



# TBI-BH ECHO

Traumatic Brain Injury - Behavioral Health ECHO  
UW Medicine | Psychiatry and Behavioral Sciences

# TBI as a Chronic Health Condition

Charles Bombardier, PhD

Professor, Rehabilitation Medicine

University of Washington

Cherry Junn, MD

Assistant Professor, Rehabilitation Medicine

University of Washington



TBI-BH ECHO

# Speaker disclosure

None



TBI-BH ECHO

# What is a chronic health condition?

## Chronic Disease:

1. WHO definition:
  - Disease not passed from person to person
  - Long duration
  - Generally slow progression
  - Result of a combination of genetic, physiological, environmental, and behavioral factors
2. CDC definition:
  - Lasts at least one year
  - Either: requires ongoing medical attention and/or limits activities of daily living

➔ Chronic condition: condition that continuing or occurring again and again



# Chronic TBI

The term chronic brain injury (CBI) was proposed “to acknowledge the constellation of persisting TBI symptoms, functional limitations, and secondary health conditions experienced by some survivors of moderate-severe TBI.”

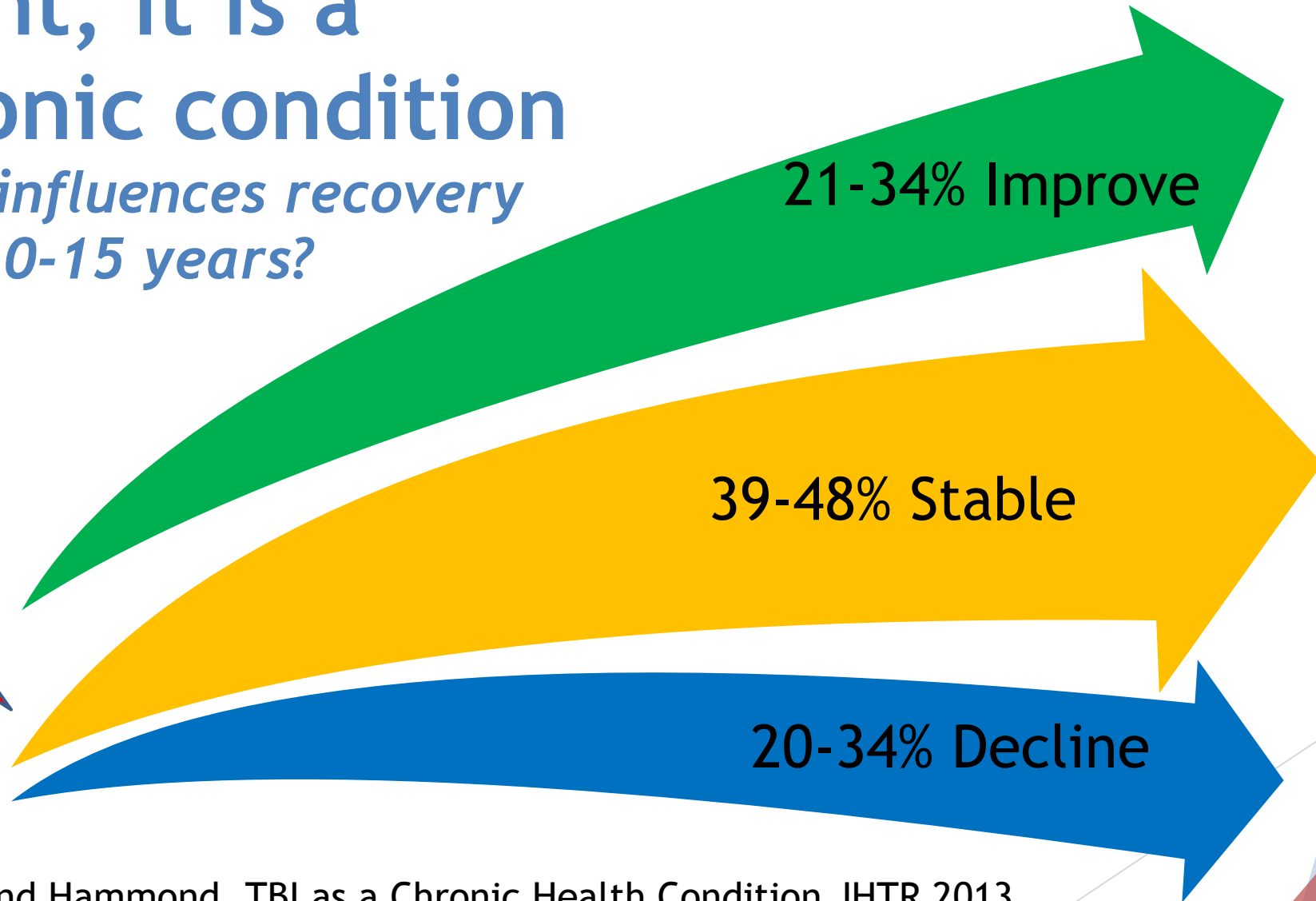
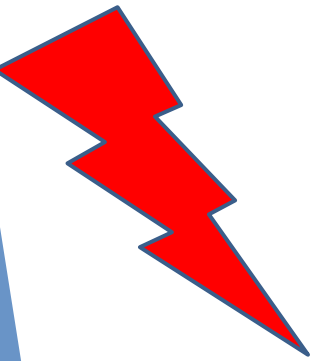
Implicit in this conceptualization is the notion that through access to effective healthcare, self-management efforts, and community supports people with TBI can alter their outcome trajectory



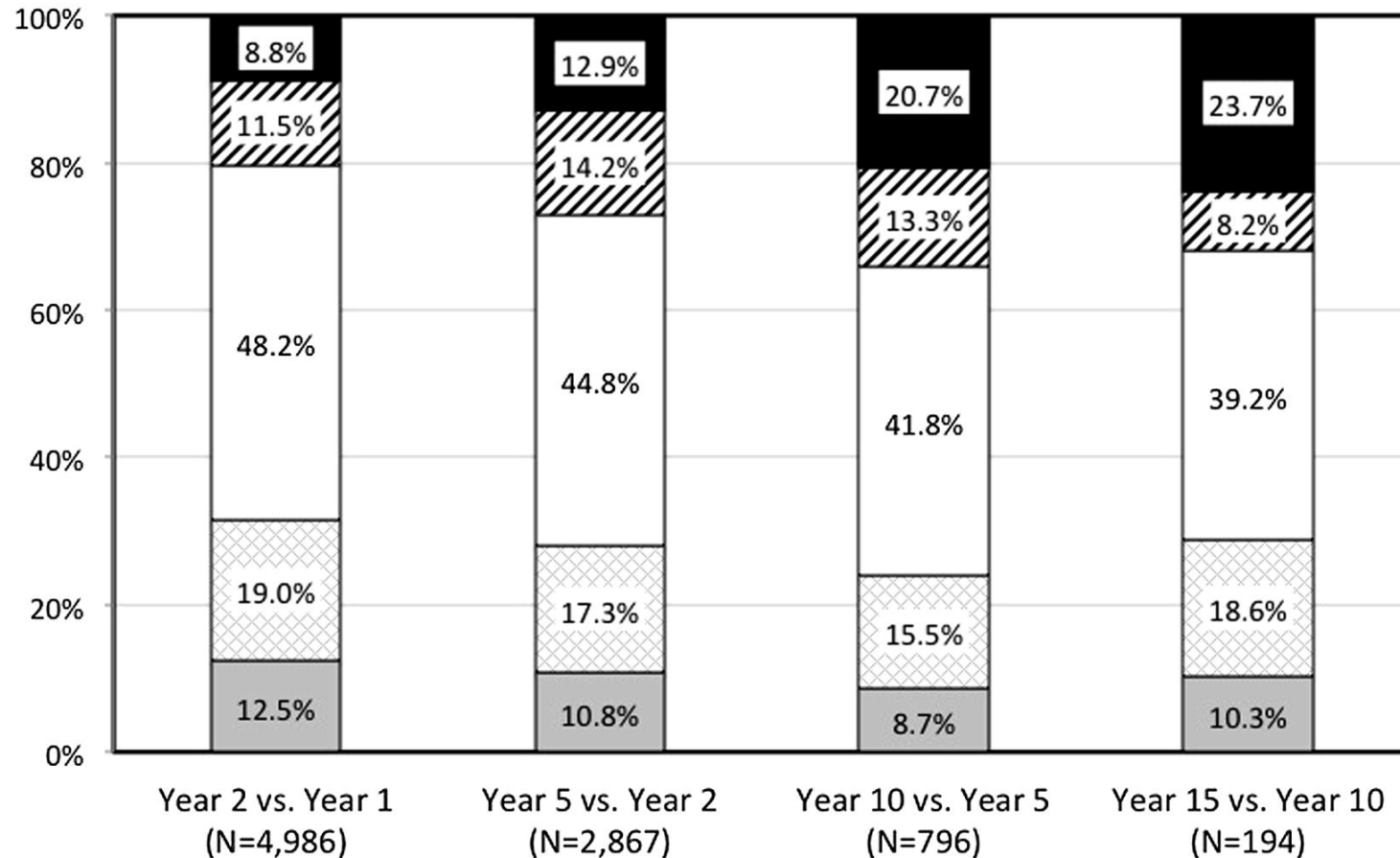
# TBI is not just an event, it is a chronic condition

