

Supplementary Material

Title: Goal-directed behavior in individuals with mild Parkinson's disease: Role of self-efficacy and self-regulation

Medication status of subjects:

Twenty-four subjects were on carbidopa/levodopa, 11 on dopamine receptor agonists, 12 on amantadine, 20 on monoamine oxidase-B inhibitors, one on safinamide, one on trihexyphenidyl, and three subjects were not taking any medication. Twelve subjects were on monotherapy and the remainder were on a combination of up to three medications, except for one subject who was on four medications. The time between the last dose of dopaminergic medication and the MDS-UPDRS III motor exam was 15.1 ± 4.1 hours. The time between the last dose of dopaminergic medication and the resting-state fMRI scan was 3.5 ± 1.0 hours.

Statistical analyses:

The Supplementary Table 1 shows the statistical results. For normally distributed scores (Shapiro-Wilk test $p > 0.05$) we used the mean values and standard deviations (SD), and for non-normally distributed scores (Shapiro-Wilk test $p < 0.05$), we used the median values and median absolute deviations (MAD) to compare them with their respective population mean or cut-off scores, when applicable, using one-sample t-tests ($p < 0.05$, two-tailed).

There is no single cut-off or mean score for the BDI-II scores. Based on the scores, depression severity is ranked as minimal (0-13), mild (14-19), moderate (20-28), and severe (29-63) [16]. The BDI-II scores of our PD cohort were not normally distributed ($p = 0.000$). The group median score of 6 was within the minimal depression range. Thirty subjects had scores in the minimal, three in the mild, one in the moderate, and one in the severe range of depression.

For apathy, the cutoff score is 14, where < 14 is considered non-apathetic and ≥ 14 is considered apathetic [17]. Our PD cohort scored significantly below the apathy cut-off, however, nine subjects scored > 14 .

The STAI-T normative scores are reported separately for gender and age groups. We compared the median scores of males and females of our cohort with the normative mean scores of males and females between the ages 50-69 [15].

The mean PFS score is calculated by dividing the sum of raw scores by 16 (number of items). A cutoff score of 2.95 separates those who experience fatigue as a problem from those who do not [18]. Our PD cohort scored significantly below that cutoff indicating that they did not experience fatigue as a problem.

The PDSI is a measure of the global impact of the disease on the wellbeing of the patient as measured by the PD quality of life questionnaire-39 (PDQ-39) [19]. It is calculated by summing the total normalized dimension scores and dividing this sum by eight, which is the number of domains. PDSI scores, like PDQ-39 individual dimension scores, range from 0-100 where 0 denotes best quality of life and 100 denotes worst quality of life. The median PDSI score of our cohort compared with the normative mean of patients with PD in the same disease stage (i.e., H & Y 2, $n = 56$) [19] was significantly lower ($p = 0.000$) indicating a significantly better quality of life in our cohort.

The mean NGSES score is calculated by dividing the sum of raw scores by eight (number of items). In the validation study, the mean \pm SD of NGSES scores of young adults (N = 323, mean age: 23 years, age range: 18-47) was 3.87 ± 0.54 . A different cohort of managers in companies (N = 48, mean age: 38 years) scored 4.14 ± 0.48 in the same study [6]. The median NGSES score of our cohort was not significantly different from that of the young adults and older managers.

In the validation study, the population mean \pm SD of SRS scores of middle-aged adults was 31.15 ± 4.34 (N = 109, age range: 40-59 years, mean age \pm SD: 49.19 ± 5.95). Those of older adults was 31.27 ± 4.42 (N = 111, age range: 60-87 years, mean age \pm SD: 74.81 ± 6.17) [10]. We compared the mean score of our cohort to the means of middle-aged and older adults, and did not find significant differences.

Supplementary Table 1. Statistics

	Shapiro-Wilk <i>p values</i>	Mean \pm SD or Median \pm MAD	Population mean/cut-off	one-sample t-test <i>p values</i>
Apathy	0.005	7.0 ± 4.0	14.00	0.000
STAI-T	0.010	37.0 ± 9.5 (M), 30.5 ± 4.5 (F)	33.86 ± 8.86 (M), 31.79 ± 7.78 (F)	0.971 (M), 0.049 (F)
PFS-16	0.144	2.3 ± 0.2	2.95	0.000
PDSI	0.045	14.8 ± 6.5	31.60 ± 17.00	0.000
SRS	0.061	30.8 ± 4.6	31.15 ± 4.34 (middle aged), 31.27 ± 4.42 (older)	0.684 (middle aged), 0.576 (older)
NGSES	0.034	4.4 ± 0.4	3.87 ± 0.54 (young), 4.14 ± 0.48 (managers)	1.000 (young), 0.999 (managers)

NGSES: New General Self-Efficacy Scale, PDSI: Parkinson's Disease Summary Index based on the PDQ-39 questionnaire, PFS: Parkinson's Fatigue Scale, SRS: Self-Regulation Scale, STAI-T: Spielberger Trait Anxiety Inventory, F/M: Female/Male.

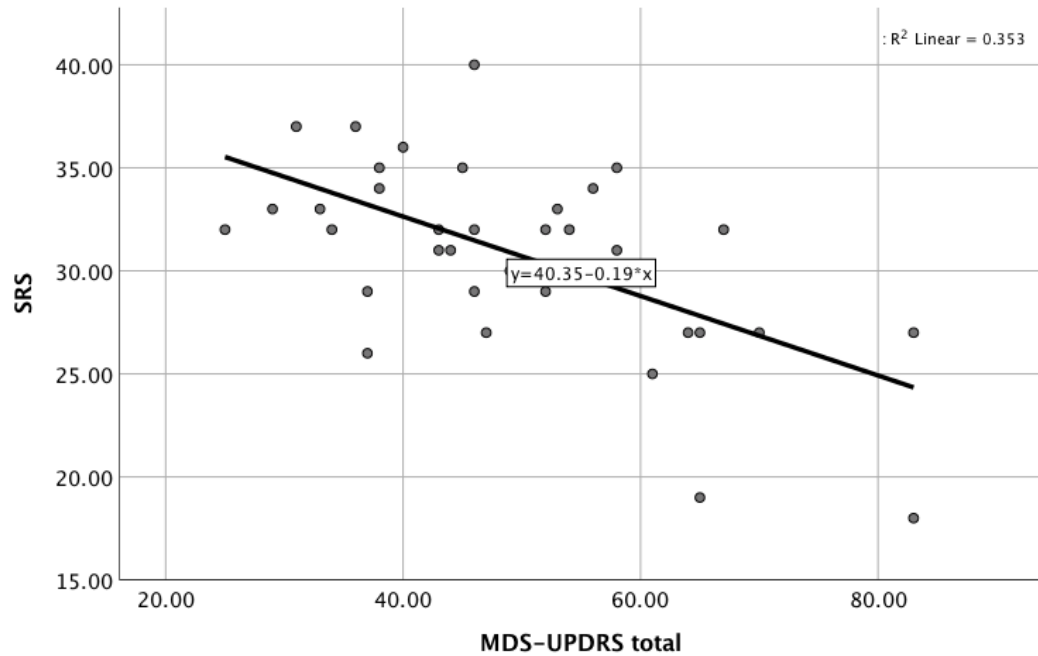
Stepwise regression analyses:

