

# Effect of Physical Activity on Aerobic Capacity and Cognitive Function in Elderly People

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# Normal aging is associated with:

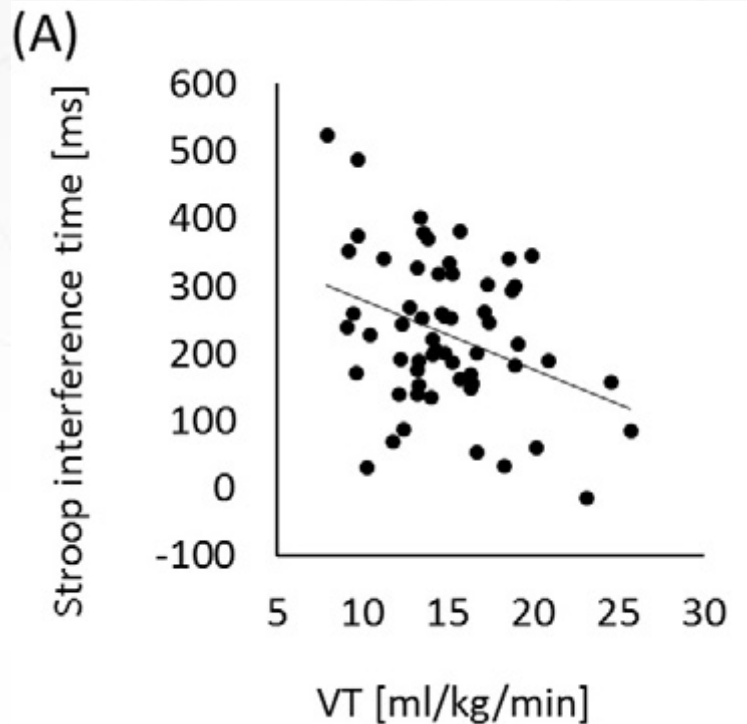
- **Decrease in the intensity and frequency of physical activity** (*Milanović et al., 2013*);
- **Reduced aerobic capacity** (*George et al., 2018*);
- **Cognitive decline** (*Aschenbrenner & Balota, 2017*).



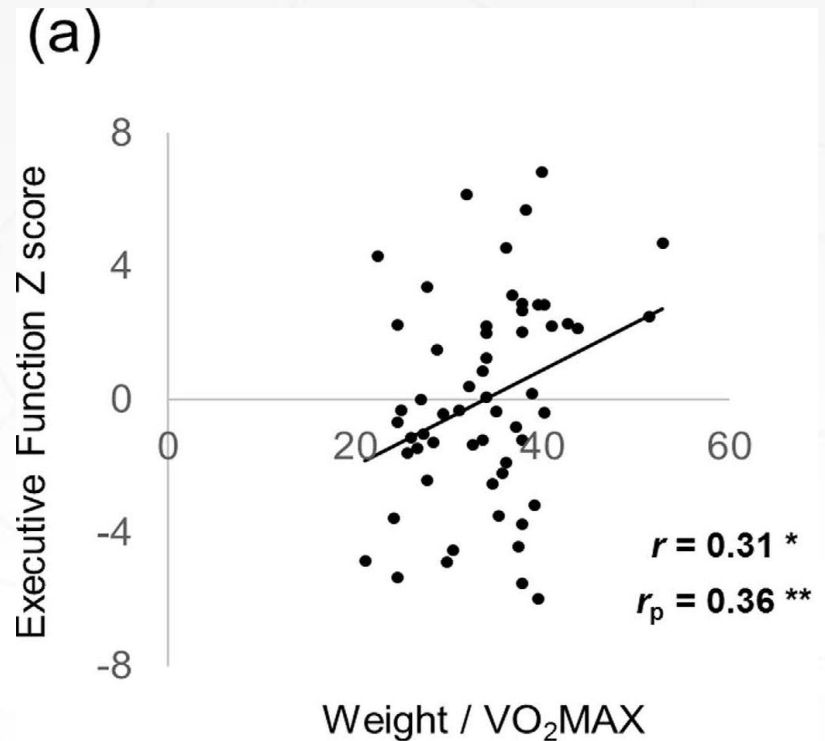
<https://thearborsassistedliving.com/wp-content/uploads/2017/07/old-man-sedentary-lifestyle-1.jpg>

# Executive Function Related with Aerobic Capacity

(Albinet et al., 2016; Colcombe & Kramer, 2003; Guiney & Machado, 2013; Benson et al., 2017; Chang et al., 2019).



Hyodo et al., 2016



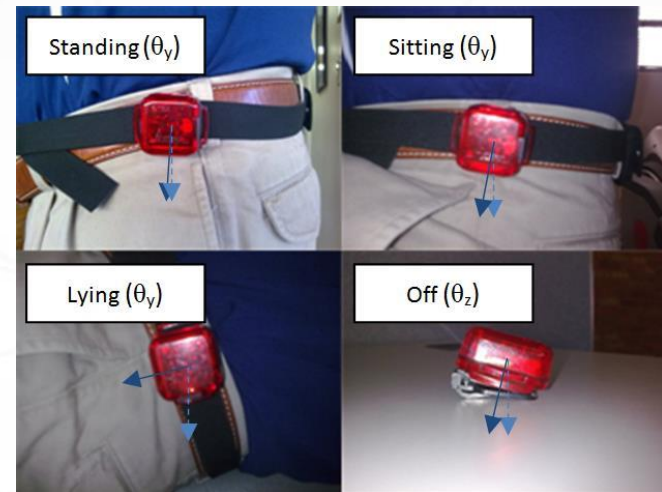
Kawagoe et al., 2017

# Physical Activity Evaluation:

- The International Physical Activity Questionnaire (IPAQ);
- Accelerometers;