*What influences recovery over 10-15 years?*

TBI



# Function changes over time after TBI



■ % 2 category declined    ▨ % 1 category declined    □ % no change  
▩ % 1 category improved    ▒ % 2 category improved



# What is behind functional decline?

- Progressive and degenerative process
- Loss of functional independence
- Cognitive changes leading to self-regulation
- Financial hardship



April 28, 2022

# Association of Traumatic Brain Injury With the Risk of Developing Chronic Cardiovascular, Endocrine, Neurological, and Psychiatric Disorders

Saeef Izzy, MD<sup>1,2</sup>; Patrick M. Chen, MD<sup>1,2</sup>; Zabreen Tahir, MD<sup>1</sup>; [et al](#)

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

*JAMA Netw Open.* 2022;5(4):e229478. doi:10.1001/jamanetworkopen.2022.9478

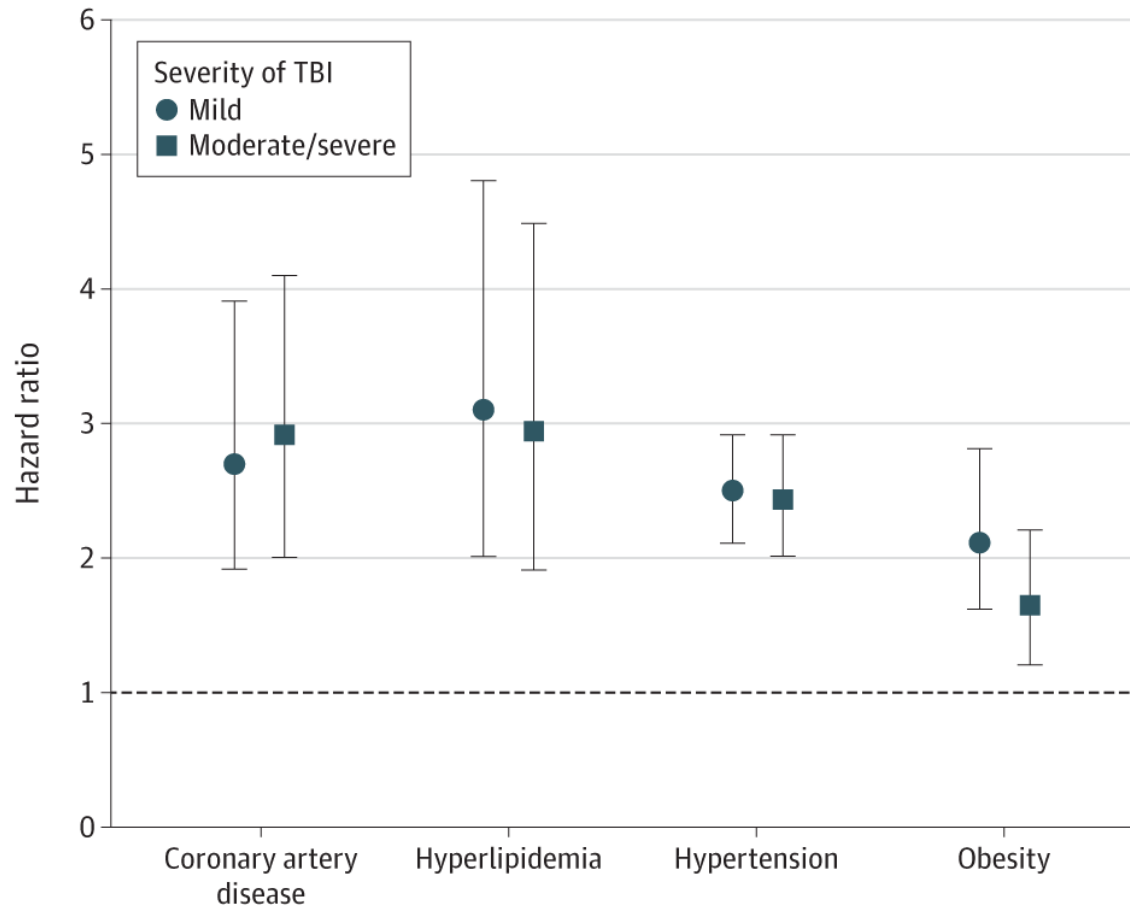
- Increased risk of developing most co-morbid conditions after both mild and moderate-severe TBI



