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

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Clinical Bottom Line

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

- 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

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

- The Drummond Foundation
- Physicians’ Services Incorporated Foundation
- Heart and Stroke Foundation
Study Design

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

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

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

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

- 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
### The Mini-Mental State Exam

<table>
<thead>
<tr>
<th>Patient</th>
<th>Score</th>
<th>Examiner</th>
<th>Date</th>
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#### Orientation
What is the (year) (season) (date) (day) (month)?

#### 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.

#### Attention and Calculation
Serial 7s. 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
2 ( ) Name a pencil and watch.
1 ( ) Repeat the following "No ifs, ands, or buts!"
3 ( ) Follow a 3-stage command: "Take a paper in your hand, fold it in half, and put it on the floor."
1 ( ) Read and obey the following: CLOSE YOUR EYES
1 ( ) Write a sentence.
1 ( ) Copy the designs shown.

#### Total Score
ASSESS level of consciousness along a continuum:

- Alert
- Drowsy
- Stupor
- Coma
Testing

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

- 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

- A linear regression model was used to predict composite Z-scores and VO_{2Peak}. Possible confounders were entered to reach a final multiple linear regression model.

- All analyses were two-tailed and performed in SPSS 16.0.
Results

- 81 subjects participated.
- \( \text{VO}_2\text{Peak} \) was positively associated with the MMSE score \((r=0.241, \ P=0.03)\).
- In univariate comparisons executive function composite Z-scores were positively associated with \( \text{VO}_2\text{Peak} \) \((r=0.307, \ P=0.005)\).
- Memory composite Z-scores were positively associated with \( \text{VO}_2\text{Peak} \) \((r=0.281, \ P=0.01)\).
Results

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

- 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

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