First, collinearity diagnostics was performed among the independent variables including age, disease duration, MoCA, STAI-T, BDI, PFS-16, apathy, MDS-UPDRS total, and PDQ39-SI. The variance inflation factor was < 10 for all variables. The condition index was > 15 in three variables (apathy, MDS-UPDRS total, PDQ39-SI) suggesting potential collinearity. However, the variance proportion for all pairs was < 0.9 indicating no significant collinearity. The only variance proportion value approaching the significance cut-off was 0.78 and observed between MoCA and PDQ39-SI.

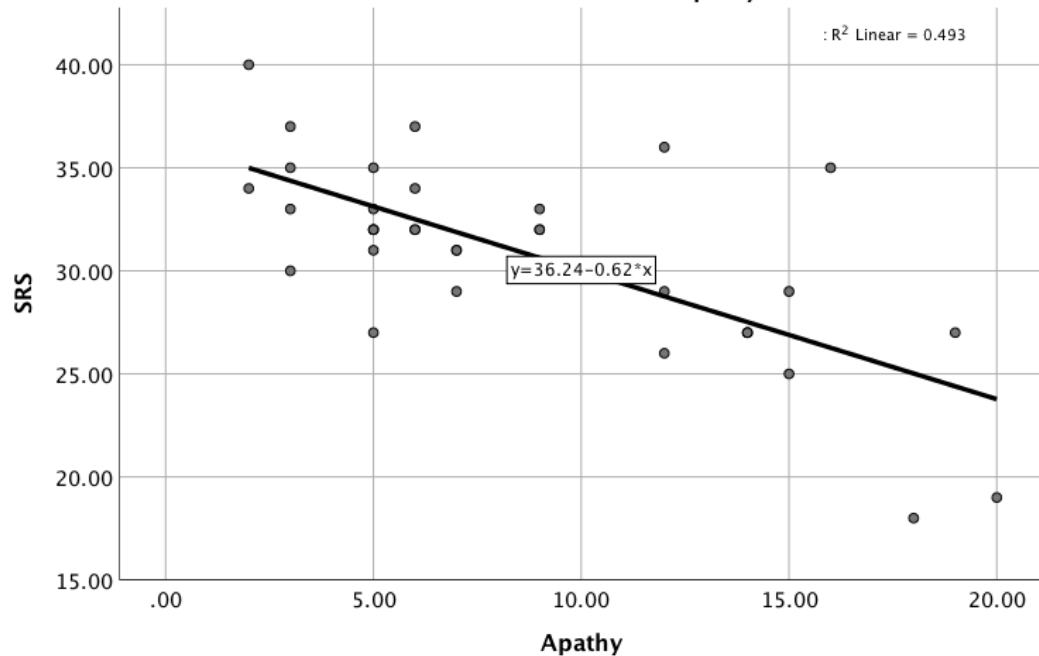
The scatter plots below show the simple correlations between the SRS and NGSES scores and;

- all other independent clinical variables (MDS-UPDRS total, apathy, disease duration, age, MoCA, STAIT, BDI, PFS-16, PDQ39-SI)
- functional connectivity between the dorsal anterior cingulate cortex (dACC) and right anterior insula (rAI) and between the dACC and left lateral parietal cortex (lLatPar).

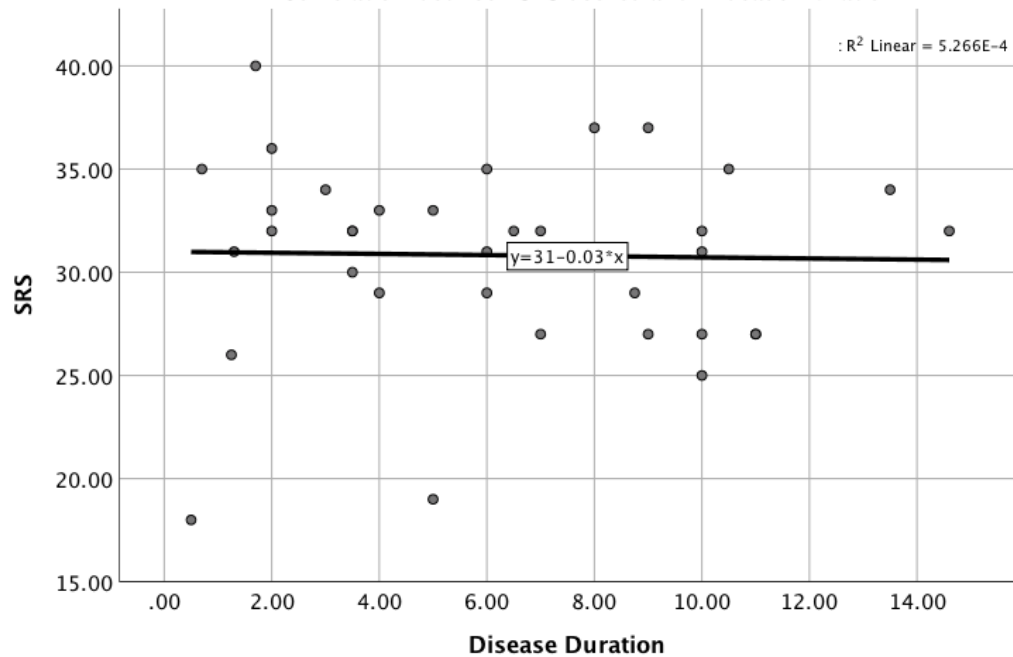
Correlation between SRS and MDS-UPDRS total scores



