



Brief Walking Test and Cognitive Function among Congestive Heart Failure Patients: Effect Modification by Duration of Congestive Heart Failure

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Various walking tests, such as the six-minute walk test (6MWT), are effective tools for assessing functional capacity in patients with cardiovascular disease.¹ Due to its convenience of implementation and acceptance, these walking tests are also widely used to assess the response to rehabilitation interventions.¹ Notably, such walking tests are a simple and useful prognostic marker of subsequent cardiac death among those with heart failure.² Acute walking tests have also been shown to associate with cognitive function in a convenience sample of patients with chronic heart failure,³ which is an important determination as cognitive dysfunction has been shown to occur among those with heart failure.^{4,8} Thus, not only may the results of a 6MWT provide valuable information about cardiopulmonary functioning among heart failure patients, it may also help to provide useful information with regard to cognitive function, which ultimately may influence engagement in physical activity behavior.⁹

Using a population-based sample, the purpose of this study was to improve our understanding of the potential relationship between the results of a short walking test and cognitive function among older adults with congestive heart failure. Particular focus is on the utilization of a 20 foot walking

test, as opposed to a 6MWT, which arguably may have greater feasibility of testing and implementation into cardiac rehabilitation due to its short testing protocol (e.g., may require less than 30 seconds of testing, as opposed to 6 minutes). Another primary focus of this study was to determine if the relationship between the walking test and cognitive function was moderated by duration of congestive heart failure. Data from the population-based 1999-2002 National Health and Nutrition Examination Survey were utilized; cycles 1999-2002 were used as these cycles included the walking test and 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, 118 participants (Age range = 60-85; Mean age = 72.5; 49.3% male; 84.5% white) had congestive heart failure and complete data on the study variables.

The Digit Symbol Substitution Test (DSST) was used to assess cognitive function. The DSST, a component of the Wechsler Adult Intelligence Test¹⁰ 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.^{11,12} Participants were asked to copy symbols that were paired with numbers within 2 min. Following the standard scoring method, one point is given for each correctly drawn symbol. In this sample of congestive heart failure patients, the DSST score ranged from 1-72, with a mean of 38.0 (SE = 1.3).

While in a corridor at the mobile examination center, participants were instructed to “walk at their usual” pace over a 20 foot distance. Timing was performed using a hand-held stopwatch. The time started when the participant’s first foot touched the floor across the start line. The stop time was when the participant’s foot touched the floor across the 20 foot line. In this sample, the range for this walking test was 4.85-26.97 seconds, with a mean of 8.0 seconds (SE=0.3). In a weighted multivariable linear regression adjusting for the complex survey design employed in NHANES, for every 1 additional second to complete the 20 foot walk test, participants had a .83 decreased score on the DSST ($\beta = -0.83$; 95% CI: -1.63 to -0.02; $P=0.04$). This model was adjusted for age (yrs; continuous), gender, race-ethnicity, income-to-poverty ratio,¹³ measured body mass index (kg/m²; continuous), C-reactive protein (mg/dL; continuous),¹⁴⁻¹⁶ self-reported smoking status (current, former, never), self-reported engagement in free-living moderate-to-vigorous physical activity¹⁷ and comorbid illness (ordinal variable indicating the number of physician-diagnosis conditions, including arthritis, coronary artery disease, heart attack, COPD, hypertension and diabetes). From a cross-product term of duration to complete the walking test and duration of congestive heart failure, along with their main effects and the covariates in a regression model, there was evidence of an interaction between the walking test and duration of congestive heart failure on cognitive function ($\beta = 0.05$; $P=0.05$). These results are exemplified in Figure 1 which clearly show that cognitive function is a function of both duration of congestive heart failure and walking test performance.

Overall, these findings provide suggestive evidence of a relationship between walking test performance during a 20 foot protocol and cognitive function among older adults with congestive heart failure. There was also evidence that cognitive function among these congestive heart failure patients was a function of both their acute walking performance and duration of heart failure. Future prospective and experimental work is needed to better inform the temporal relationship between walking performance and cognition among congestive heart failure patients. These findings underscore the importance of optimizing gait mechanics^{18,19} among congestive heart failure patients, particularly those with a longer duration of congestive heart failure. This, along with adequate lower extremity strength,²⁰ may help to promote regular participation in physical activity in this population, which may have fall risk implications^{21,22} as well as implications in preserving cognitive function.⁹

Declarations of Interest

The author has no conflicts of interest to disclose. I have not received any funding or grants for this project.

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The author states they he abides by the statement of ethical publishing of the International Cardiovascular Forum Journal.²³

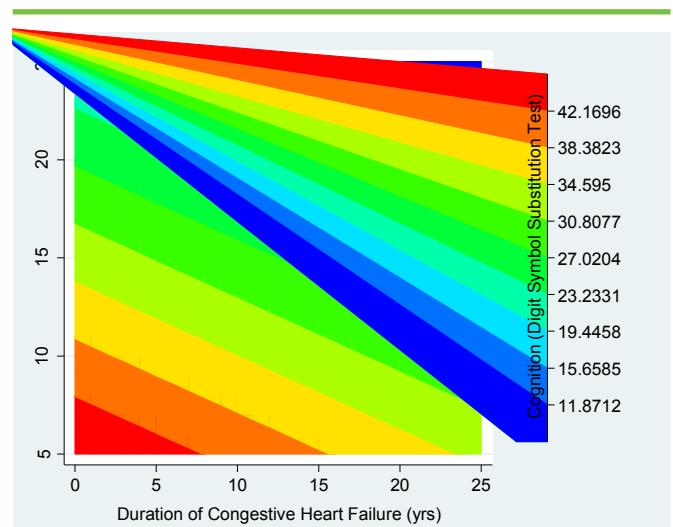


Figure 1. Margins plot demonstrating interaction effect of duration of congestive heart failure and 20 foot walking test performance on cognitive function.

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