<https://projects.iq.harvard.edu/bparc/news/accelerometer-loan-program>



<https://www.actigraph.nl/en/product/11/actilife-6.html>

# Physical activity guidelines suggest:

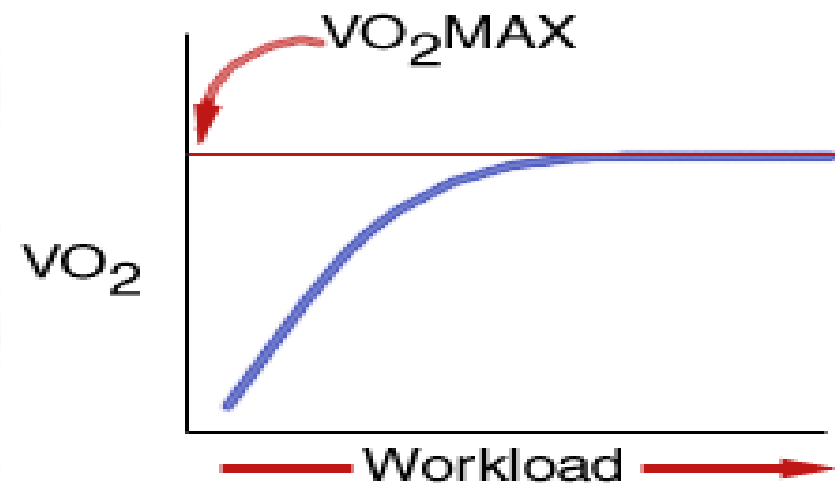
- **≥150 min** moderate to vigorous PA (MVPA) per week in bouts lasting **≥10 min** (*Jefferis et al., 2019*).
- Walk at least **7,500 steps** per day (*Bogen et al., 2017*).
- Increase of **1,000 steps/day** is associated with a **15% reduction** in mortality (*Jefferis et al., 2019*).



<https://www.care2.com/>

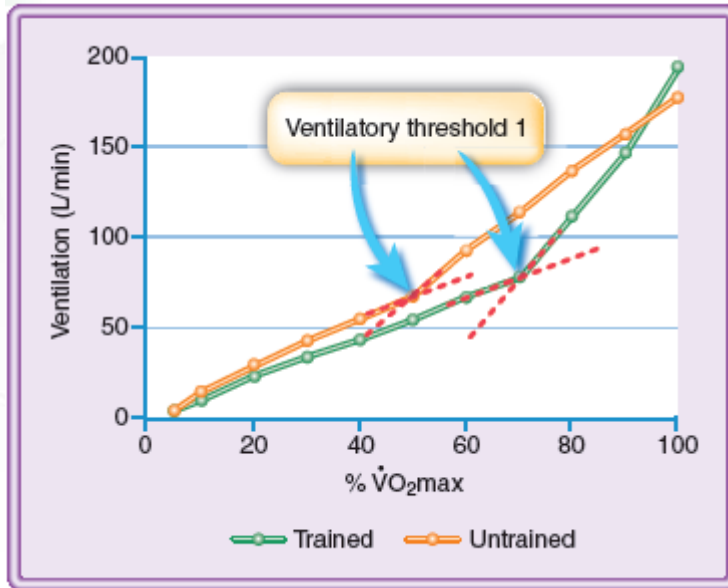
# Aerobic capacity criterions:

1. Maximal oxygen consumption ( $\dot{V}O_{2max}$ );
2. First Ventilatory threshold ( $VeT_1$ );
3. Kinetic behavior of HR,  $\dot{V}O_2$ , and [HHb];



<http://www.medicine.mcgill.ca/physio/vlab/exercise/backg.htm>

# First Ventilatory threshold



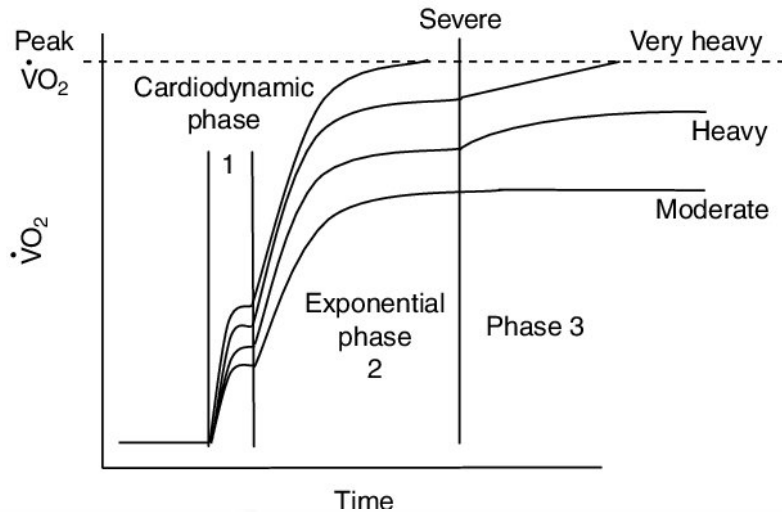
- Exercise intensity progressively becomes more difficult;
- VE increases steeply and breaks from linearity;
- The point at which VE first breaks from linearity with respect to oxygen uptake is termed the first ventilatory threshold (VeT<sub>1</sub>).

The advantage of having a higher ventilatory threshold is the ability to perform steady state exercise at a higher intensity (or speed/pace) with less reliance on anaerobic energy sources.

