

## Objective

- Ejection fraction (EF) is used as a clinical indicator of cardiac function and has been associated with reduced executive functioning among heart failure (HF) patients (2).
- However, other HF studies have found no association between EF and neurocognitive measures (7, 10).
- This meta-analysis examines the relationship between EF and executive functioning using the Trail Making Test-B (TMT-B).

## Data Selection

- Two researchers independently searched nine databases, extracted required data, and calculated effect sizes.
- Inclusion criteria for articles: (a) adults diagnosed with HF, (b) matched control group on demographics (e.g. age), (c) standardized neuropsychological testing, and (d) data that allows for the calculation of effect size.
- Exclusion criteria included: (a) comorbidity of HF with other types of major organ failure (i.e., lung or liver failure), (b) data that compared between different New York Heart Association (NYHA) classes of HF, or (c) not published or translated into English.
- Once the required data were extracted, effect sizes were calculated. A total of eight articles (HF n = 592 and HC n = 268) were analyzed in this study.

## Data Synthesis

- The TMT-B evidenced a statistically significant and medium effect size estimate ( $g = 0.568$ ,  $p < 0.001$ ).
- The heterogeneity of TMT-B was not statistically significant.
- The meta-regression analysis between EF and effect size was not statistically significant ( $Q = .434$ ,  $df = 1$ ,  $p = .510$ ).

Table 1. Study Characteristics of Articles

| Primary Study     | Year | Location    | Sample Size (n) |     | Mean Age (SD) |            |            |
|-------------------|------|-------------|-----------------|-----|---------------|------------|------------|
|                   |      |             | Total           | HF  | Control       | HF         | Control    |
| Almeida & Tamai   | 2001 | Brazil      | 80              | 50  | 30            | 67.3(6.1)  | 76.7(7.7)  |
| Hoth et al.       | 2008 | USA         | 62              | 31  | 31            | 69.1(8.5)  | 68.9(8.5)  |
| Jung et al.       | 2017 | USA         | 40              | 20  | 20            | 59.5(12.8) | 58.8(11.6) |
| Nikendai et al.   | 2016 | Germany     | 47              | 24  | 23            | 70.4(11.6) | 69.8(11.8) |
| Pressler et al.   | 2010 | USA         | 312             | 249 | 63            | 62.9(14.6) | 53.3(17.2) |
| Putzke et al.     | 2000 | USA         | 113             | 75  | 38            | 50.4(11.1) | 47.0(9.1)  |
| Staniforth et al. | 2001 | UK          | 102             | 81  | 21            | 63.8(1.0)  | 66.0(1.4)  |
| Vogels et al.     | 2007 | Netherlands | 104             | 62  | 42            | 69.2(9.2)  | 67.2(9.2)  |