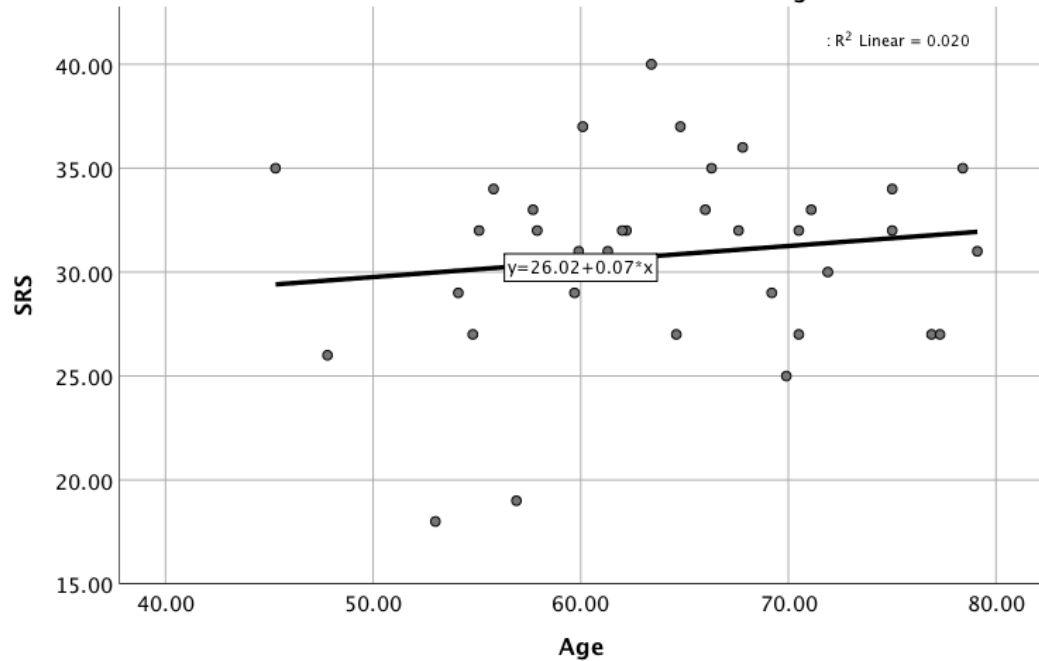
Correlation between SRS and Apathy scores



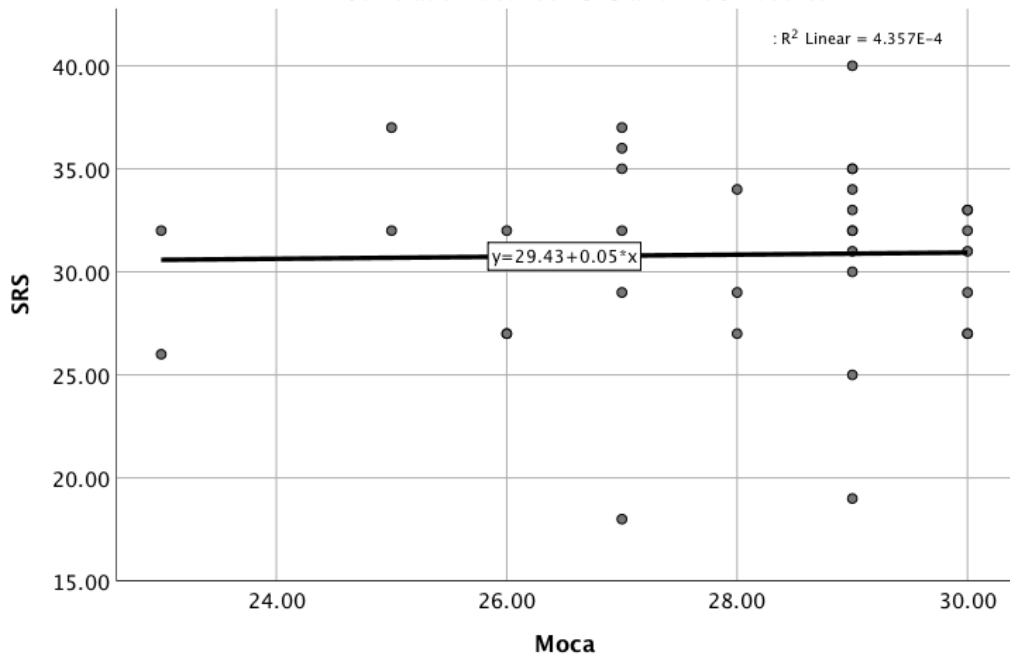
Correlation between SRS scores and Disease Duration