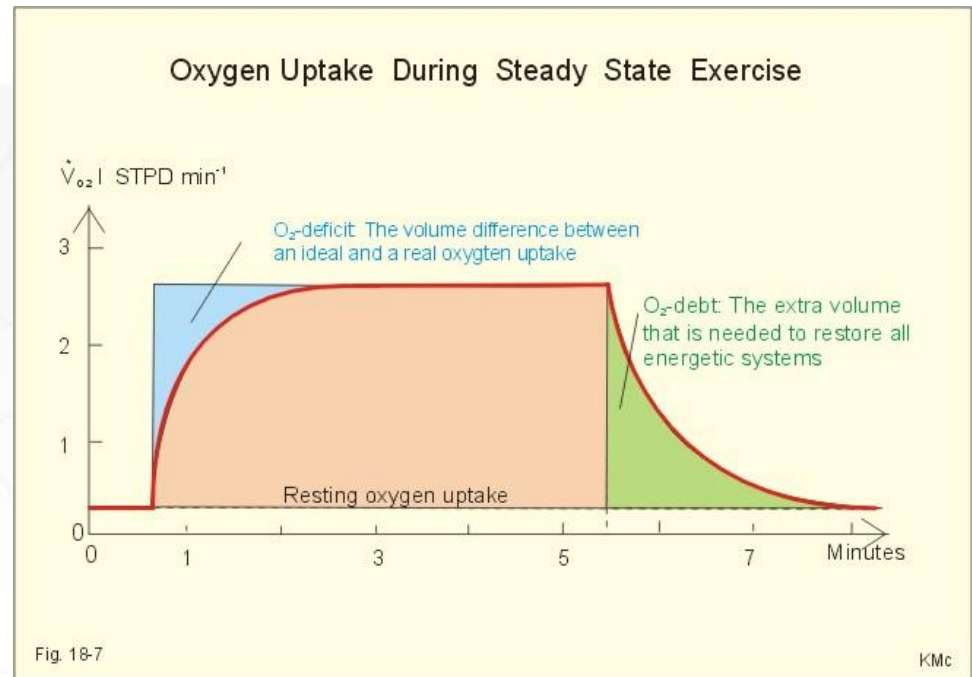
Having to rely more on anaerobic energy sources at lower workloads can lead to premature fatigue during exercise in untrained individuals.

# Oxygen uptake kinetics

<https://www.zuniv.net/physiology/book/chapter18.html>



Fawkner, S. G., & Armstrong, N. (2003).



- One of the most important characteristics of the whole body and muscle energetics during physical exercise (Zoladz et al., 2014).
- Slower  $\dot{V}O_2$  kinetics at the start of exercise increases the requirement for anaerobic sources of energy, leading to an early onset of fatigue and lower exercise tolerance (Burnley & Jones, 2007).



# Association between physical exercise and mental health in 1.2 million individuals in the USA between 2011 and 2015: a cross-sectional study

Lancet Psychiatry 2018

5: 739-46

Published Online

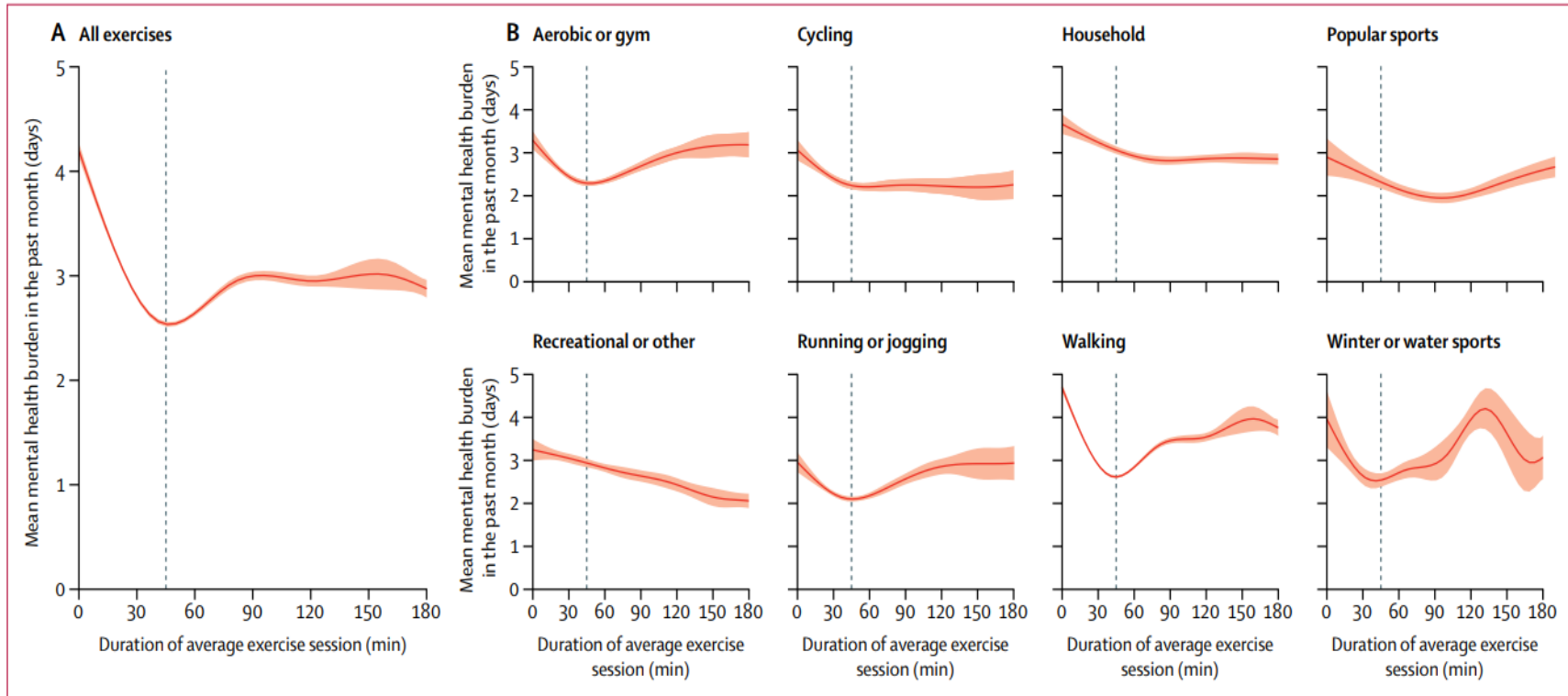
August 8, 2018

[http://dx.doi.org/10.1016/S2215-0366\(18\)30227-X](http://dx.doi.org/10.1016/S2215-0366(18)30227-X)

S2215-0366(18)30227-X

IF 18,329.

