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Short Communication

Physical activity and cognitive function among older adults with congestive heart failure patients

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ABSTRACT

Objective: Research among the general population demonstrates that regular participation in physical activity is associated with enhanced cognitive function. Although less investigated among congestive heart failure patients, this is important to consider among congestive heart failure patients because this population exhibits less physical activity behavior, worse executive function, psychomotor speed and memory-related cognitive function. The purpose of this brief report was to examine the association between physical activity and cognitive function among congestive heart failure patients. **Methods:** Data from the 1999-2002 population-based National Health and Nutrition Examination Survey was used. Moderate-to-vigorous physical activity (MVPA) and congestive heart failure status were subjectively assessed, with cognitive function assessed via the Digit Symbol Substitution Test (DSST). **Results:** 133 participants (Age_{range} = 60-85; Age_{mean} = 72.8; 51.3% male; 83.7% white) had congestive heart failure and complete data on the study variables. In a weighted multivariable linear regression accounting for the complex survey design employed in NHANES, congestive heart failure patients who engaged in any level of MVPA in the past month had a significantly higher DSST score ($\beta_{adjusted}$ = 5.40; 95% CI: 0.58-10.22; P=0.03). **Conclusion:** Physical activity was positively associated with cognitive function among congestive heart failure patients, which provides suggestive evidence that physical activity may help to preserve cognitive function among older adults with evidence of congestive heart failure.

KEY WORDS: Cognitive function; Elderly; Epidemiology; Exercise; Executive function

INTRODUCTION

Research among the general population demonstrates that regular participation in physical activity is associated with enhanced cognitive function [1, 2]. This is important to consider among congestive heart failure patients because this population exhibits worse executive function, psychomotor speed and memory-related cognitive function [3, 4]. A potential mechanism to explain this cognitive function decline observed among congestive heart failure patients is heart failure-induced cerebral hypoperfusion [5, 6]; heart failure patients exhibit up to a 31% reduction in cerebral blood flow [7], which may compromise cognitive function [5, 6]. Although physical activity is associated with improved cognitive function among the broader adult population as well as older adults (mechanisms discussed elsewhere [1]), the ability for physical activity to preserve cognitive function among congestive heart failure patients has been considerably less investigated [8-13]. To improve our understanding of the relationship between physical activity and cognitive function among older adults with congestive heart failure, the purpose of this *brief report* was to explore this relationship in a population-based sample.

METHODS

Study Design and Participants

Data from the population-based National Health and Nutrition Examination Survey were utilized; cycles 1999-2002 were used as these cycles included a cognitive assessment. Participants who answered "yes" to the following question were considered to have congestive heart failure: "*Has a doctor or other health professional ever told you that you had congestive heart failure*?" In these 1999-2002 NHANES cycles, 133 participants (Age_{range} = 60-85; Age_{mean} = 72.8; 51.3% male; 83.7% white) had congestive heart failure and complete data on the study variables.

Measures

As described elsewhere [14], physical activity was assessed via self-report and reported as MET (metabolic equivalent of task)-Min-Month of moderate-to-vigorous physical activity (MVPA). These congestive heart failure patients were defined as engaging in MVPA or not within the past month. Such a dichotomy of MVPA was necessary, as 89 of the 133 congestive heart failure patients reported engaging

in no MVPA in the past month; in this sample of congestive heart failure patients, the MVPA MET-Min-Month ranged from 0-20160, with a mean of 1039.1 MVPA MET-Min-Month.

The Digit Symbol Substitution Test (DSST) was used to assess cognitive function. The DSST, a component of the Wechsler Adult Intelligence Test [15] and a test of visuospatial and motor speed-of-processing, has a considerable executive function component and is frequently used as a sensitive measure of frontal lobe executive functions [16, 17]. The DSST was used to assess participant cognitive function tasks of pairing (each digit 1-9 has a symbol it is associated with) and free recall (allowing participants to draw more figures in the limited time due to remembering pairs). Participants were asked to draw as many symbols as possible that were paired with numbers within 2 min. Following the standard scoring method, one point is given for each correctly drawn and matched symbol, and one point is subtracted for each incorrectly drawn and matched symbol, with a maximum score of 133. In this sample of congestive heart failure patients, the DSST scores ranged from 1-72, with a mean of 36.97 (SE = 1.3).

Analysis and Results

In a weighted multivariable linear regression accounting for the complex survey design employed in NHANES, congestive heart failure patients who engaged in any level of MVPA in the past month had a significantly higher DSST score (β = 5.40; 95% CI: 0.58-10.22; P=0.03). That is, after adjustment, those who engaged in MVPA (vs. those who did not) had a DSST score 5.4 units higher. This model was adjusted for age (yrs; continuous), gender, race-ethnicity, income-to-poverty ratio [18], measured body mass index (kg/m^2; continuous), C-reactive protein (mg/dL; continuous) [19-21], self-reported smoking status (current, former, never) and comorbid illness (ordinal variable indicating the number of physician-diagnosis conditions, including arthritis, coronary artery disease, heart attack, COPD, hypertension and diabetes). When adding in duration of congestive heart failure as a covariate, MVPA remained significantly associated with cognitive function (β = 6.52; 95% CI: 2.01-11.03; P=0.007). Similarly, when adding in glomerular filtration rate [22] as a covariate, MVPA remained significantly associated with cognitive function (β = 5.43; 95% CI: 0.58-10.28; P=0.03). Creating a cross-product term along with their main effects and the covariates in a linear regression, there was no evidence of multiplicative interaction by age ($\beta_{interaction}$ = 0.70; P=0.08), gender ($\beta_{interaction}$ = -6.8; P=0.21), race-ethnicity ($\beta_{interaction}$ = 0.70; P=0.77), poverty ($\beta_{interaction}$ = -0.64; P=0.73) or body mass index ($\beta_{interaction}$ = -0.03; P=0.93).

DISCUSSION

The findings of this study, which complement the emerging work on this topic among congestive heart failure patients [8-13], provides suggestive evidence that physical activity may help to preserve cognitive function among older adults with evidence of congestive heart failure. Limitations of this study includes the subjective assessment of physical activity and cross-sectional design, with strengths including the relatively novel topic and utilization of a population-based sample of congestive heart failure patients. Future work employing prospective and experimental designs, and objective measures of physical activity and cardiac function, are warranted.

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