Figure 1. Effect Size and Forest Plot

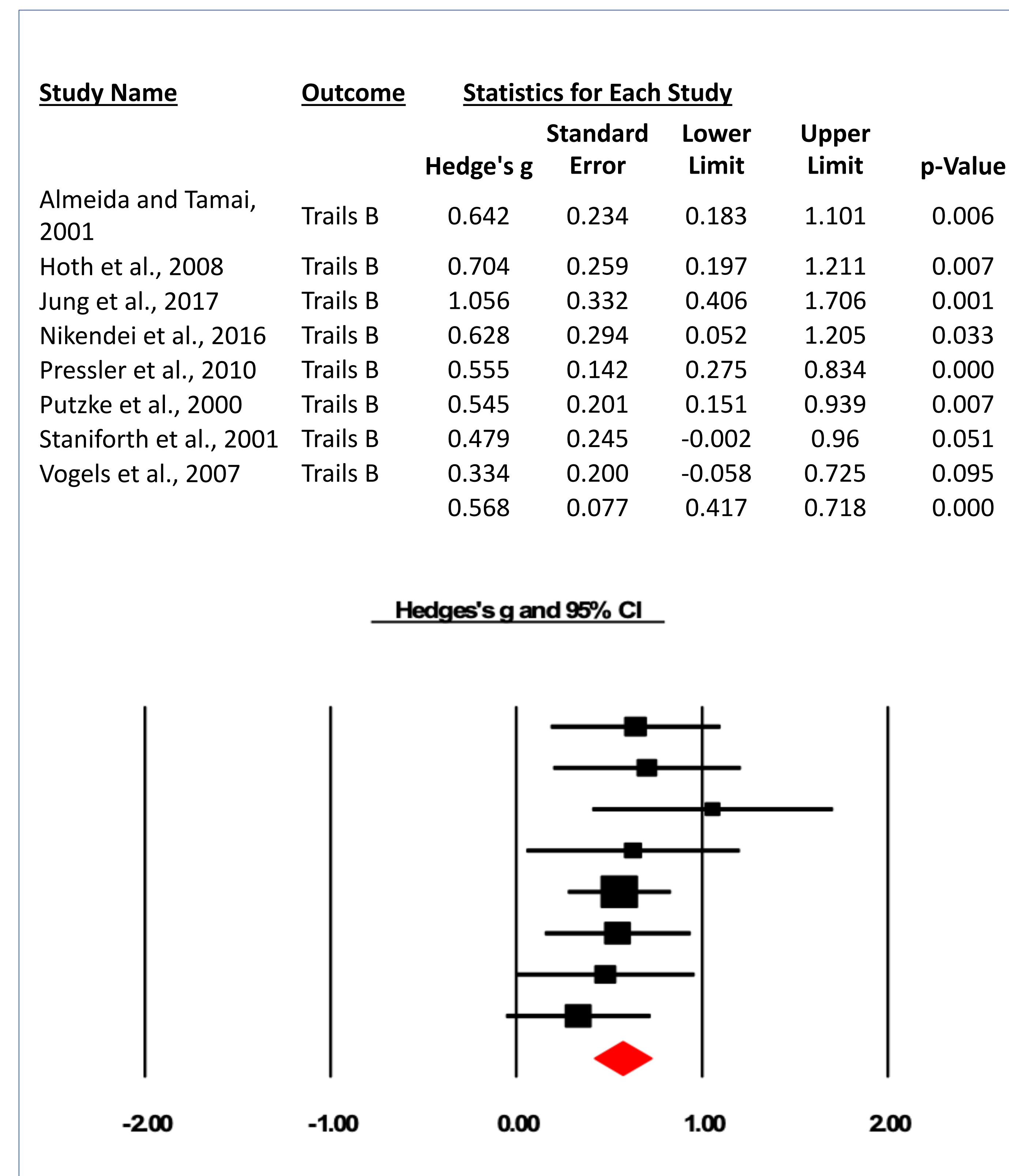
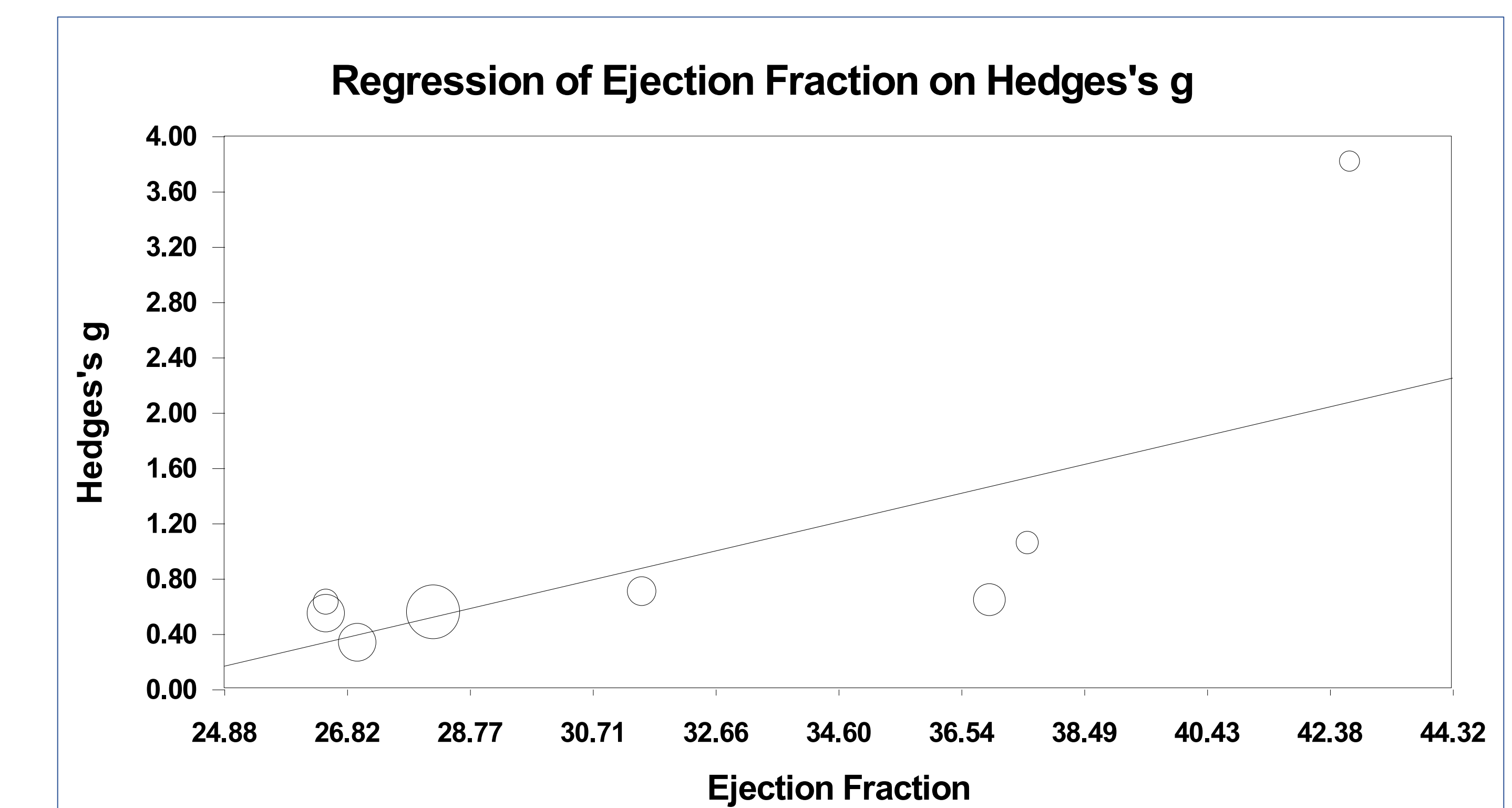