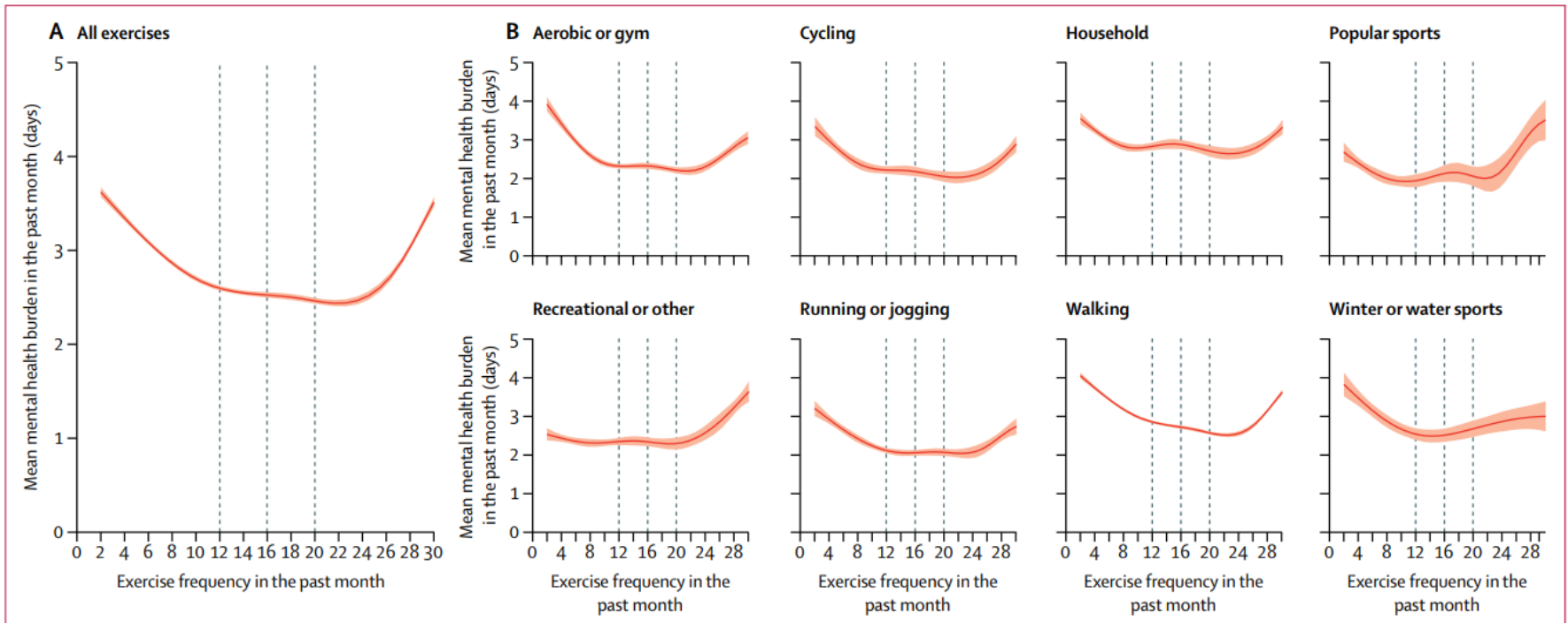
Sammi R Chekroud, Ralitz Gueorgieva, Amanda B Zheutlin, Martin Paulus, Harlan M Krumholz, John H Krystal, Adam M Chekroud



**Figure 2: Mental health burden as a function of exercise duration**

(A) Across the whole sample, individuals who exercised for approximately 45 min per session had the lowest mental health burden. Durations less than 45 min were associated with higher mental health burden, and durations longer than 60 min were generally not better than 45 min. (B) This pattern was broadly consistent across several exercise categories. Lines represent smoothed conditional means with generalised additive model smoothing, with ribbons representing 95% CIs. Dashed lines indicate exercise durations of 45 min.

*Chekroud, S. R., et al (2018). Association between physical exercise and mental health in 1.2 million individuals in the USA between 2011 and 2015: a cross-sectional study. The lancet psychiatry, 5(9), 739-746.*



**Figure 3: Mental health burden as a function of exercise frequency**

(A) Across the whole sample, individuals who exercised between three and five times per week had the lowest mental health burden. (B) The pattern was remarkably consistent across most exercise groups. Frequencies of less than three per week (12 times per month), or more than five per week (20 times per month) were associated with greater mental health burden. Lines represent smoothed conditional means using generalised additive model smoothing with cubic regression splines, with ribbons representing 95% CIs. Dashed lines indicate exercise frequencies of three, four, and five times per week (12, 16, and 20 times per month).

# Physical Activity and Mental Health

## People had a lower mental health burden:

- Exercise between **3 and 5 times** a week than those who exercised fewer than 3 or more than 5 times.
- Exercising between **120 min and 360 min** per week;
- Exercise durations between **30 min and 60 min** (peaking around 45 min);
- Durations of more than 3 h were associated with worse mental health burden than exercising for either 45 min or not exercising at all.



# Mental Health

- Moderate/high intensity PA is associated with larger effect sizes than low-intensity PA for mental health and cardiorespiratory fitness and for better cognitive outcomes in established **schizophrenia**.



- **Reducing depressive symptoms** intervention consists of **2–3** sessions of aerobic and/or aerobic and resistance training exercise a week of **45–60 minutes** duration of **moderate intensity**.

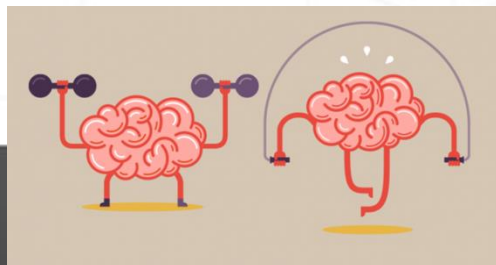
Stubbs, B., Vancampfort, D., Hallgren, M., Firth, J., Veronese, N., Solmi, M., ... & Schmitt, A. (2018). EPA guidance on physical activity as a treatment for severe mental illness: a meta-review of the evidence and Position Statement from the European Psychiatric Association (EPA), supported by the International Organization of Physical Therapists in Mental Health (IOPTMH). *European Psychiatry*, 54, 124-144.

