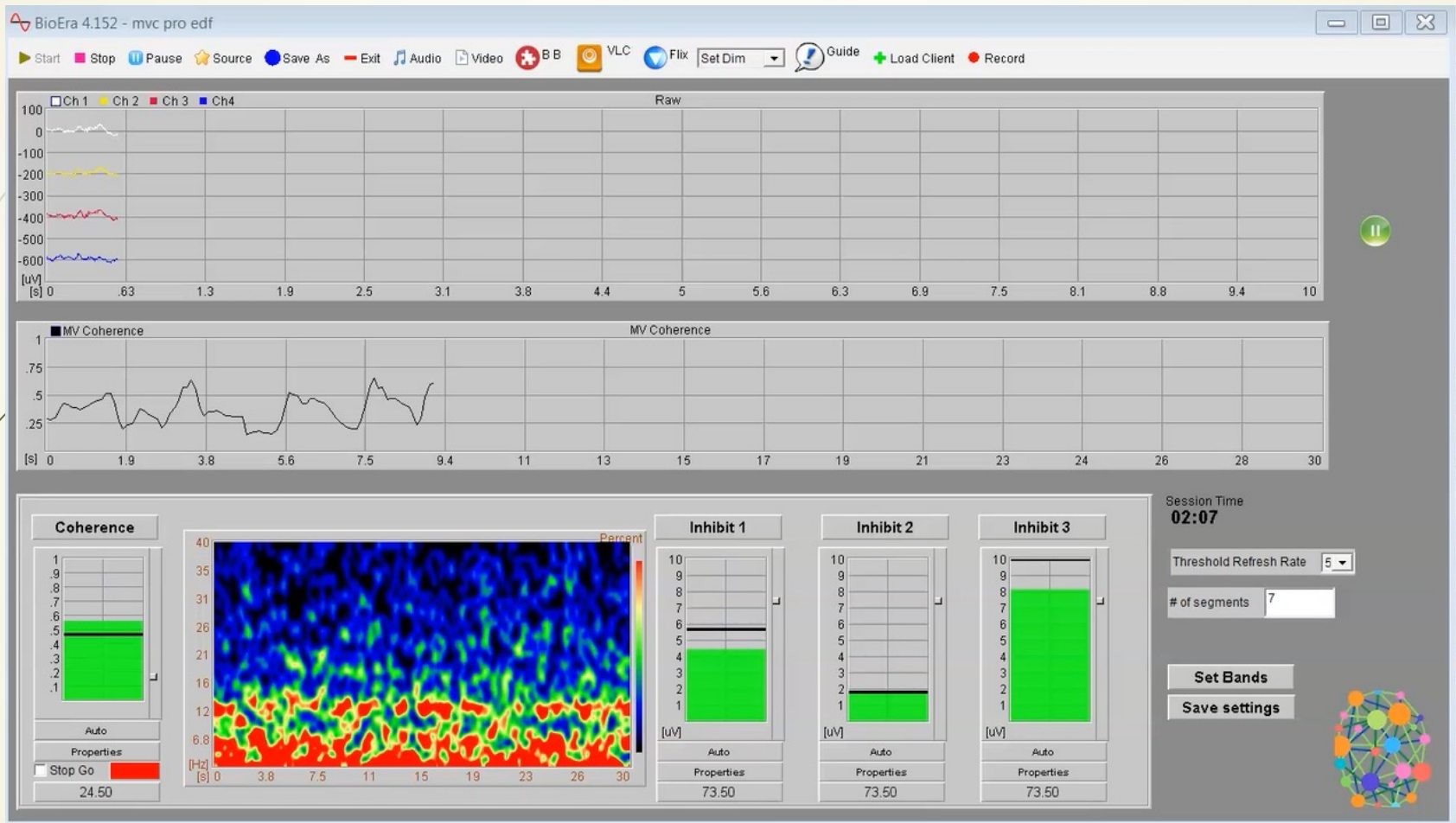


# New neurofeedback system for the office or at home.

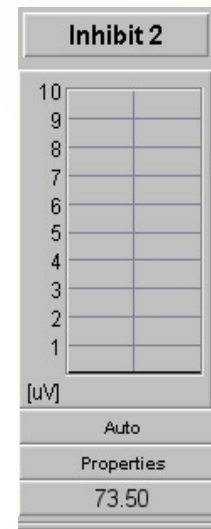
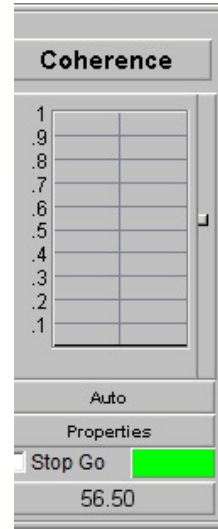
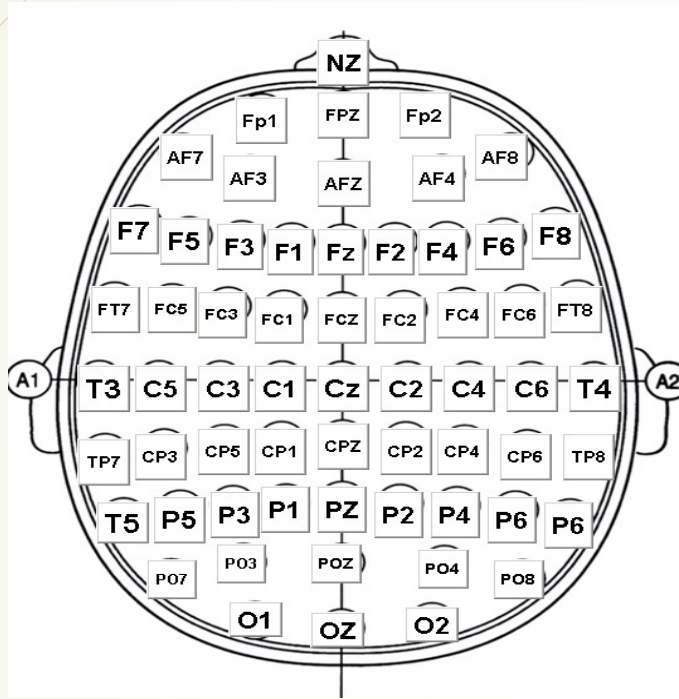
- ▶ 4 channel eeg amp with pre-programmed bioera pro software.
- ▶ Can run 4 ch mvcmf or single channel training.
- ▶ There is both a home and pro/clinic version.
- ▶ Easy to learn how to use and affordable.
- ▶ No cost per client or for sessions.
- ▶ Adjustable settings.







# Adjustable settings



Nested Set Band Filters dialog box. It contains buttons for Coherence, Inhibit 1, Inhibit 2, and Inhibit 3. A Save button is at the bottom right.

Session Time: 05:55  
Threshold Refresh Rate: 5  
# of segments: 7  
Buttons: Set Bands, Save settings

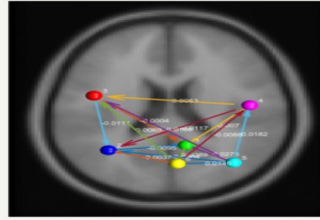
Properties dialog box with the following settings:

- Bin count: 256
- Output rate: 10
- Windowing function: HANNING
- Low frequency [Hz]: 20