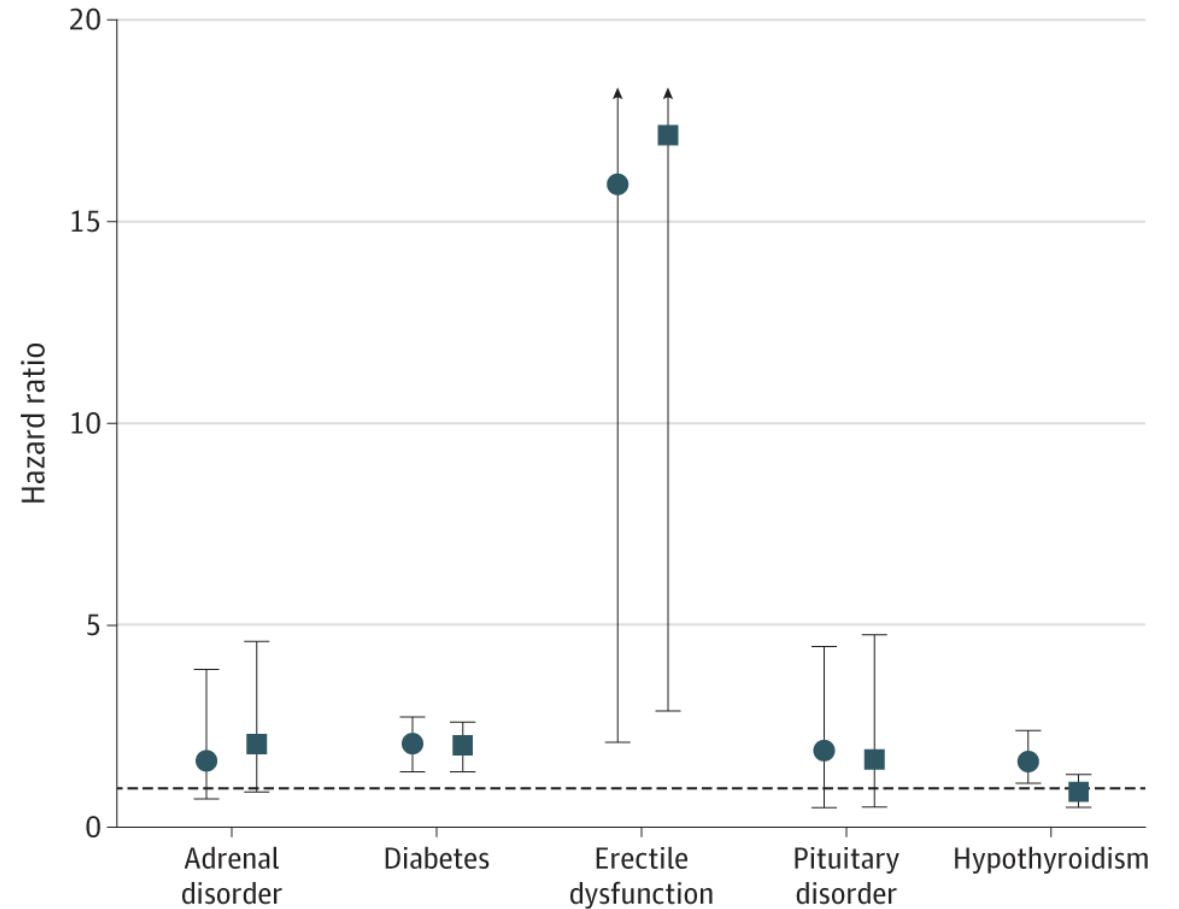


# Co-morbidities

**A** Cardiovascular disorders

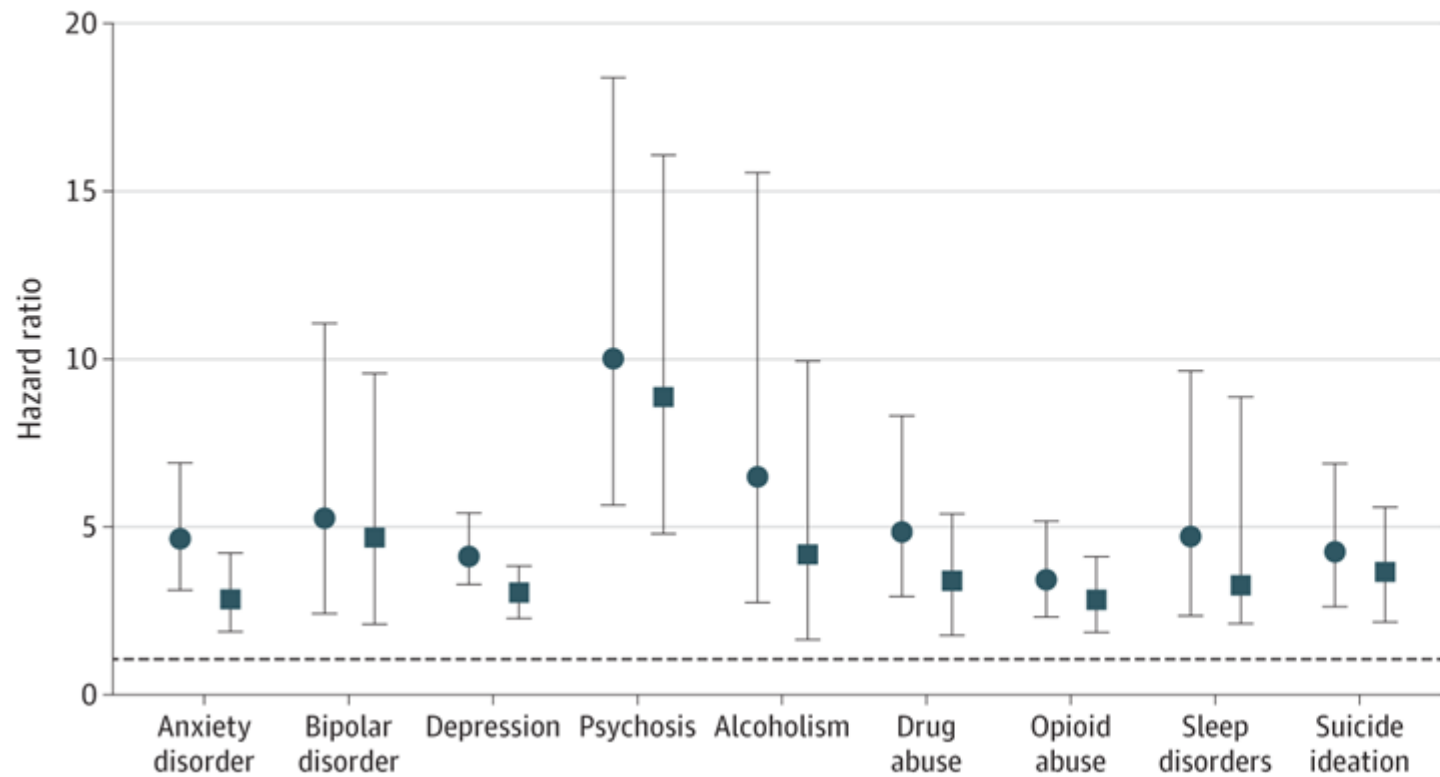


**B** Endocrine disorders

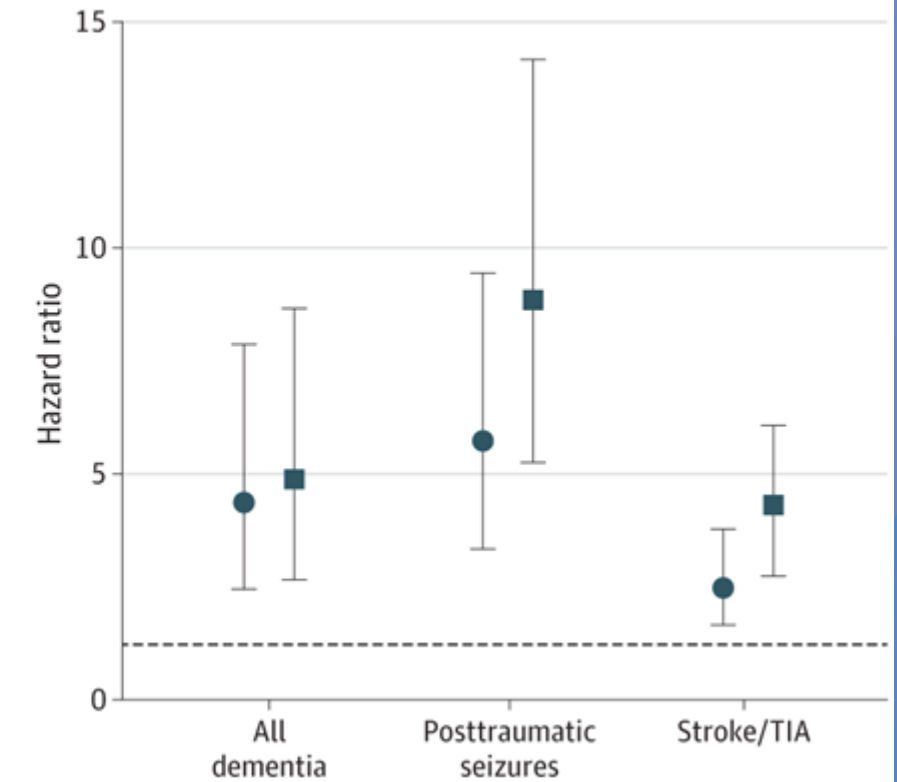


# Co-morbidities

**C** Psychiatric disorders

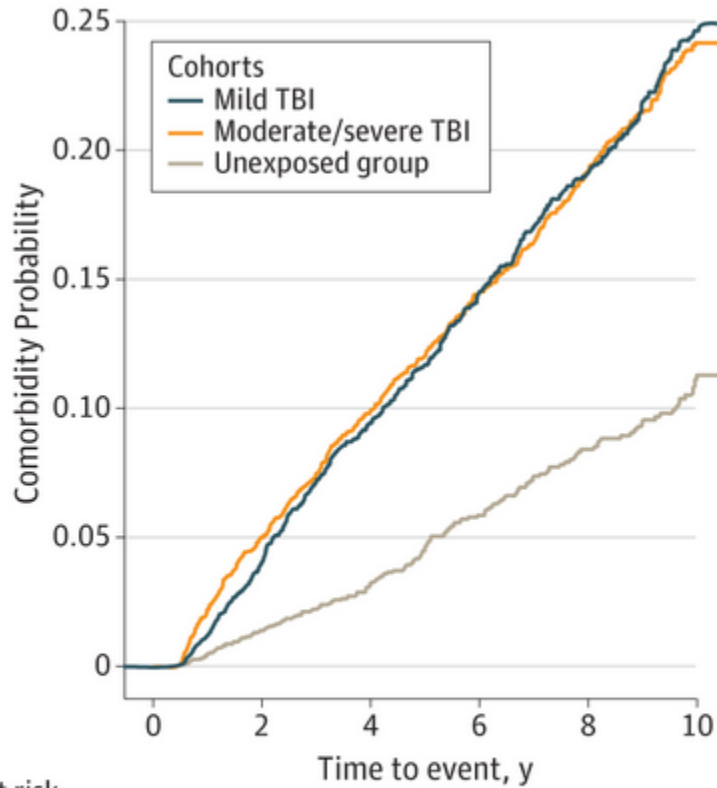


**D** Neurologic disorders



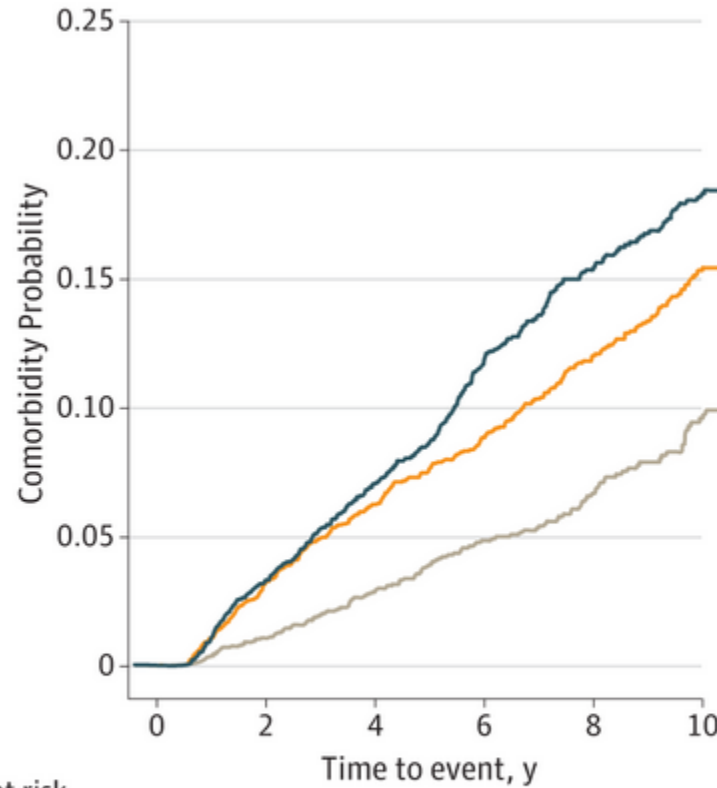
# Cardiovascular risks

**A** Hypertension



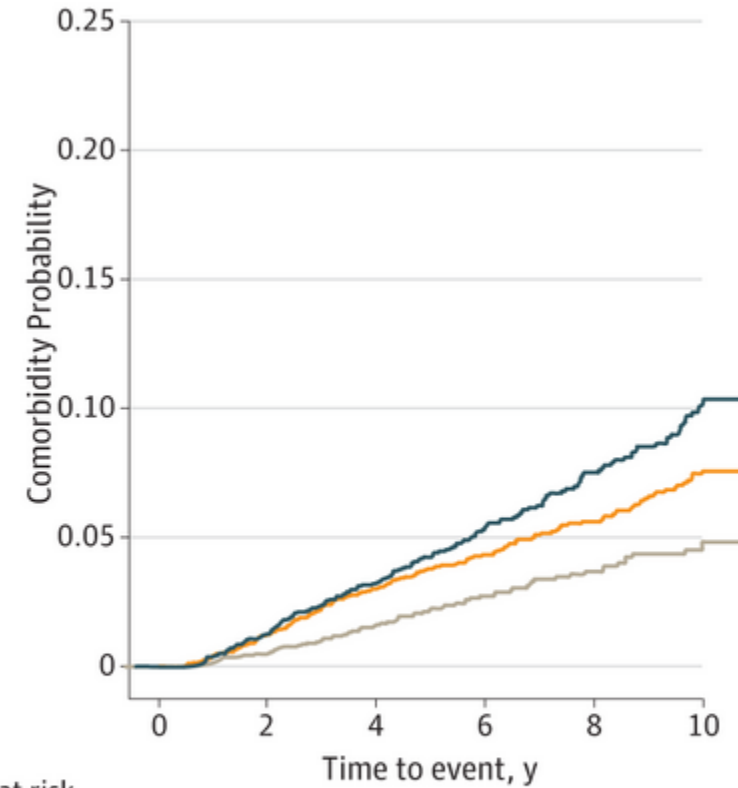
No. at risk	0	2	4	6	8	10
Unexposed group	4351	2808	2211	1644	1153	803
Mild TBI	4338	2399	1875	1284	893	573
Moderate/severe TBI	4350	2613	1915	1280	863	583

**B** Hyperlipidemia



No. at risk	0	2	4	6	8	10
Unexposed group	4351	2859	2283	1736	1247	873
Mild TBI	4338	2405	1877	1291	893	575