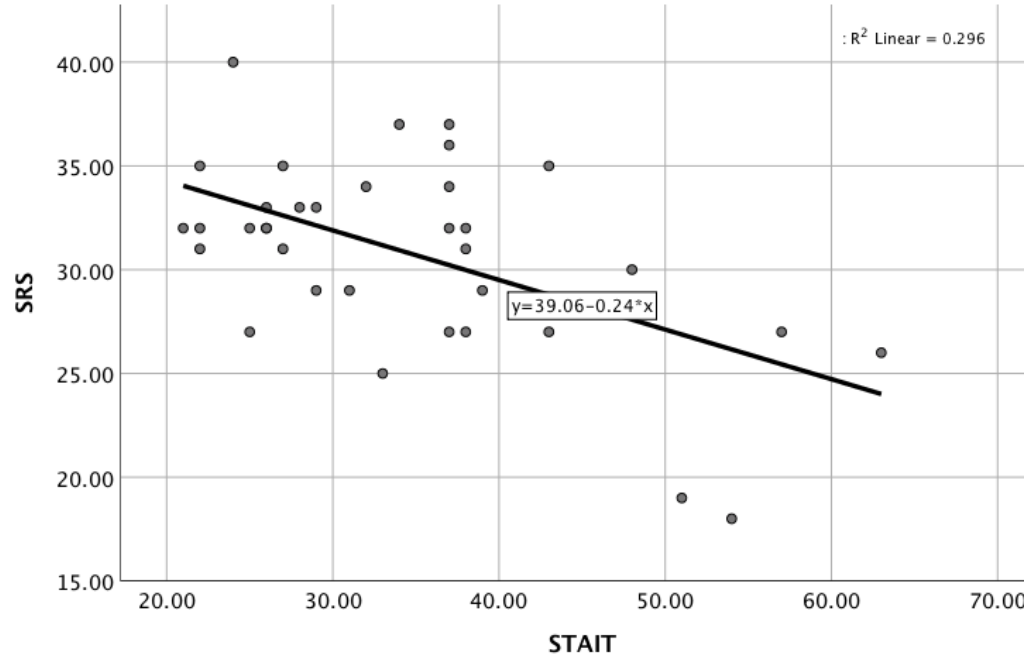
Correlation between SRS scores and Age



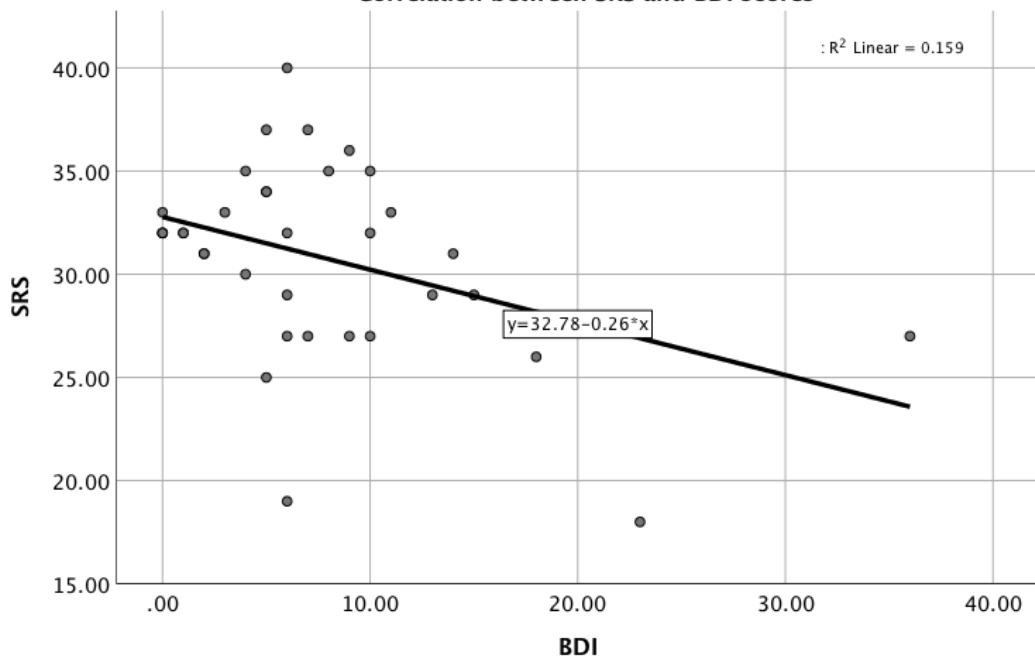
Correlation between SRS and MoCA scores



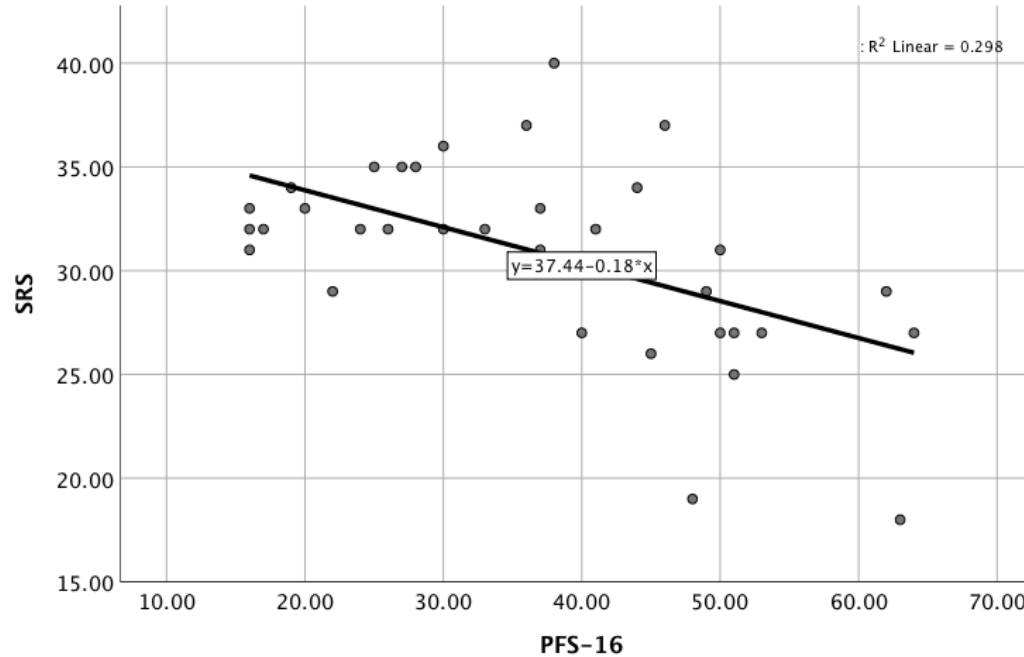
Correlation between SRS and STAIT scores