- High frequency [Hz]: 30
- Average period [s]: 0.1

Buttons: OK, Cancel, Apply

## CASE STUDY: 70-YEAR-OLD FEMALE

Presented for evaluation related to memory problems, headaches, fatigue and joint pain.



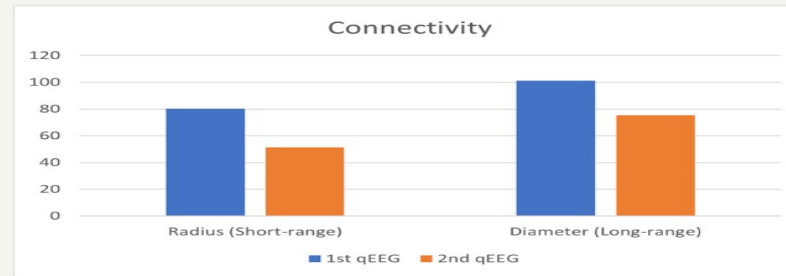
### BRAIN MAP INDICATIONS:

- Visuospatial processing, memory and language not functioning properly.
- Poor connectivity, specifically over the regions in the left hemisphere

### TREATMENT PLAN

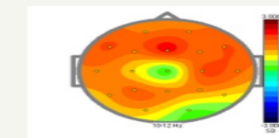
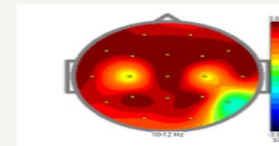
Nutrition Program & At-Home Photobiomodulation

### 3-MONTH FOLLOW-UP PERIOD



Different regions of the brain communicating more effectively

**Dramatic reductions in theta from the front to back of the brain**



*Anecdotal reports of decreased headaches, fatigue and pain. Improved bone resorption rates.*

Thank you!  
Any questions  
we can  
answer?

**Integrate Brain Health**



## Contact Us!



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