Moderate/severe TBI	4350	2630	1942	1299	889	620

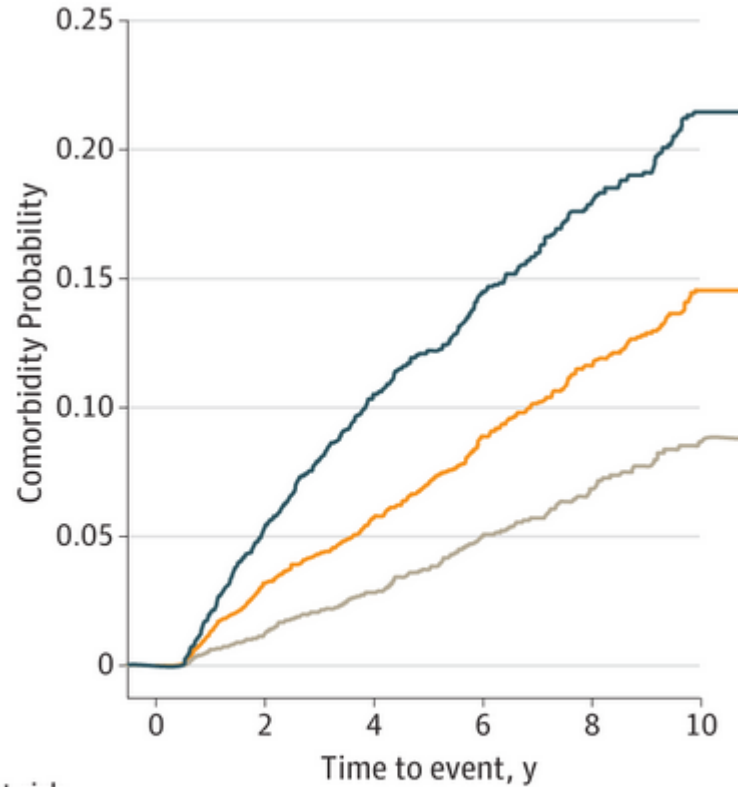
**C** Obesity



No. at risk	0	2	4	6	8	10
Unexposed group	4351	2920	2368	1824	1351	978
Mild TBI	4338	2421	1901	1310	910	596
Moderate/severe TBI	4350	2684	2017	1394	975	689

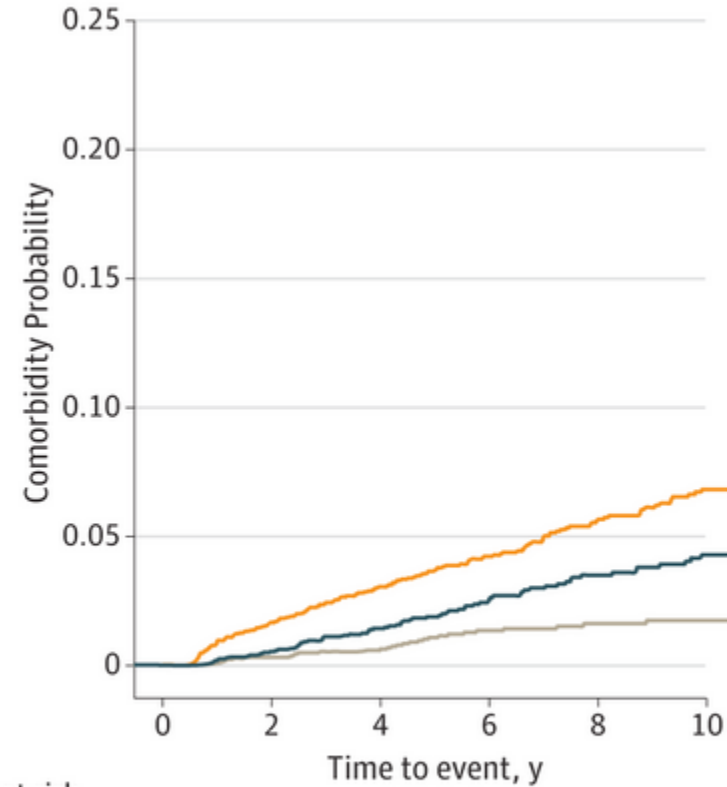
# Co-morbidities

**E** Sleep disorder



No. at risk	0	2	4	6	8	10
Unexposed group	4351	2860	2304	1749	1275	910
Mild TBI	4338	2403	1879	1292	902	585
Moderate/severe TBI	4350	2575	1880	1299	903	639

**H** Ischemic stroke or TIA

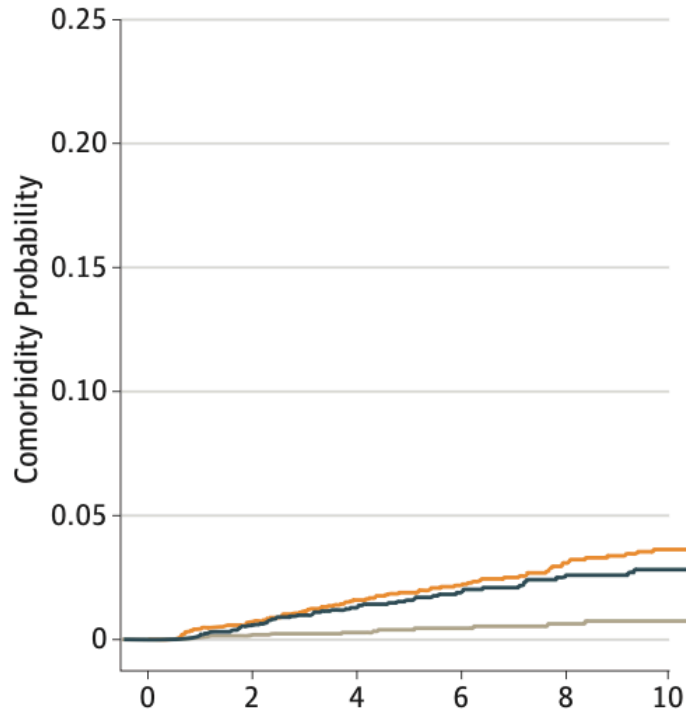


No. at risk	0	2	4	6	8	10
Unexposed group	4351	2912	2379	1839	1355	992
Mild TBI	4338	2430	1927	1334	935	615
Moderate/severe TBI	4350	2706	2068	1447	1025	744



