

# Cardiopulmonary Fitness Is Associated with Cognitive Performance in Patients with Coronary Artery Disease

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# Clinical Bottom Line

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- Poorer cardiopulmonary fitness is associated with poorer cognition, especially executive function, in patients with CAD.

# Introduction

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- Past studies show cardiovascular disease has an association with cognitive decline.
- Physical activity leads to lower rates of dementia in the general population.
- Cardiopulmonary fitness in CAD patients is an important determinant of cardiac prognosis and mortality, but an association with cognition had not been studied.

# Objectives

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- To investigate the association between cardiopulmonary fitness and cognitive performance in subjects with coronary artery disease (CAD).

# Sources of Funding

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- The Drummond Foundation
- Physicians' Services Incorporated Foundation
- Heart and Stroke Foundation

# Study Design

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- Cross-sectional observational study. Patients were contacted after entry into a cardiac rehabilitation program. Their medical records were reviewed for inclusion/exclusion criteria.

# Participants

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- Eighty-one subjects with CAD after taking into account people who declined to be interviewed and those meeting exclusion criteria.

# Inclusion Criteria

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- Documented history of CAD- having had a MI within 6 weeks, angiographic evidence of  $\geq 50\%$  blockage in at least one major coronary artery, PCI within 3 weeks, or CABG within 6 weeks.



# Exclusion Criteria

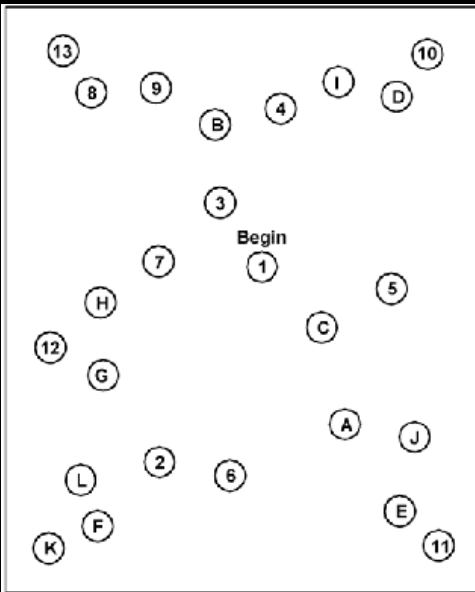
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- Previously diagnosed neurodegenerative disorder, schizophreniform disorder, or bipolar disorder.
- Inability to complete cognitive testing.
- Incomplete medical records.

# Testing

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- Cognitive Testing- used to measure executive function, memory, and global cognition
  - Trail-Making Test Part B
  - Stroop Test (Victoria Version)
  - Digit Symbol Coding task
  - Wechsler Adult Intelligence Scale
  - California Verbal Learning Test
  - Mini-Mental State Examination
  - Revised Brief Visuospatial Memory Test



red white green brown  
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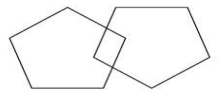


**The Mini-Mental State Exam**

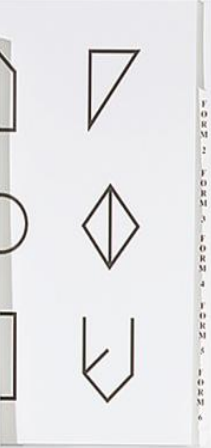
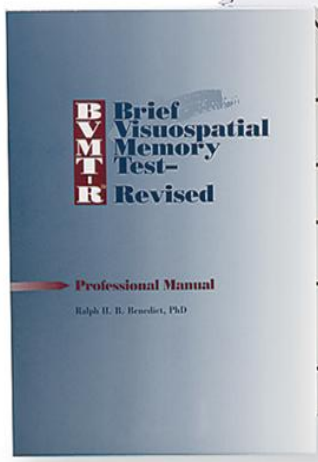
Patient \_\_\_\_\_ Examiner \_\_\_\_\_ Date \_\_\_\_\_

Maximum	Score
5	( )
5	( )
3	( )
5	( )
3	( )
2	( )
1	( )
3	( )
1	( )
1	( )
1	( )

- Orientation**  
What is the (year) (season) (date) (day) (month)?  
Where are we (state) (country) (town) (hospital) (floor)?
- Registration**  
Name 3 objects: 1 second to say each. Then ask the patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he/she learns all 3. Count trials and record.  
Trials \_\_\_\_\_
- Attention and Calculation**  
Serial 7's. 1 point for each correct answer. Stop after 5 answers. Alternatively spell "world" backward.
- Recall**  
Ask for the 3 objects repeated above. Give 1 point for each correct answer.
- Language**  
Name a pencil and watch.  
Repeat the following "No ifs, ands, or buts"  
Follow a 3-stage command:  
"Take a paper in your hand, fold it in half, and put it on the floor."  
Read and obey the following: CLOSE YOUR EYES  
Write a sentence.  
Copy the design shown.



Total Score \_\_\_\_\_  
 ASSESS level of consciousness along a continuum \_\_\_\_\_  
 Alert Drowsy Stupor Coma



# Testing

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- Cardiopulmonary Fitness- used a standardized exercise stress test to measure breath-by-breath gas samples.  $\text{VO}_{2\text{Peak}}$  (peak volume of oxygen uptake) was calculated.
  - A highly reliable measure of ventilatory capacity at peak effort



# Analysis

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- For each cognitive test, a Z-score was calculated based on age and sex-matched norms.
- The measured  $\text{VO}_{2\text{Peak}}$  was divided by the expected value.
- Pearson correlations and univariate analyses of variance were used to identify characteristics associated with test values.

# Analysis

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- A linear regression model was used to predict composite Z-scores and  $\text{VO}_{2\text{Peak}}$ . Possible confounders were entered to reach a final multiple linear regression model.
- All analyses were two-tailed and performed in SPSS 16.0.

# Results

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- 81 subjects participated.
- $VO_{2Peak}$  was positively associated with the MMSE score ( $r=0.241$ ,  $P=.03$ ).
- In univariate comparisons executive function composite Z-scores were positively associated with  $VO_{2Peak}$  ( $r=0.307$ ,  $P=.005$ ).
- Memory composite Z-scores were positively associated with  $VO_{2Peak}$  ( $r=0.281$ ,  $P=.01$ ).



# Results

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- Executive function was the only composite Z-score independently associated with fractional  $\text{VO}_{2\text{Peak}}$ .
- Executive function was also the only score that remained significant after being entered into the multiple linear regression model.

# Discussion

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- This study not only demonstrates association between cardiopulmonary fitness and executive function, but shows this relation is independent of other cardiovascular risk factors.
- Does cognitive decline cause a decrease in physical activity or does decreasing physical activity cause cognitive decline?

# Limitations

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- Small sample size
- Lack of structural MRI to determine possible neuroanatomical correlates
- Cross-sectional study, making it difficult to assess causal relationships.