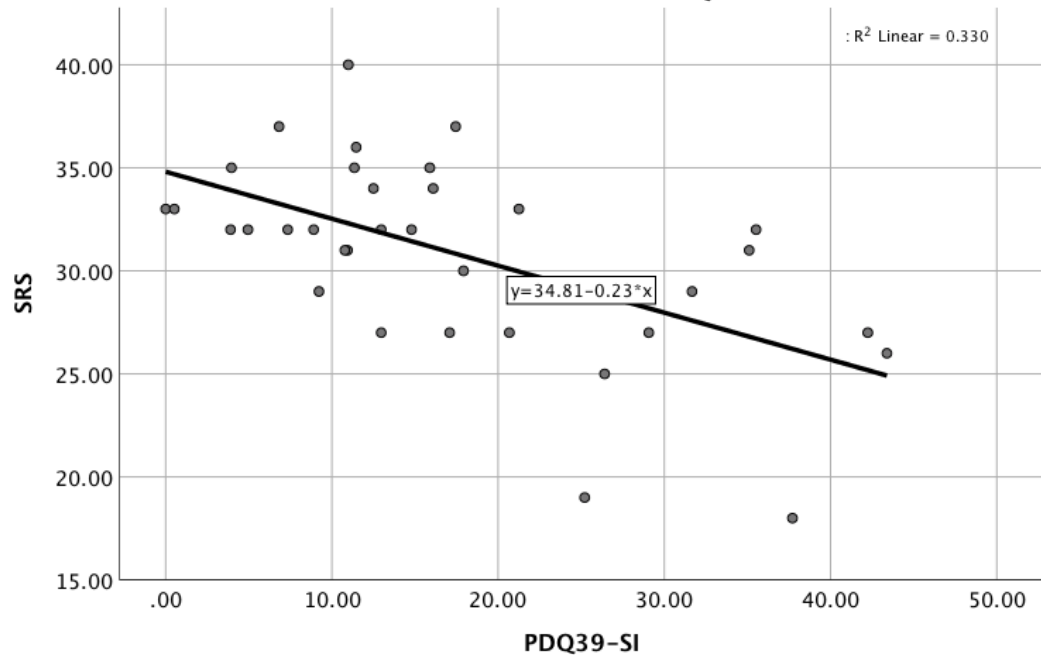
Correlation between SRS and BDI scores



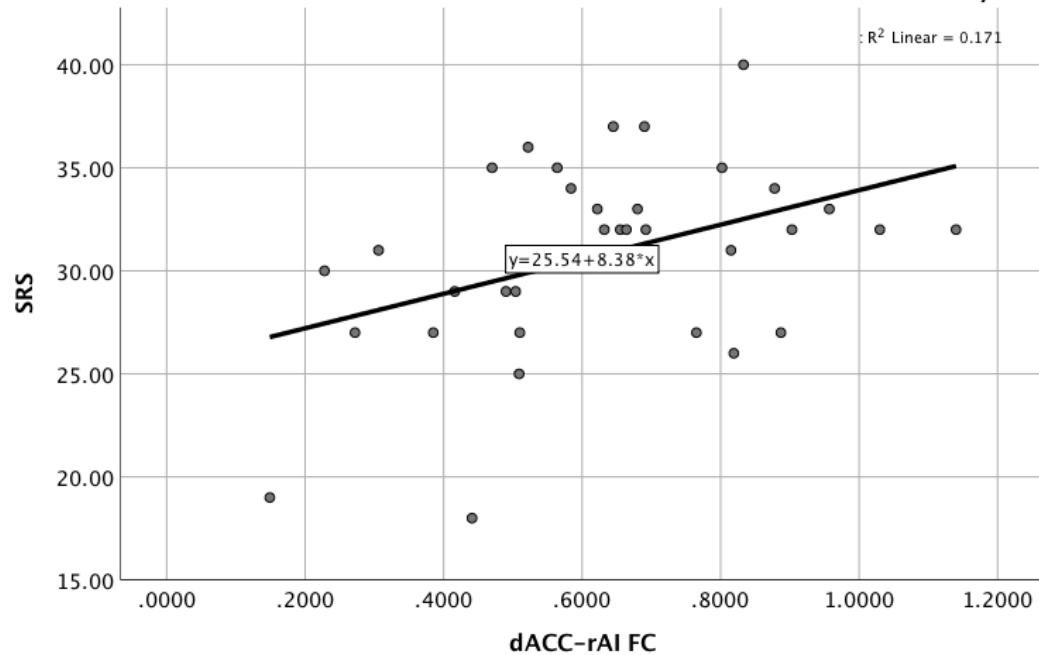
Correlation between SRS and PFS-16 scores



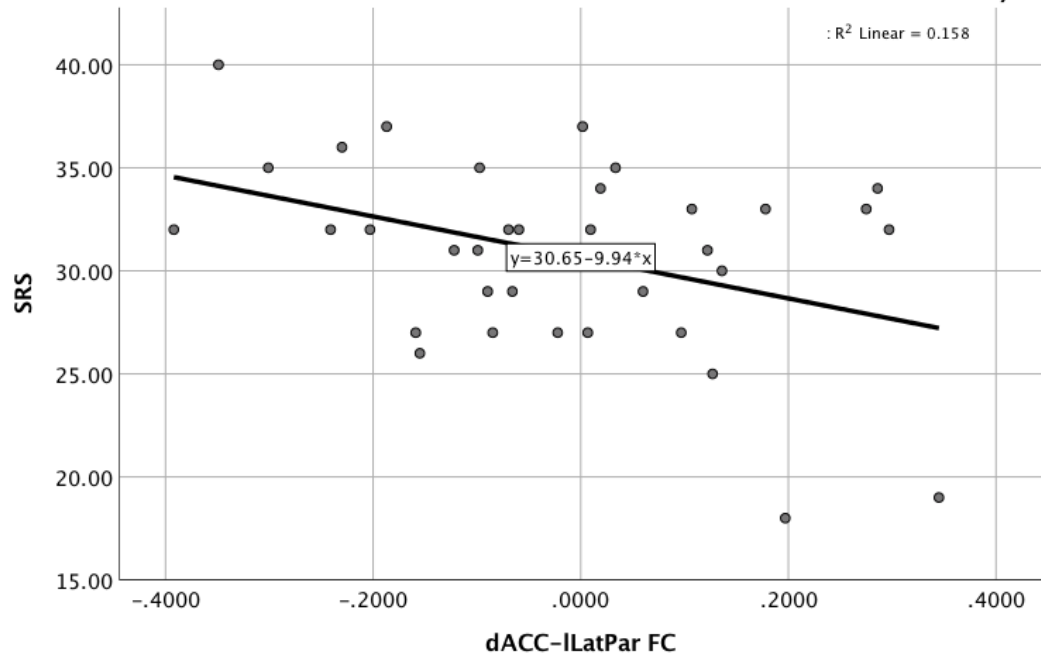
Correlation between SRS and PDQ39-SI scores