# Exercise interventions for cognitive function in adults older than 50: a systematic review with meta-analysis

Joseph Michael Northey,<sup>1,2</sup> Nicolas Cherbuin,<sup>3</sup> Kate Louise Pumpa,<sup>1,2</sup> Disa Jane Smees,<sup>2</sup>  
Ben Rattray<sup>1,2</sup>

Br J Sports Med, 2018, 52.3: 154-160

- Physical exercise interventions significantly improved cognitive function in adults older than 50 years, regardless of baseline cognitive status.
- Positive benefits to cognition occurred with an exercise intervention that included Tai Chi, or resistance and aerobic training, prescribed either in isolation or combined.
- When exercise training variables were considered, interventions that included exercise with a minimum duration of 45min and at moderate to vigorous intensity showed improvements to cognitive function.



# Physical activity and cognitive function:

## Exercises improve:

- cardiovascular function;
- blood flow within the CNS;
- cognitive, sensory, and motor test outcomes;
- angiogenesis and neurogenesis;
- Brain plasticity ;
- increases the gray and white matter volume in the brain;
- Increase in the hippocampal volume.



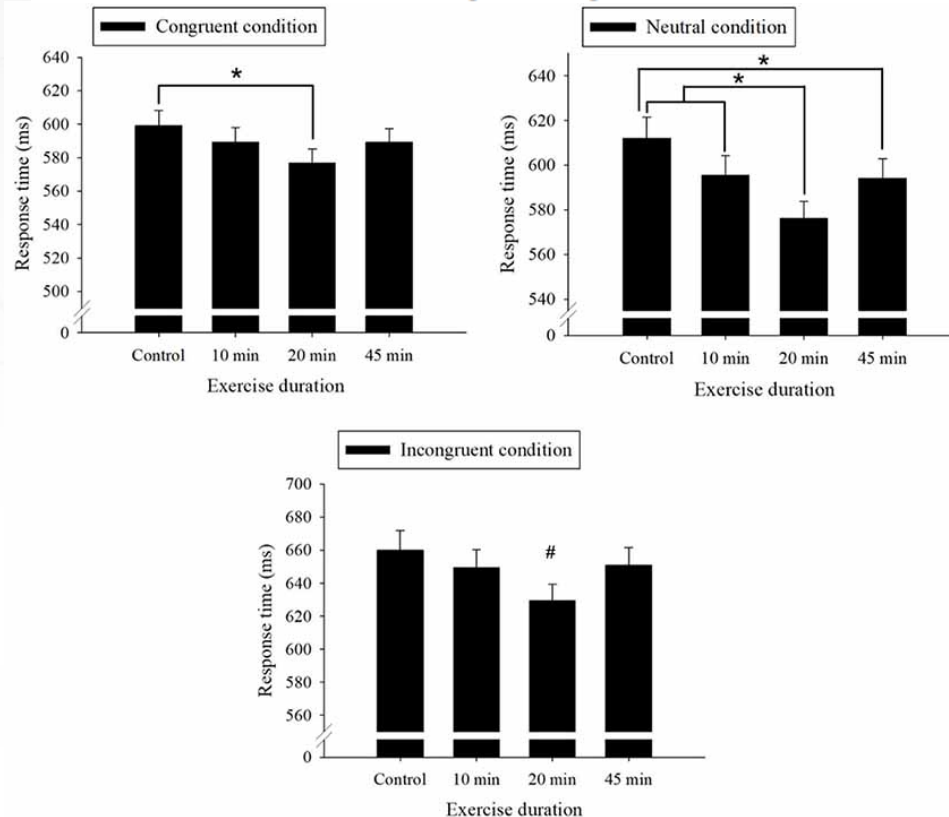
<https://blackfitnesstoday.com/physical-activity-increases-brain-function/>

*Mattson et al., 2012; Ding et al., 2006; Erickson et al., 2011; Pereira et al., 2007; Weinstein et al., 2012 Johnson et al., 2012; Tseng et al., 2013 Erickson et al., 2011; Szabo et al., 2011*



# Effects of Acute Exercise Duration on the Inhibition Aspect of Executive Function in Late Middle-Aged Adults

Yu-Kai Chang<sup>1,2</sup>, Feng-Tzu Chen<sup>1</sup>, Garry Kuan<sup>3</sup>, Gao-Xia Wei<sup>4</sup>, Chien-Heng Chu<sup>1</sup>, Jun Yan<sup>5</sup>, Ai-Guo Chen<sup>5\*</sup> and Tsung-Min Hung<sup>1,2\*</sup>



- The participants who participated in the 20-min session showing the best cognitive performances in the Stroop congruent and incongruent conditions.

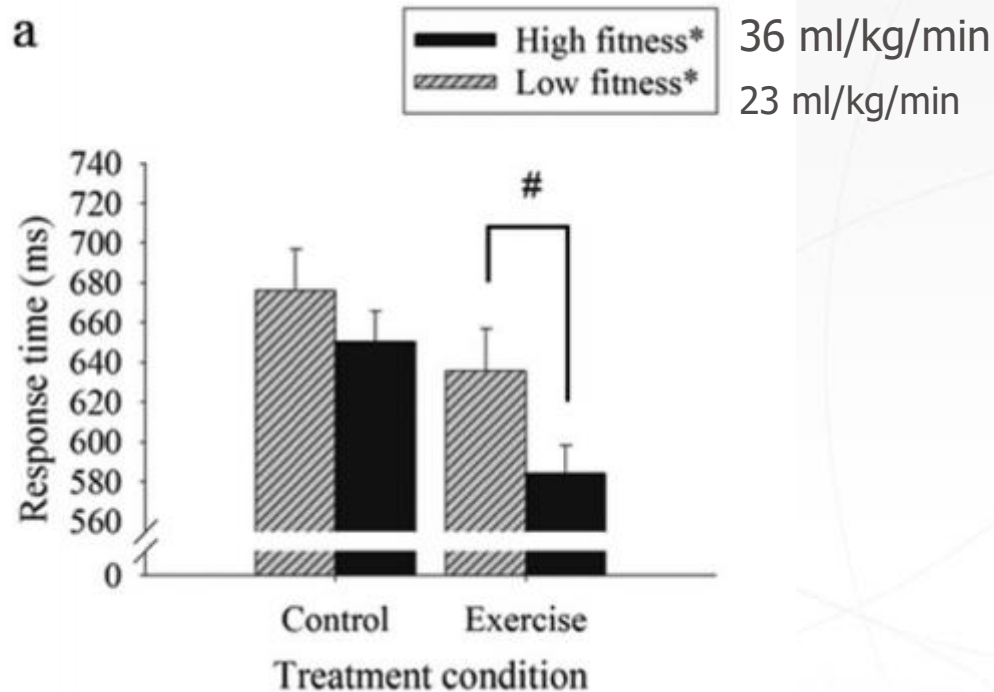
Moderate-to-vigorous intensity exercise Stroop test performances age of 55–65 years old

