

The Relationship Between Health and Cognitive Ability

Eric March, Applied Data Analysis, Wesleyan University

Introduction

- ❖ There seems to be a link between exercise habits and either a preservation of or an improvement in cognitive abilities (Fernandes et al., 2018)
- ❖ Exercise has been shown to be integral in cognitive preservation among the elderly (Lautenschlager et al., 2019)
- ❖ Aerobic exercise, in particular, seems to be most helpful (Tomprowski et al., 2003)(Erickson et al., 2011)
- ❖ Physical exercise in children and adolescents has been linked to improved scholastic performance, cognitive ability, and perhaps even brain development (Tomprowski et al., 2008)(Herting et al., 2017)
- ❖ It's not known if exercise enhances cognitive abilities at all ages, or at least in the same ways, if aerobic or other types of exercise have similar effects, or if general health is the true variable at play here
- ❖ Testing what the statistical relations between cognitive ability and general health or exercise type and frequency are could help to fill the gaps in this research

Research Questions

- ❖ Does general physical health have a significant association with cognitive ability, as measured by a word repetition test?
- ❖ Are there other factors which might have a significant association with cognitive performance, such as mental health or the level of an individual's education?

Methods

Sample

- ❖ The ADDHEALTH represents a population sample of 4196 adolescents (wave 1, surveyed in 1994) who were also interviewed in their late 30s or 40s (wave 5, surveyed in 2018). 623 of those surveyed in wave 5 answered all of the relevant questions for proper analysis of this subject. Research will be focused on observations of these individuals

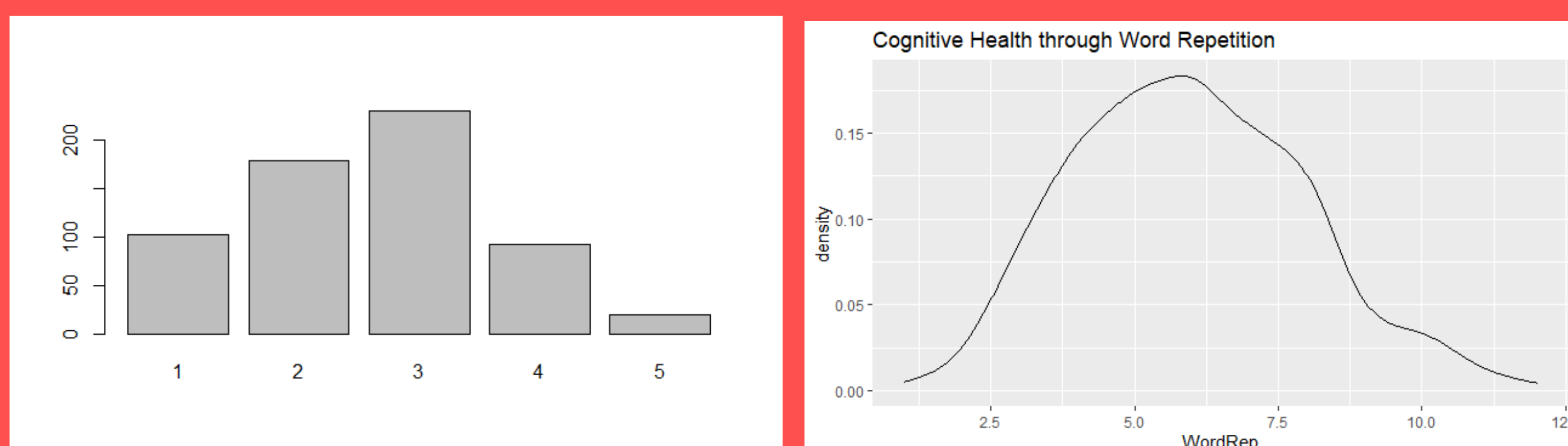
Measures

- ❖ Cognitive ability is assessed utilizing a word repetition test in which respondents were asked to recall as many listed words (15 max) as possible over a 90 second period, as well as a further pass/fail test in which respondents were asked to repeat a list of numbers backwards. The word repetition test gives a score of 1-15 corresponding to the number of correctly repeated words. The number string test gives a 0 for incorrect and a 1 for correct recitation
- ❖ Physical Health is self-reported. A reply of 1 means that the respondent is in excellent health, 2 means very good health, 3 means good health, 4 means fair health and respondents replying with 5 are in poor overall health
- ❖ Possible confounding variables such as a common mental health issue (Depression diagnosis with 1 being yes and 0 being no) and education level were also recorded. For simplicity education level has been collapsed into those who have (1) and have not (0) completed a bachelor's degree or higher

Results

Univariate

- ❖ The mean cognitive score for the word repetition test was 6.2
- ❖ The mean overall health score was 2.6 with almost 50% of the respondents saying that they felt excellent (1) or very good (2)



Figures 1 and 2: Figure 1 (left) shows the distribution of respondents' Health status with 1 being excellent and 5 being poor. Figure 2 (right) shows the number of words respondents were able to repeat over 90sec