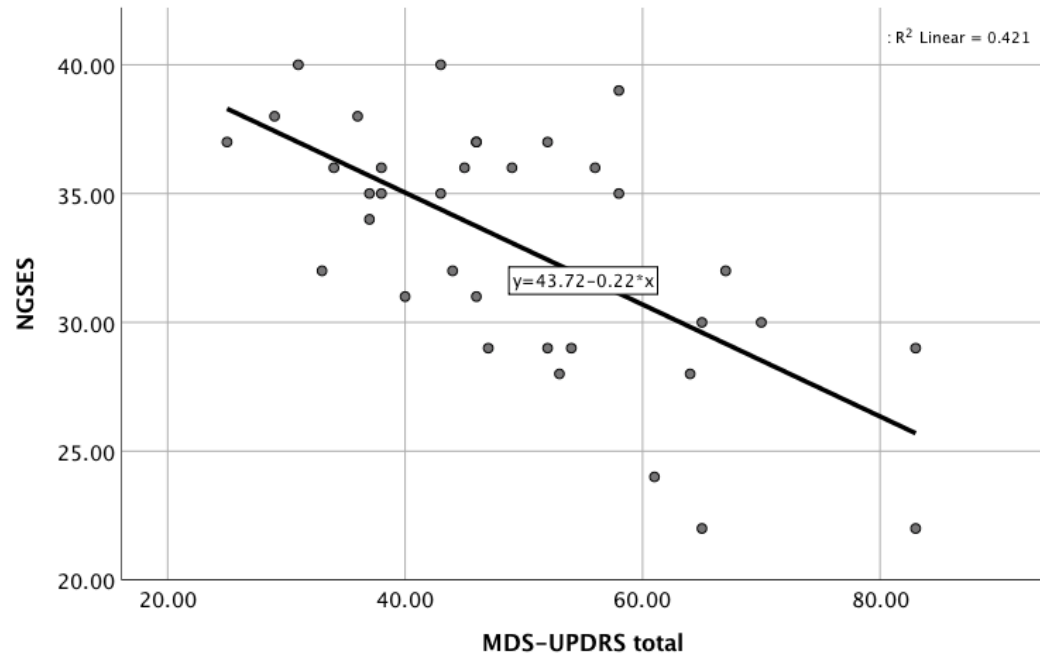
Correlation between SRS scores and dACC-rAI functional connectivity



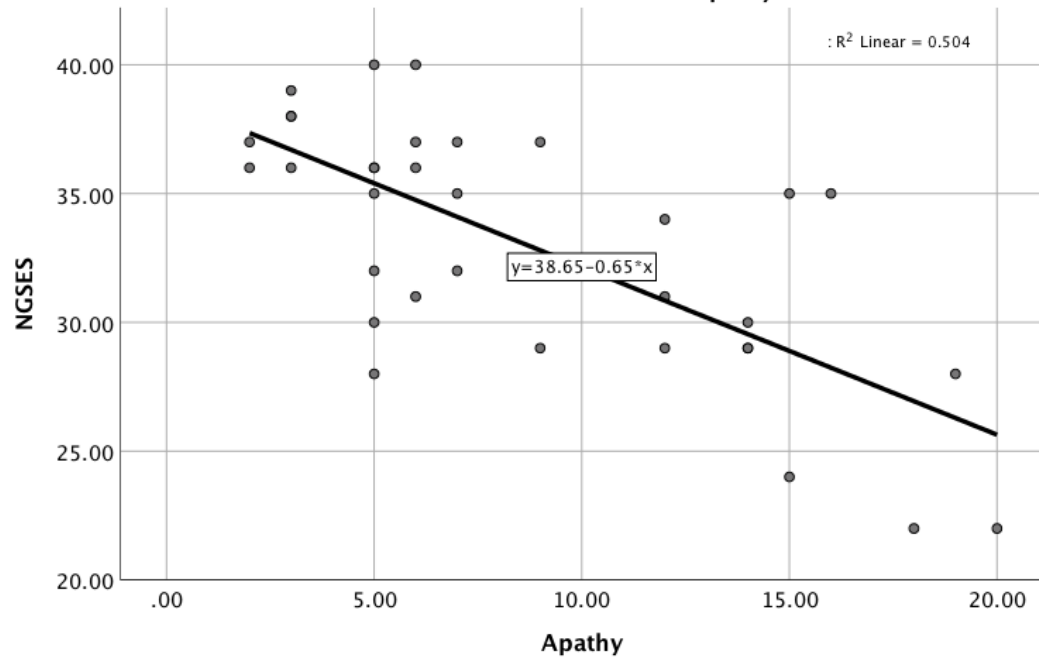
Correlation between SRS scores and dACC-lLatPar functional connectivity



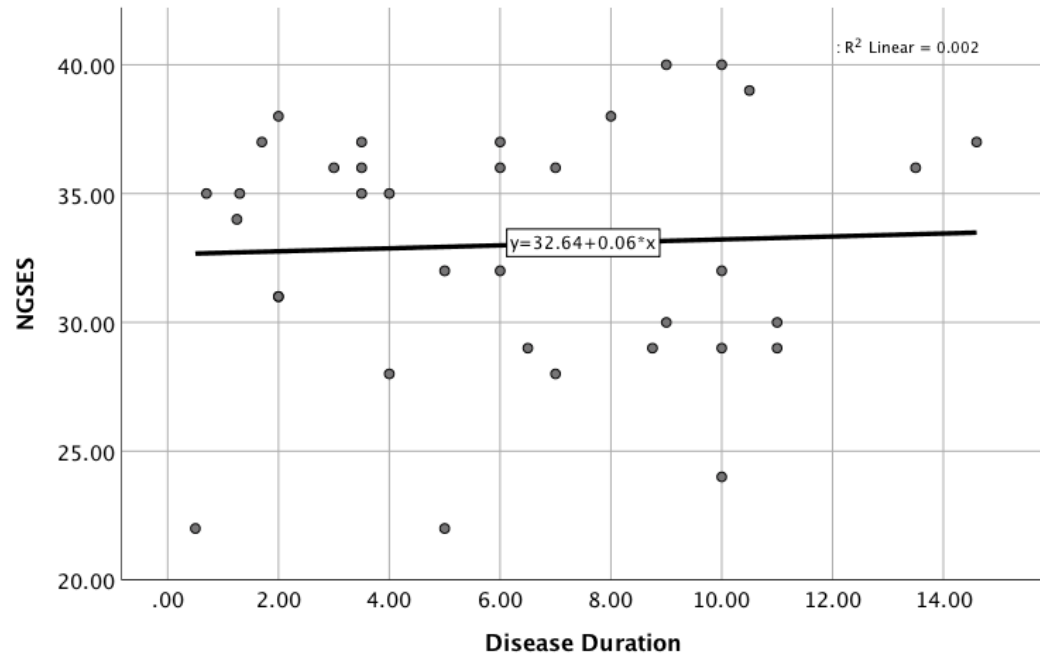
Correlation between NGSES and MDS-UPDRS total scores