Chien-Heng Chu  
National Taiwan Sport University

Ai-Guo Chen  
Yangzhou University

Tsung-Min Hung  
National Taiwan Normal University

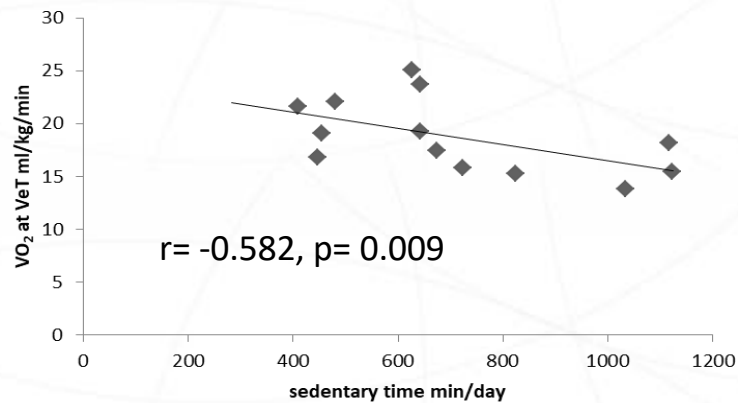
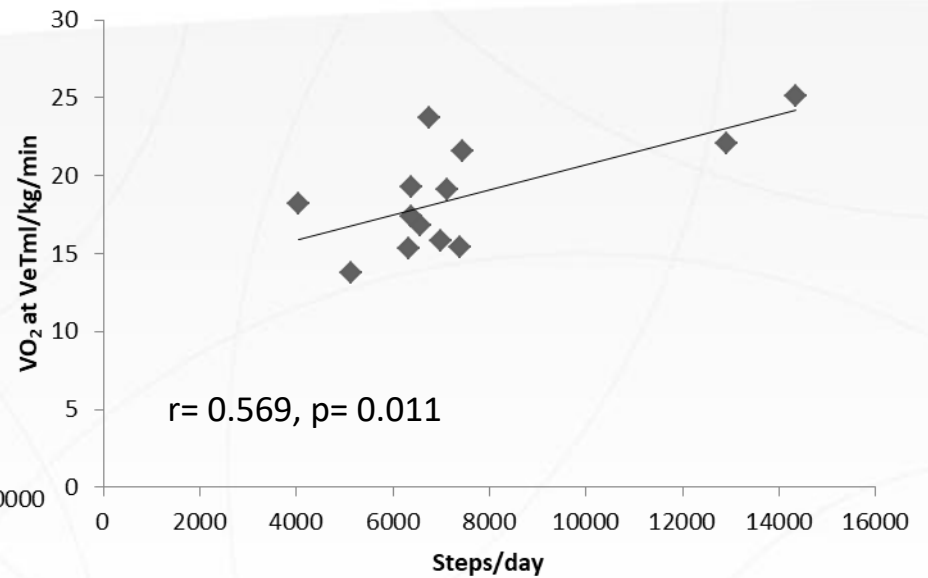
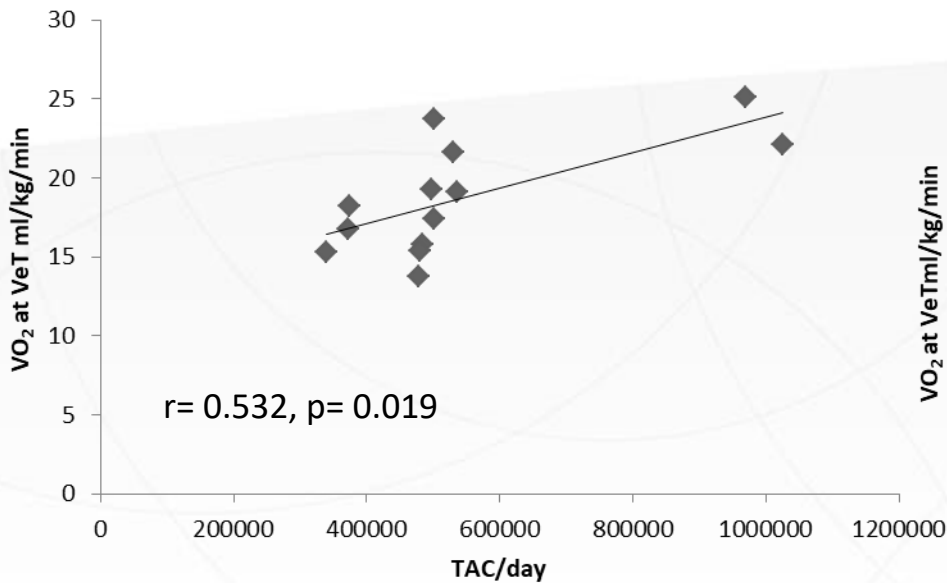
Chun-Chih Wang and Yu-Kai Chang  
National Taiwan Sport University