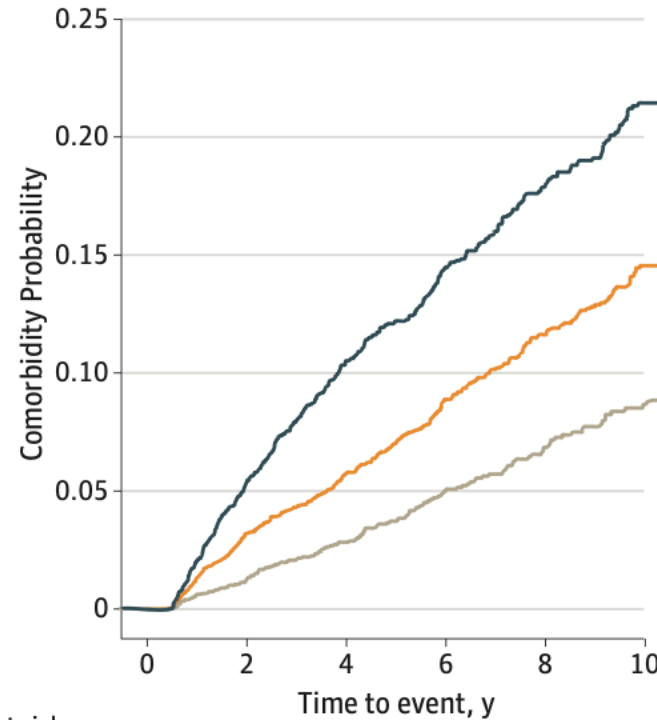
# Behavioral Health Comorbidities

**F** Anxiety disorder



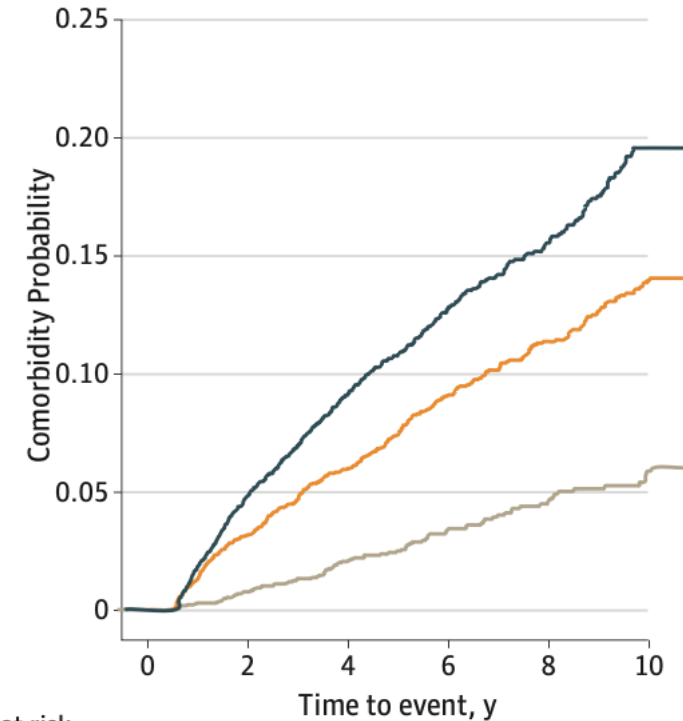
	0	2	4	6	8	10
No. at risk	4351	2936	2415	1876	1397	1030
Unexposed group	4338	247	1927	1338	939	617
Mild TBI	4350	2702	2067	1461	1042	759
Moderate/severe TBI						

**E** Sleep disorder



	0	2	4	6	8	10
No. at risk	4351	2860	2304	1749	1275	910
Unexposed group	4338	2403	1879	1292	902	585
Mild TBI	4350	2575	1880	1299	903	639
Moderate/severe TBI						

**D** Depression



	0	2	4	6	8	10
No. at risk	4351	2860	2297	1736	1277	919
Unexposed group	4338	2416	1894	1302	908	592
Mild TBI	4350	2591	1905	1304	911	642
Moderate/severe TBI						

# Behavioral Health Contributors to Chronic TBI

- ▶ Hypertension, diabetes, cancers, rheumatoid arthritis, and anxiety negatively affected the trajectory of motor functioning over time
- ▶ Diabetes, cancers, chronic bronchitis, anxiety, and depression negatively impacted cognitive functioning.
- ▶ Sleep disorder, alcoholism, drug addiction, anxiety, panic attacks, PTSD, depression, and bipolar disorder, as well as hypertension, liver disease, and cancers diminished life satisfaction.



**Table 2. Logistic Regression Analysis of Associations Between Post-Traumatic Brain Injury Comorbidities and Mortality**

Comorbidities	Odds ratio (95% CI)
Psychiatric disorders	
Depression	1.3 (0.9-1.8)
Bipolar disorder	2.0 (0.8-4.1)
Schizophrenia or psychosis	3.0 (2.1-4.4)
Anxiety disorder	1.4 (1.1-1.9)
Sleep disorder	1.1 (0.7-1.6)
Suicide ideation, intent, or attempt	2.4 (1.1-4.6)
Substance misuse	3.7 (2.2-5.9)
Opioid misuse	3.7 (2.0-6.0)
Alcohol misuse	2.5 (1.6-3.8)



# Theoretical Strategies to Manage Chronic TBI

- ▶ Exercise/be physically active
- ▶ Eat well
- ▶ Avoid alcohol and drugs
- ▶ Sleep well
- ▶ Get help for mental health issues
- ▶ Connect with social support
- ▶ Prevent another TBI