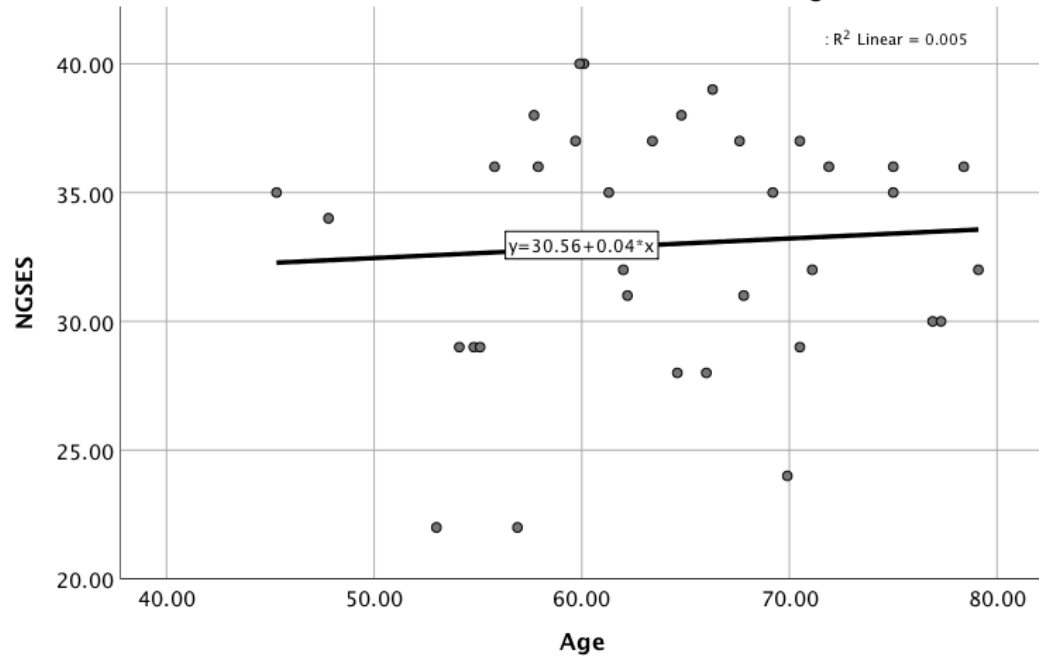
Correlation between NGSES and Apathy scores



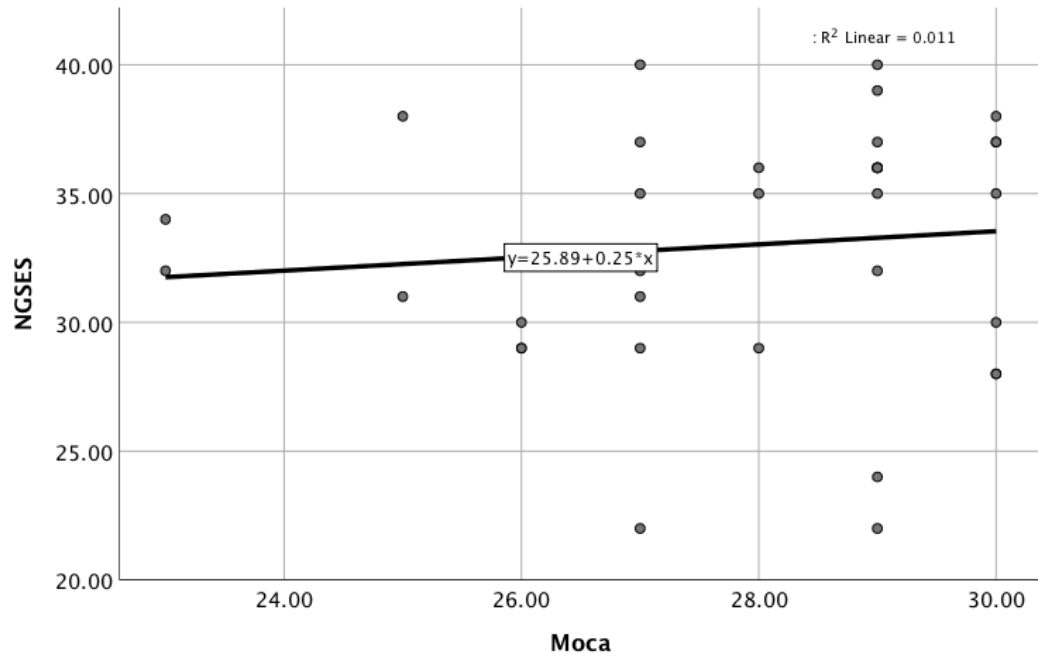
Correlation between NGSES scores and Disease Duration