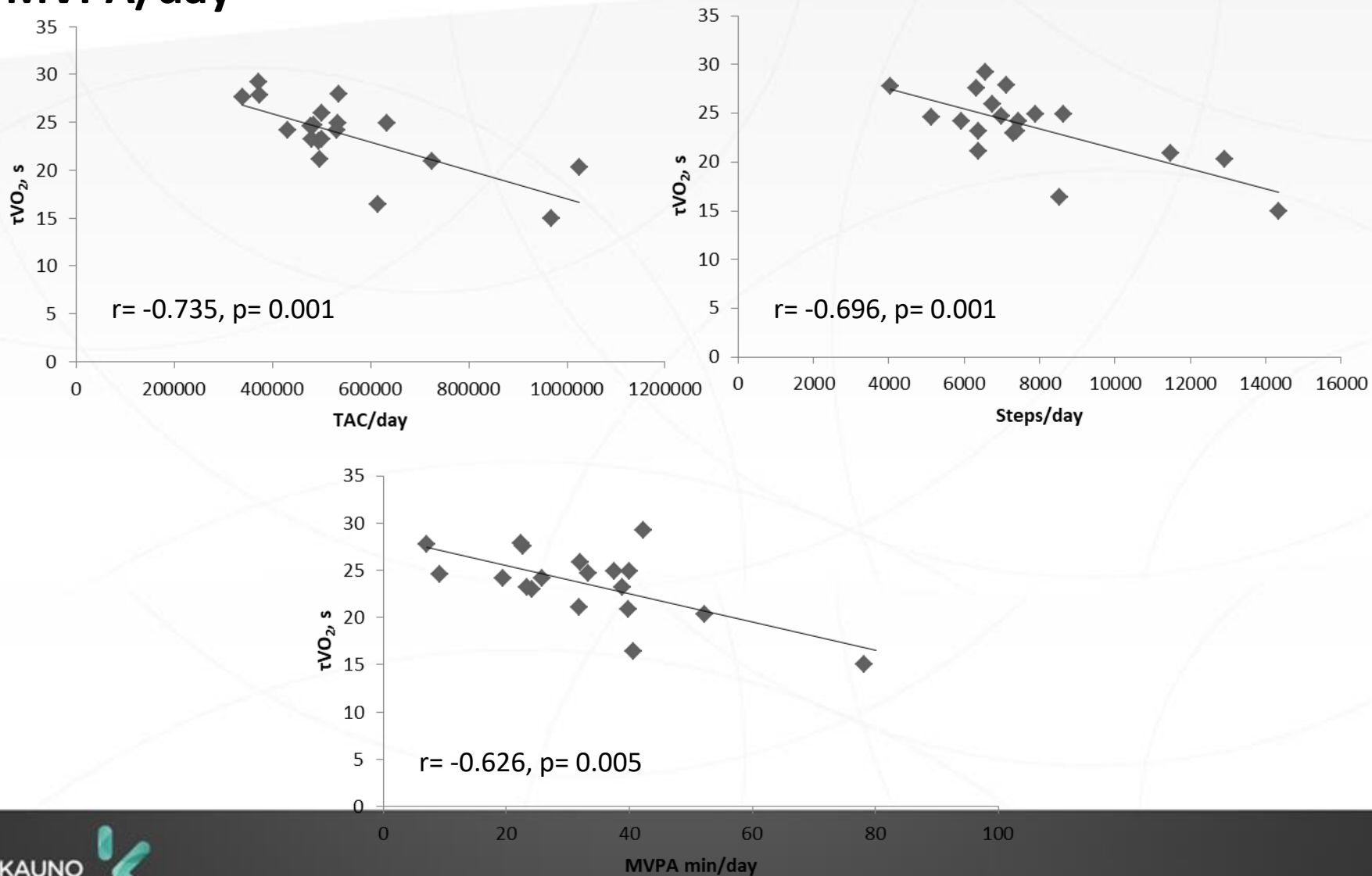
5 min post 20 min moderate intensity exercise. Age ~65 years



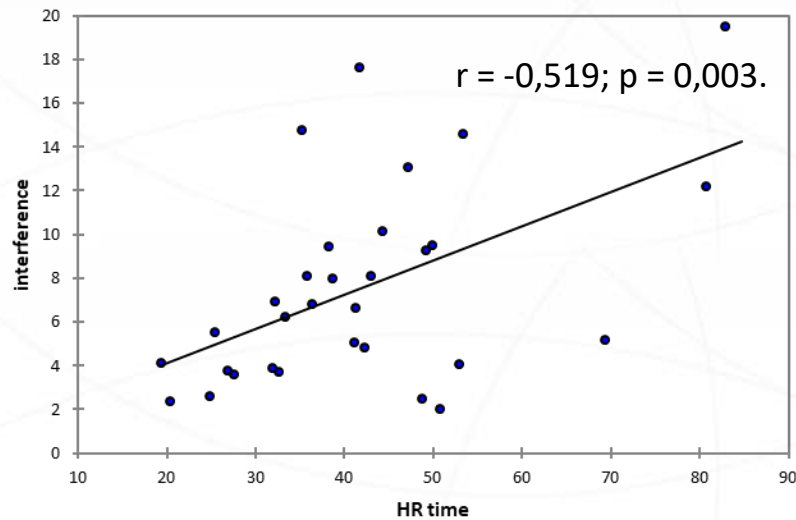
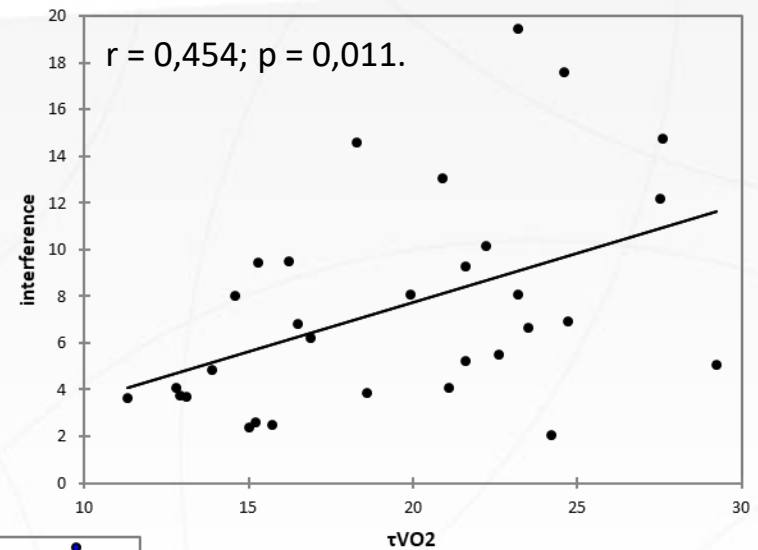
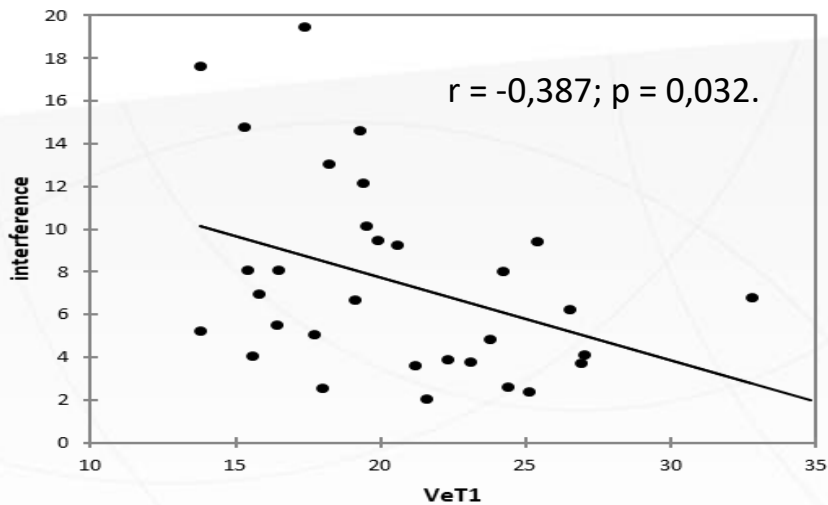
# Correlations between $VeT_1$ , TAC/day, steps/day and sedentary time