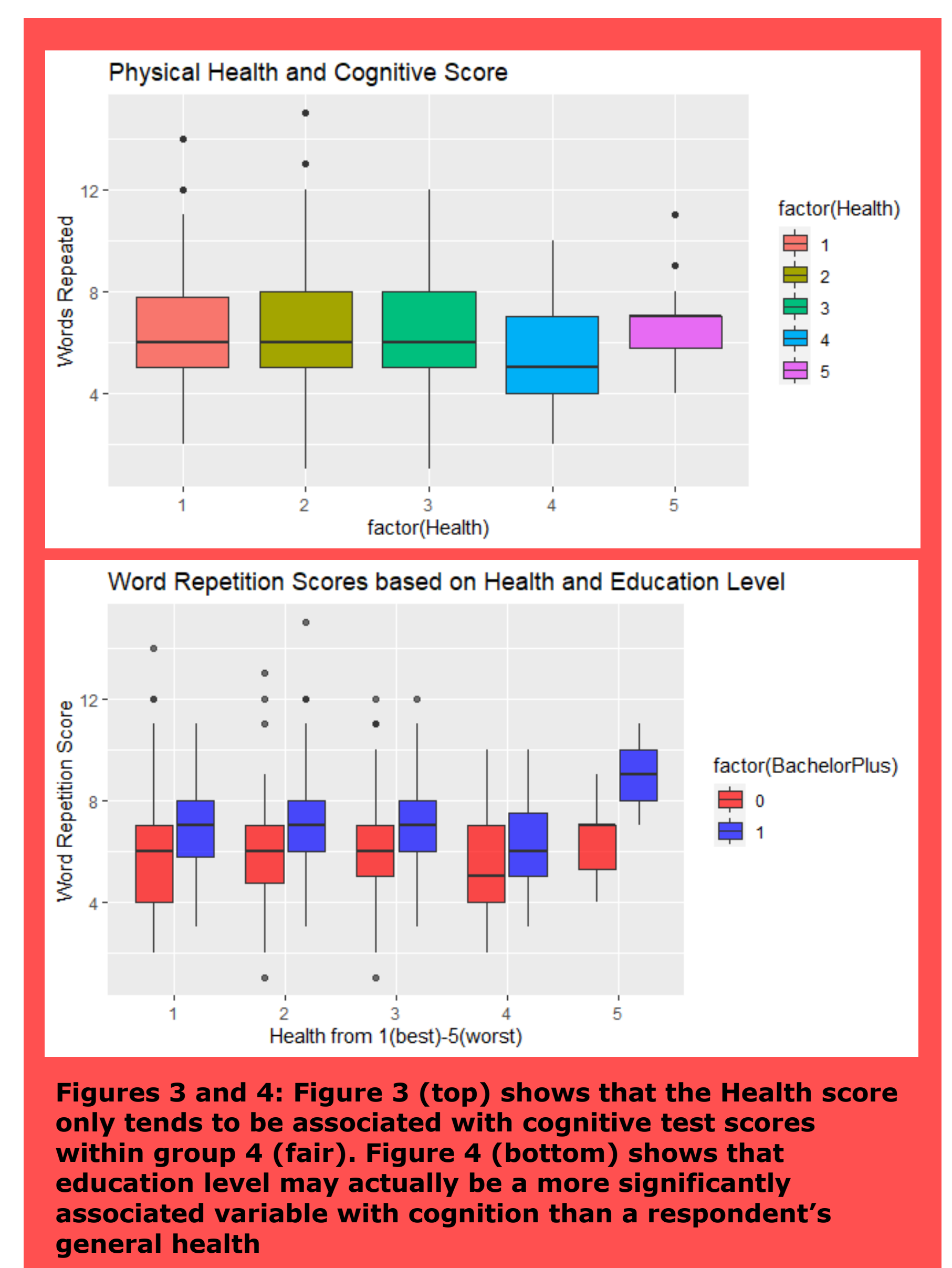
Bivariate

- ❖ Bivariate box plotting showed little association between Health and cognitive score, with those in Health Group 4 (fair) showing the only significant difference
- ❖ This was verified by an ANOVA analysis which revealed a negative correlation between those in fair health ($F=3.46$, $p=0.008$) which was statistically significant. Further analysis showed a p-value less than 0.05 between groups 4-2 and 4-3.

- ❖ Linear Regression also showed a similar and significant relationship with a regression plot showing an overall negative cognitive trend as health scores decline

Multivariate

- ❖ After controlling for education level and depression, those in health group 4 still had a statistically significant negative association with cognitive tests
- ❖ Both the plot and the multiple regression revealed that education is also associated with cognitive scores ($B=0.96$, $p=2.2e-7$).
- ❖ Multivariate testing with the number string test shows a clear positive association between cognitive tests, confirming those that score well on one test tend to score better on others



Figures 3 and 4: Figure 3 (top) shows that the Health score only tends to be associated with cognitive test scores within group 4 (fair). Figure 4 (bottom) shows that education level may actually be a more significantly associated variable with cognition than a respondent's general health

Discussion

- ❖ General health is associated with cognitive test scores in a middle-aged population.
- ❖ It's possible that low sample sizes in the groups at either extreme end of the health score may have impacted the p-value. A larger sample size overall would clarify findings
- ❖ Further testing is required in order to determine if such a unique association is consistent among more stringent categorical standards. If a health score were based on tangible standards, such as a score on standardized physical fitness tests or answers to a series of health screening questions, these results would be greatly refined
- ❖ The role of education on cognitive test scores leaves room for further research. Majors, cognitive scores before and after education, or GPAs all seem like practical next steps in determining if education throughout life might have a similarly beneficial effect on cognition as does exercise