Table 2. Meta-Regression Results of EF and Effect Size

|           | Point Estimate | Standard Error | Lower Limit | Upper Limit | Z-value | p-Value |
|-----------|----------------|----------------|-------------|-------------|---------|---------|
| Slope     | 0.009          | 0.143          | -0.019      | 0.037       | 0.658   | 0.510   |
| Intercept | 0.276          | 0.449          | -0.604      | 1.156       | 0.613   | 0.539   |
|           | Q              | df             | p-Value     |             |         |         |
| Model     | 0.434          | 1.000          | 0.510       |             |         |         |
| Residual  | 3.680          | 6.000          | 0.720       |             |         |         |
| Total     | 4.115          | 7.000          | 0.776       |             |         |         |

Figure 2. Meta-Regression of EF and Effect Size



## Discussion

- TMT-B detects executive functioning deficits associated with heart failure.
- A meta-regression did not reveal a significant relationship between EF and TMT-B.
- It is likely that other factors moderated this relationship making it difficult to detect a relationship between these two variables in a diverse sample of studies.

## References

- Almeida, O. P., & Tamai, S. (2001). Congestive heart failure and cognitive functioning amongst older adults. *Arquivos de Neuro-psiquiatria*, 59(2-8), 324-329. <https://doi.org/10.1590/s0004-282x2001000300003>
- Hoth, K. F., Pappas, A., Moser, D. J., Paul, R. H., & Cohen, R. A. (2008). Cardiac dysfunction and cognition in older adults with heart failure. *Cognitive and Behavioral Neurology*, 21(2), 65-72. <https://doi.org/10.1097/WNN.0b013e3181799dc8>
- Jung, M., Jonides, J., Northouse, L., Berman, M. G., Koelling, T. M., & Pressler, S. J. (2017). Randomized crossover study of the natural restorative environment intervention to improve attention and mood in heart failure. *Journal of Cardiovascular Nursing*, 32(5), 464-479. <https://doi.org/10.1097/jcn.0000000000000368>
- Nikendai, C., Schafer, H., Weisbrod, M., Huber, J., Gels, N., Katus, H. A., & Schultz, J.-H. (2016). The effects of mitral valve repair on memory performance, executive function, and psychological measures in patients with heart failure. *Psychosomatic Medicine*, 78(4), 432-442. <https://doi.org/10.1097/PSY.0000000000000284>
- Pressler, S. J., Subramanian, U., Kareken, D., Perkins, S. M., Gradus- Pizlo, I., Sauve, M. J., & Shaw, R. M. (2010). Cognitive deficits in chronic heart failure. *Nursing Research*, 59(2), 127-139. <https://doi.org/10.1097/NNR.0b013e3181d1a747>
- Putzke, J. D., Williams, M. A., Daniel, F. J., Bourge, R. C., & Boli, T. J. (2000). Activities of daily living among heart transplant candidates: Neuropsychological and cardiac function predictors. *Journal of Heart and Lung Transplantation*, 19(10), 995-1006.
- Putzke, J. D., Williams, M. A., Rayburn, B. K., Kirklm, J. K., & Boli, T. J. (1998). The relationship between cardiac function and neuropsychological status among heart transplant candidates. *Journal of Cardiac Failure*, 4(4), 295-303. [https://doi.org/10.1016/s1071-9164\(98\)90235-4](https://doi.org/10.1016/s1071-9164(98)90235-4)
- Staniforth, A. D., Kinneer, W. J., & Cowley, A. J. (2001). Cognitive impairment in heart failure with Cheyne-stokes respiration. *Heart*, 85(1), 18-22.
- Vogels, R. L., Oosterman, J. M., van Harten, B., Schellens, P., van der Flier, W. M., Schroeder-Tanka, J. M., & Weinstein, H. C. (2007). Profile of cognitive impairment in chronic heart failure. *Journal of American Geriatrics Society*, 55(11), 1764-1770. <https://doi.org/10.1111/j.1532-5415.2007.01395.x>
- Wolfe, R., Worrall-Carter, L., Foister, K., Keks, N., & Howe, V. (2006). Assessment of cognitive function in heart failure patients. *European Journal of Cardiovascular Nursing*, 5(2), 158-164. <https://doi.org/10.1016/j.ejcnurse.2005.10.005>