# Correlations between $\tau\text{VO}_2$ , TAC/day, steps/day and MVPA/day



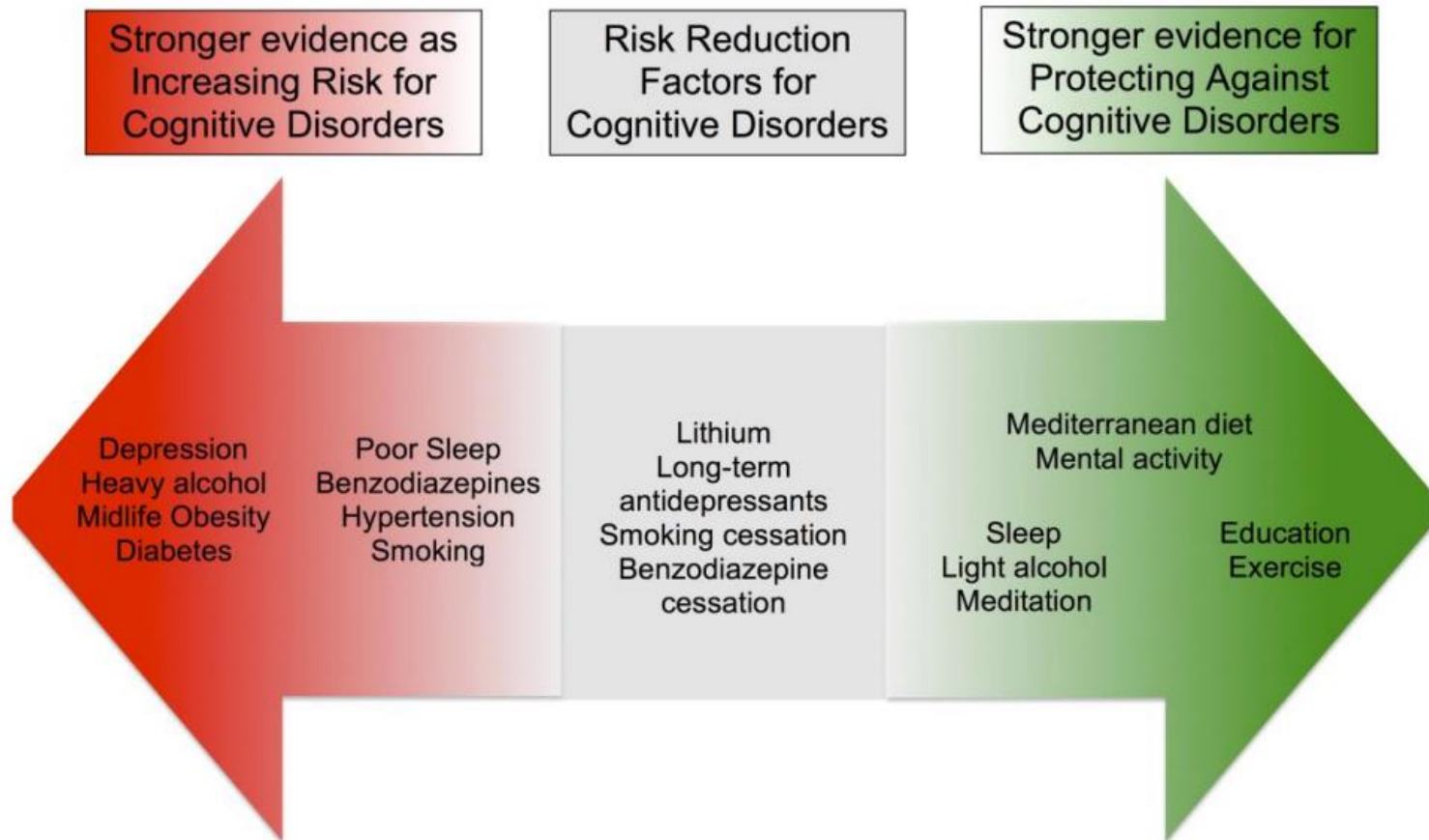
# Correlations between Stroop interference, $VeT_1$ , $\tau VO_2$ and $\tau HR$



Review

# Health-Promoting Strategies for the Aging Brain

Stephen T. Chen M.D.<sup>1,2,3</sup>, Dax Volle M.D.<sup>1,2,3</sup>, Jason Jalil M.D.<sup>1,2,3</sup>, Pauline Wu D.O.<sup>1,2,3</sup>, Gary W. Small M.D.<sup>1,2,3</sup>



# THANK YOU FOR YOUR ATTENTION!