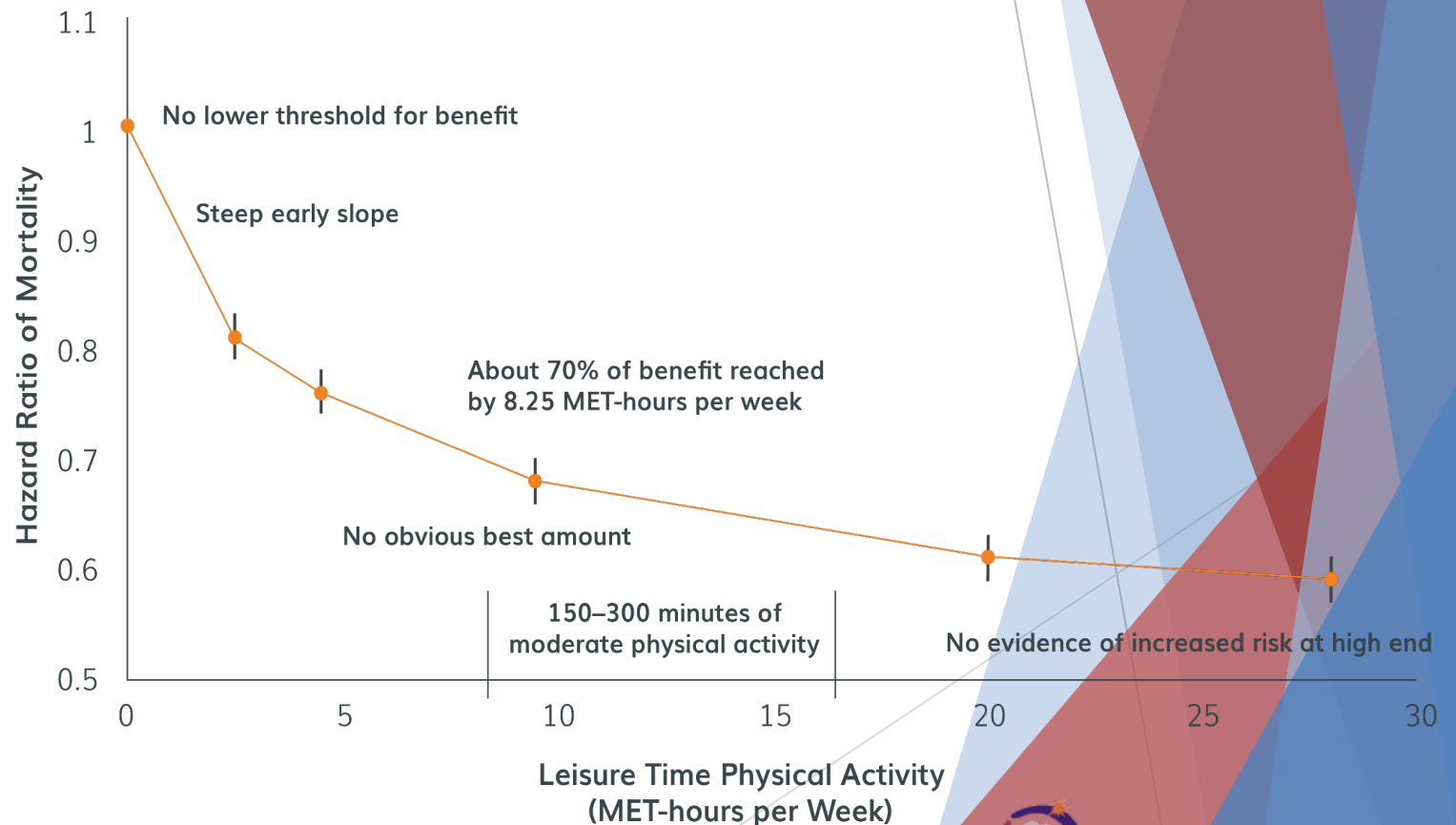




# Physical Activity Guidelines

- ▶ Based on benefits of moderate to vigorous physical activity (MVPA) to reduce mortality
- ▶ For inactive people even small increases in minutes of MVPA per week reduces risk of death
- ▶ 70% of the benefit in reducing risk of mortality is achieved at 150-300 minutes per week of MVPA

## Relationship of Moderate-to-Vigorous Physical Activity to All-Cause Mortality



# Many People with TBI are Physically Inactive

---

- ▶ More deconditioned than controls (Mossberg 2007)
- ▶ Report only 46 minutes of MVPA per week (Driver 2012, 2016)
- ▶ During IPR the longest period of MVPA was 2 minutes (Driver 2015)
- ▶ Only 8% of people with TBI meet physical activity guidelines (Hassett 2015)
- ▶ Physical activity is lower than needed to maintain health (Hamilton 2016)
- ▶ 72% of those with persistent post-concussion symptoms were under-active (reported less than 150 minutes per week of MVPA) and that subgroup reported more severe depression, anxiety, fatigue and poorer QOL relative to the active group (Mercier, 2021)



# Longer-term Benefits of Physical Activity

- ▶ Lower risk of death
- ▶ Lower risk of heart disease
- ▶ Lower risk of diabetes
- ▶ Lower blood pressure
- ▶ Lower risk of dementia
- ▶ Weight loss
- ▶ More energy/Less fatigue
- ▶ Improved cognition
- ▶ Improved mood
- ▶ Lower anxiety
- ▶ Better sleep
- ▶ Less pain
- ▶ Better quality of life

From the Physical Activity Guidelines for Americans, Second Edition, 2018 Available at [health.gov/PAGuidelines](https://www.health.gov/PAGuidelines).



TBI-BH ECHO

# Immediate/Short-term Benefits of Exercise

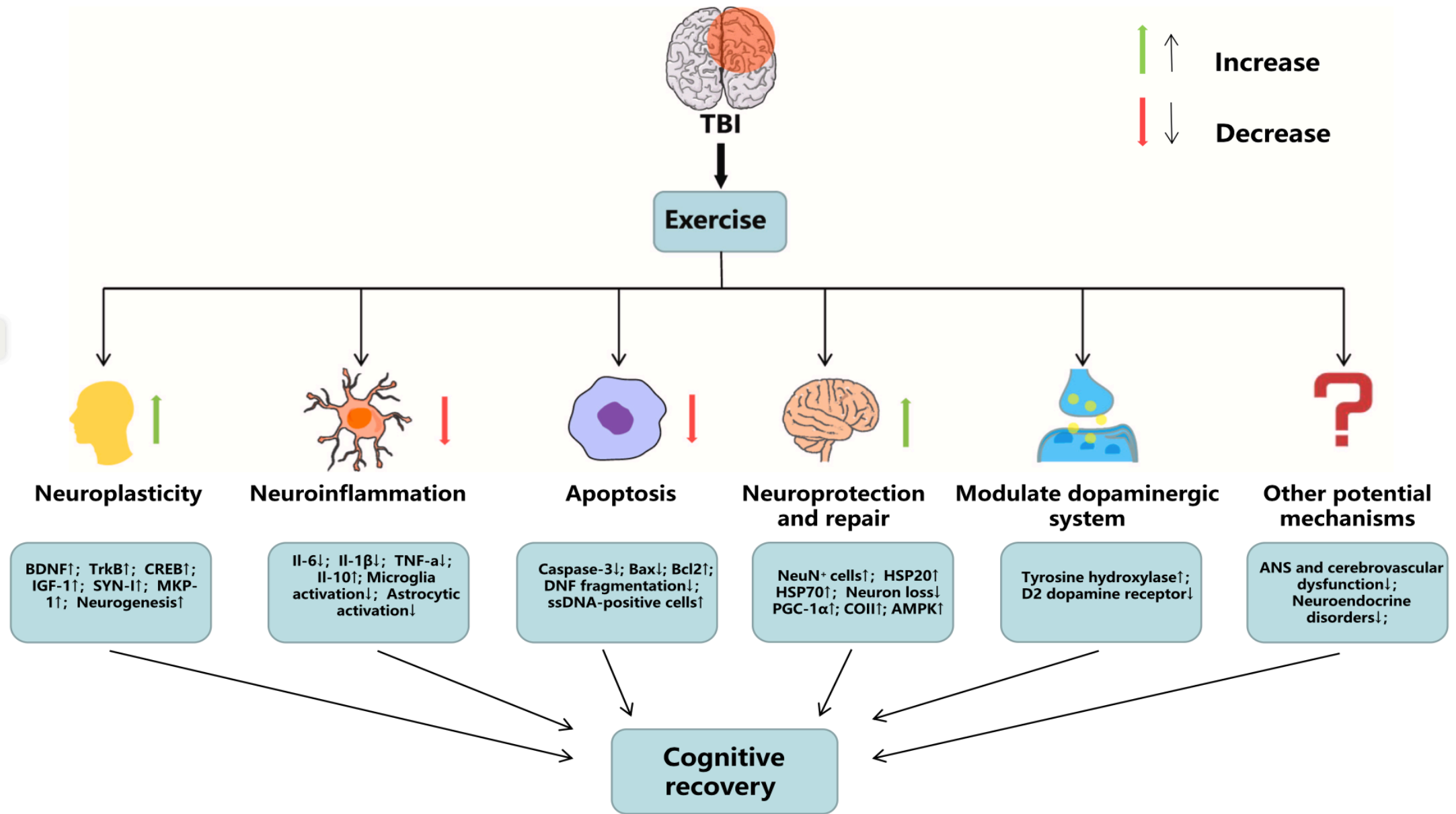
1. Exercise decreases negative affect e.g., depression, stress, anger, confusion; and increases positive affect e.g., feeling energized

- ▶ Affective benefits begin within a few minutes and last up to 24 hours
- ▶ Starting out too hard postpones the psychological benefits
- ▶ Participating in physical activities one enjoys boost effects

2. Exercise improves cognitive task performance especially attention, working memory problem solving, cognitive flexibility, verbal fluency, decision making, and inhibitory control

- ▶ Cognitive benefits last up to two hours and occurs with low, moderate, and high intensity exercise.





**Fig. 1.** Potential mechanisms by which exercise promotes recovery from TBI-induced cognitive impairment: (i) Enhance neuroplasticity; (ii) Anti-Neuroinflammation; (iii) Anti-Apoptosis; (iv) Neuroprotection and repair; (v) Modulate dopaminergic system; (vi) Other potential mechanisms which have not been observed directly include: Improves ANS and cerebrovascular dysfunction, and neuroendocrine disorders that may arise from TBI.

# Screen for Physical Inactivity

## Physical Activity Vital Sign

Exercise  
is Medicine®

AMERICAN COLLEGE  
of SPORTS MEDICINE®

1. On average, how many days per week do you engage in moderate to vigorous physical activity (like a brisk walk)? \_\_\_\_\_ days
  2. On average, how many minutes do you engage in physical activity at this level? \_\_\_\_\_ minutes
- Total minutes per week of physical activity (multiply #1 by #2) \_\_\_\_\_ minutes per week**

National guidelines recommend 150 minutes per week of moderate intensity physical activity. That's just 2 1/2 hours out of 168 hours in a week! In place of moderate intensity activity, you can complete 75 minutes of vigorous intensity activity, or an equivalent combination of moderate and vigorous intensity physical activity.

- 1 minute of vigorous activity is equal to 2 minutes of moderate activity.
- You can perform activity in multiple “bouts” of any length throughout the day to add up to the 150 minutes/week.

## Stage of Change Action Step

### Precontemplation

(Patient has no intention to be physically active)

- Discuss the health benefits of regular physical activity particularly related to that patient's unique health concerns and needs.
- The individual is likely not ready to receive a physical activity prescription at this point.

### Contemplation

(Patient knows they should exercise and is thinking about becoming physically active)

#### Independent

Write prescription. Provide info. Refer to exercise professional.

#### Supervision Necessary

Refer to clinical exercise pro, cardiac rehab or physical therapy as appropriate.

- Emphasize the pros and reducing the cons of being more physically active that are particularly relevant to the patient.
- The individual may be receptive to receiving basic guidance on becoming more physically active.

### Preparation

(Patient is planning to become physically active in the near future)

Write prescription; refer to non-clinical exercise professionals.

Refer to clinical exercise pros, cardiac rehab or physical therapy as appropriate

### Action

(Patient is meeting the physical activity guidelines but for less than 6 months)

Applaud efforts. Encourage continued exercise.

Encourage continued supervised exercise training.

Discuss relapse prevention strategies: planning ahead for challenges, getting back to activity after a lapse.

### Maintenance

(Patient is meeting the physical activity guidelines for the last 6 months or more)

Applaud efforts. Encourage continued exercise.

Encourage continued supervised exercise.

Encourage them to spend time with people with similar healthy behaviors; continue to engage in healthy activities to cope with stress.

# Assess Readiness to Be Physically Active

Exercise  
is Medicine®

AMERICAN COLLEGE  
of SPORTS MEDICINE®

<https://www.exerciseismedicine.org/>



TBI-BH ECHO



# 2022 PAR-Q+

## The Physical Activity Readiness Questionnaire for Everyone

The health benefits of regular physical activity are clear; more people should engage in physical activity every day of the week. Participating in physical activity is very safe for MOST people. This questionnaire will tell you whether it is necessary for you to seek further advice from your doctor OR a qualified exercise professional before becoming more physically active.

### GENERAL HEALTH QUESTIONS

Please read the 7 questions below carefully and answer each one honestly: check YES or NO.	YES	NO
1) Has your doctor ever said that you have a heart condition <input type="checkbox"/> OR high blood pressure <input type="checkbox"/> ?	<input type="checkbox"/>	<input type="checkbox"/>
2) Do you feel pain in your chest at rest, during your daily activities of living, OR when you do physical activity?	<input type="checkbox"/>	<input type="checkbox"/>
3) Do you lose balance because of dizziness OR have you lost consciousness in the last 12 months? Please answer NO if your dizziness was associated with over-breathing (including during vigorous exercise).	<input type="checkbox"/>	<input type="checkbox"/>
4) Have you ever been diagnosed with another chronic medical condition (other than heart disease or high blood pressure)? PLEASE LIST CONDITION(S) HERE: _____	<input type="checkbox"/>	<input type="checkbox"/>
5) Are you currently taking prescribed medications for a chronic medical condition? PLEASE LIST CONDITION(S) AND MEDICATIONS HERE: _____	<input type="checkbox"/>	<input type="checkbox"/>
6) Do you currently have (or have had within the past 12 months) a bone, joint, or soft tissue (muscle, ligament, or tendon) problem that could be made worse by becoming more physically active? Please answer NO if you had a problem in the past, but it does not limit your current ability to be physically active. PLEASE LIST CONDITION(S) HERE: _____	<input type="checkbox"/>	<input type="checkbox"/>
7) Has your doctor ever said that you should only do medically supervised physical activity?	<input type="checkbox"/>	<input type="checkbox"/>

**If you answered NO to all of the questions above, you are cleared for physical activity. Please sign the PARTICIPANT DECLARATION. You do not need to complete Pages 2 and 3.**

- Start becoming much more physically active – start slowly and build up gradually.
- Follow Global Physical Activity Guidelines for your age (<https://www.who.int/publications/i/item/9789240015128>).
- You may take part in a health and fitness appraisal.
- If you are over the age of 45 yr and NOT accustomed to regular vigorous to maximal effort exercise, consult a qualified exercise professional before engaging in this intensity of exercise.
- If you have any further questions, contact a qualified exercise professional.

#### PARTICIPANT DECLARATION

If you are less than the legal age required for consent or require the assent of a care provider, your parent, guardian or care provider must also sign this form.

I, the undersigned, have read, understood to my full satisfaction and completed this questionnaire. I acknowledge that this physical activity clearance is valid for a maximum of 12 months from the date it is completed and becomes invalid if my condition changes. I also acknowledge that the community/fitness center may retain a copy of this form for its records. In these instances, it will maintain the confidentiality of the same, complying with applicable law.

NAME \_\_\_\_\_ DATE \_\_\_\_\_

SIGNATURE \_\_\_\_\_ WITNESS \_\_\_\_\_

# Ensure the Patient is Safe to Exercise

<https://eparmedx.com/>



TBI-BH ECHO



Name: \_\_\_\_\_ Date: \_\_\_\_\_

### 2018 Physical Activity Guidelines for Adults:

- 150-300 minutes/week of moderate-intensity activity or 75-150 minutes/week of vigorous activity (somewhat hard to very hard) or a combination of both
- Muscle strength training 2 or more times a week



### Aerobic Activity (check)

Frequency (days/week):     1     2     3     4     5     6     7

Intensity:     Light (casual walk)     Moderate (brisk walk)     Vigorous (like jogging)

Time (minutes/day):     10     20     30     40     50     60 or more

Type:     Walk     Run     Bike     Swim/Water Exercise     Other \_\_\_\_\_

Steps/day:     2,500     5,000     7,500     10,000 or more     Other \_\_\_\_\_

### What about aerobic activity?

- Moderate activity is at a pace where you can talk but cannot “sing.” Examples: *brisk walking, light biking, water exercise and dancing.*
- Vigorous activity is done at a pace where you cannot talk and may be out of breath. Examples: *jogging, swimming, tennis and fast bicycling.*
- You can exercise for any length of time. For example, you might walk:
  - 30 minutes 5 days/week or
  - 20 minutes daily
  - 5 minutes here, 10 minutes there. Just work your way up to 150 total minutes/week.
- Your ultimate goal is to gradually build up to 7,500-10,000 steps/day.

# Template for Writing Exercise Prescription

<https://www.exerciseismedicine.org/>



TBI-BH ECHO

# Single Session Motivational Interview

- ▶ If you wanted to move in the direction of being more physically active....
- ▶ What—if anything, are you willing to do now? Exactly what would you plan to do? What activities? How much?
- ▶ When—would you plan to do it? For how long?
- ▶ Where would you start? What “baby” steps would you take?
- ▶ Why—what are your most important reasons to exercise?
- ▶ How--would you do it? How would you set things up to increase your chances of success e.g., environmental cues and reminders
- ▶ Who—do you need to help you, if anyone?



# Social Isolation and Loneliness

- ▶ *Social isolation* is the objective state of having few social relationships or infrequent social contact with others
  - ▶ 24% of community-dwelling Americans aged 65 and older are socially isolated
- ▶ *Loneliness* is a mismatch between one's desired and actual social relationships where an individual sees themselves as socially isolated even if they have opportunities to engage socially
  - ▶ 35% of U.S. adults aged 45 and older and 43% of adults aged 60 and older report feeling lonely

# Social Isolation and Loneliness

- ▶ Berkman-Syme Social Network Index
  - ▶ People are considered socially isolated if they have fewer than six confidants, no spouse, and no group affiliations
- ▶ Loneliness
  - ▶ UCLA Loneliness Scale: How often do you feel you lack companionship? How often do you feel left out? How often do you feel isolated?

# Health Effects of Social Isolation and Loneliness

- Social isolation *SOCIAL ISOLATION AND LONELINESS IN OLDER ADULTS, National Academies of Sciences, Medicine, and Behavioral Sciences*
  - ▶ increases risk of all-cause mortality as much as smoking, obesity, and inactivity
  - ▶ 29% increase in risk of all-cause mortality
  - ▶ 25% increased risk for cancer mortality
  - ▶ ~50% increased risk of developing dementia
- ▶ Loneliness
  - ▶ higher rates of clinically significant depression, anxiety, and suicidal ideation
  - ▶ 59% increased risk of functional decline
  - ▶ 45% increased risk of death
  - ▶ among heart failure patients, nearly four times increased risk of death

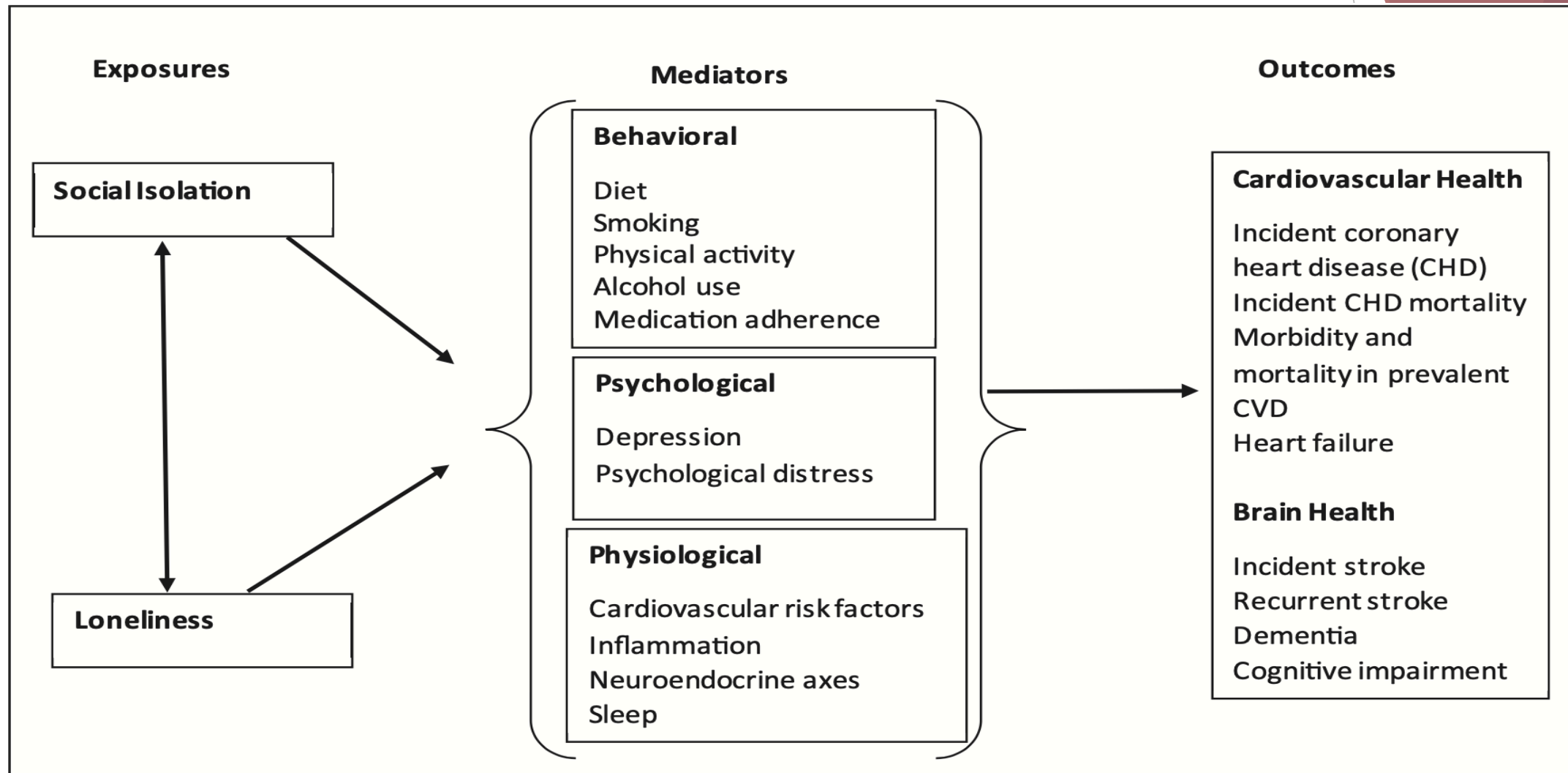


# Social Connection and Health

- ▶ Loneliness is like pain; meant to trigger adaptive social responses
- ▶ 40-80% of wellness is directly or indirectly linked to social factors
- ▶ Significant fraction of the population is isolated, lonely or both
  - ▶ 35% of adults 45 and older report feeling lonely
  - ▶ 43% of adults aged 60 or older report feeling lonely
- ▶ In a meta-analysis of studies 1980-2014
  - ▶ Loneliness increased risk of mortality by 29%
  - ▶ Living alone increased mortality risk by 32%
  - ▶ Social isolation worsens the impact of loneliness on health



# Hypothetical Mechanisms of Action



# Loneliness in TBI

- ▶ In a nationally representative health survey sample, people over 50 with self-reported TBI reported significantly greater loneliness than those without TBI after adjusting for covariates.
- ▶ Depression partially mediated the relationship between TBI and loneliness
- ▶ Loneliness was greater in people within 10 years of TBI
- ▶ Loneliness may magnify TBI related increases in depression, functional impairment, medical comorbidities, mortality, and healthcare utilization



# Social Isolation in Prison Settings

- ▶ Study of 229,274 people incarcerated and released from the North Carolina prison system Jan 2000-Dec 2016
- ▶ 33.7% spent time in restrictive housing (aka solitary confinement)
- ▶ After controlling for demographic and offence related factors, relative to those who spent no time in restrictive housing, those who were placed in restrictive housing were:
  - ▶ More likely to die (HR=1.24) from suicide (HR=1.78) or homicide (1.54)
  - ▶ More likely to die from opioid overdose (HR=2.16) within 2 weeks
  - ▶ More likely to be reincarcerated (HR=2.16)

# Interventions for Social Isolation/Loneliness

- ▶ Providing psychosocial support to inpatients and outpatients in medical settings significantly increases likelihood of survival
- ▶ Using Digital technologies to decrease loneliness were not effective
- ▶ Cognitive behavioral strategies to modify maladaptive social cognitions reduce loneliness
- ▶ Mindfulness-based interventions and weekly Tai Chi Qigong meditation reduced loneliness
- ▶ Interventions aimed at providing ways for isolated people to interact more with existing social circles may be more beneficial than those aimed at making new friends.



# CASES



TBI-BH ECHO

# Case #1 - Patient Information

1. Patient year of birth: 1980
2. Patient gender: Male
3. Who is part of the patient's support network: mother, sister, and brother
4. Patient housing status: living with his mother at his sister's place
5. Patient employment status: unemployed since injury. Previously held multiple jobs
6. Highest level of education: some high school
7. Current level of functioning: transfers and walks short distance with a walker, some assistance needed with feeding and upper body dressing, dependent for iADLs
8. Pre-injury level of functioning: independent



# Case #1 - TBI History

1. What are the patient's current symptoms? left spastic hemiparesis, ataxia, dysarthria, cognitive deficit, and behavioral disturbances
2. Date of injury? 1999 with skull fracture
3. Mechanism of injury - ped vs car
4. Loss of Consciousness? - yes. Unresponsive and not consistently following commands for almost 6 months
5. Glasgow Coma Scale at Presentation - not available
6. Severity classification of Injury - severe
7. Duration of post-traumatic amnesia - not available, but he has no recollection for months after his injury
8. What were the initial treatments received after injury? Surgical intervention for skull fracture followed by outpatient therapies



# Case #1 - TBI History

9. Did the patient receive acute inpatient rehabilitation? -no

10. Does the patient have seizures? -no

11. Did the patient require surgical management as part of TBI treatment? - yes

12. Previous head injuries (are there any lingering symptoms)? No previous head injuries

If past symptoms resolved, what is the estimated duration of symptoms:



# Case #1 - TBI History

## 13. Current/past medical diagnoses/problems

left spastic hemiparesis, ataxia, dysarthria and cognitive deficit

behavioral disturbances: emotional lability, impulsive aggression. Worse at night, telling family that there are things under his bed and physically violent towards family. While trying to calm him down, his mother sustained a radial fracture.

## 14. Current medications:

bupropion, duloxetine, propranolol



# Case #1 - Past Psychiatric History

1. Please provide the patient's mental health hx: **none prior to his injury**
2. Prior psychiatric medication trials: **started on bupropion and duloxetine by his primary care physician**
3. Prior psychiatric admissions: **no**
4. Family psychiatric history: **no**
5. Please describe family psychiatric history: **n/a**





# Case #1 - Substance Use History

1. Please provide the patient's substance use history: **no history of substance use prior to injury. Did not smoke or drink before his injury.**
2. When was the last time the patient used any substances?  
**Not applicable**



# Case #1 - Lab and Rating Scale Values

1. Please enter value and date for any results you may have: **all labs within normal limits**
2. PHQ-9: **not available**
3. GAD-7: **14/21**