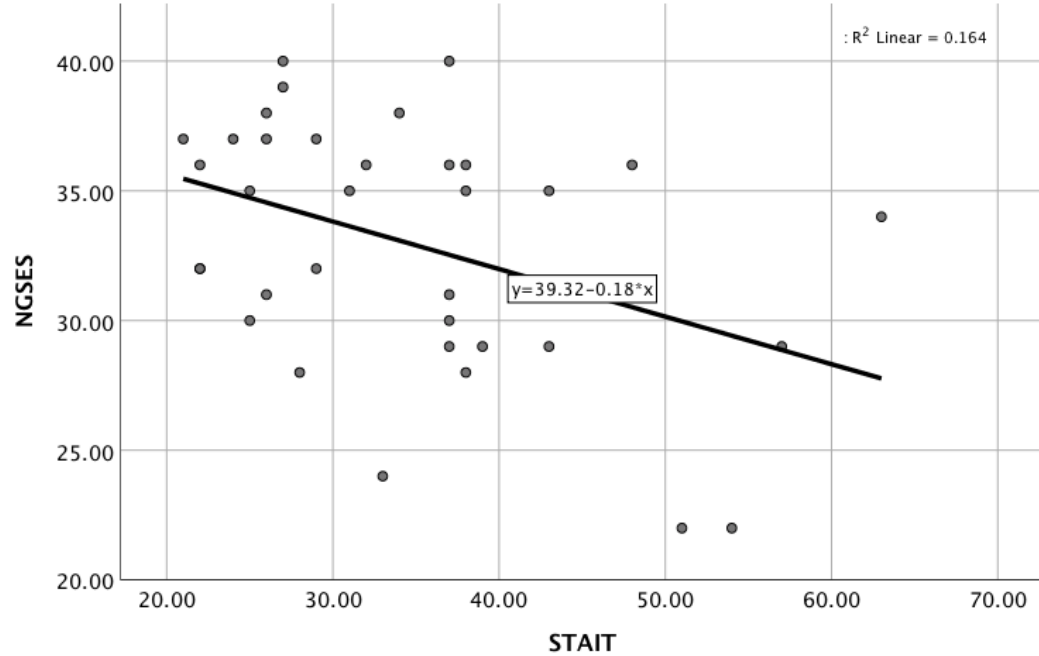
Correlation between NGSES scores and Age



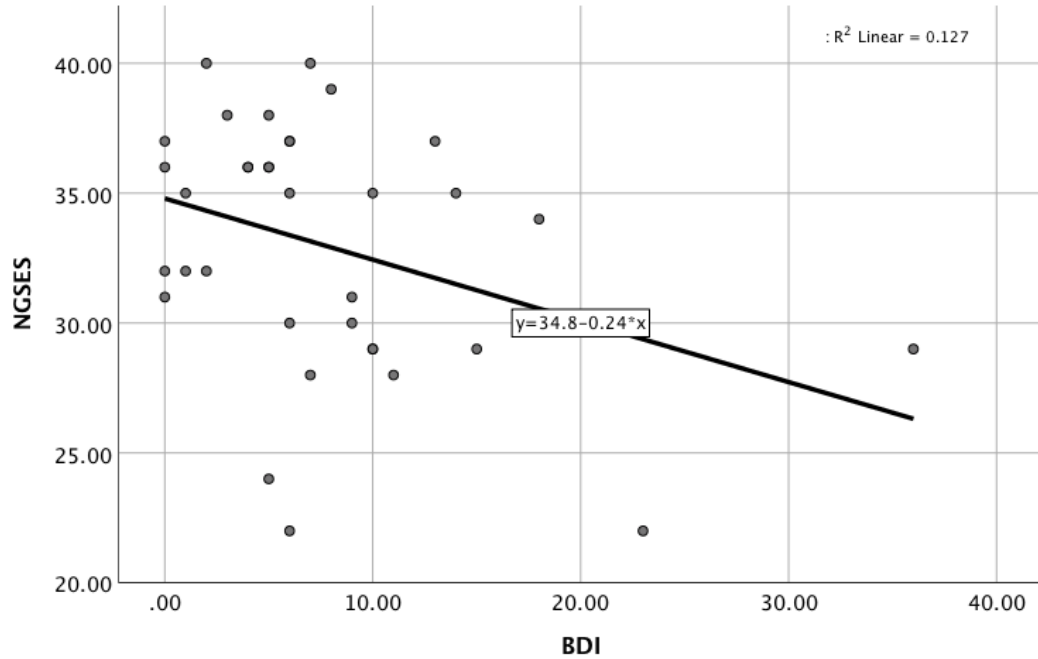
Correlation between NGSES and MoCA scores



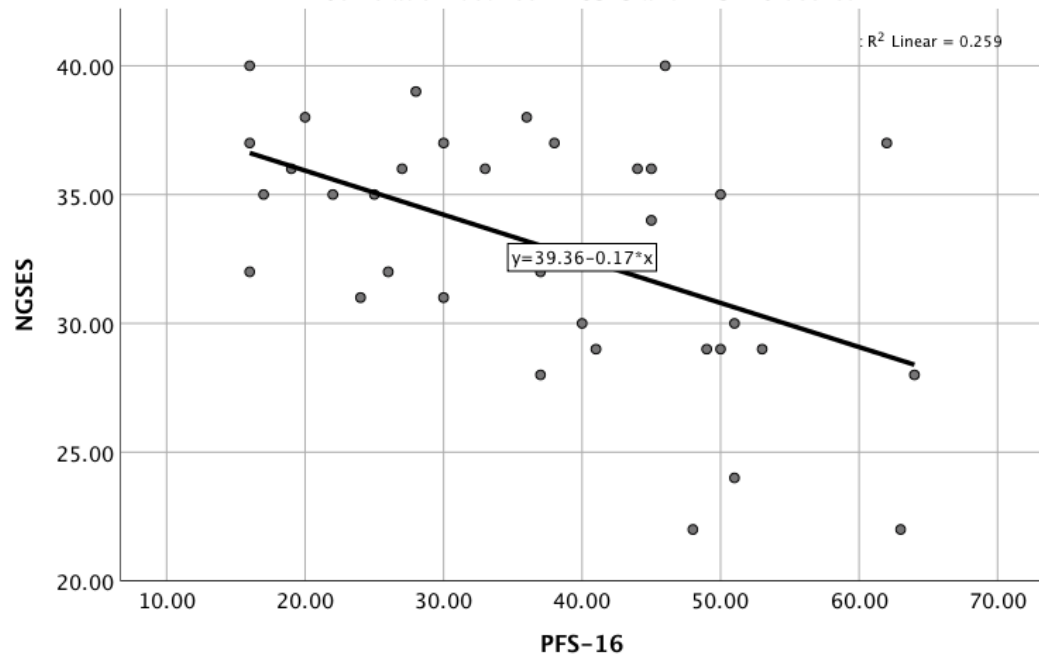
Correlation between NGSES and STAIT scores



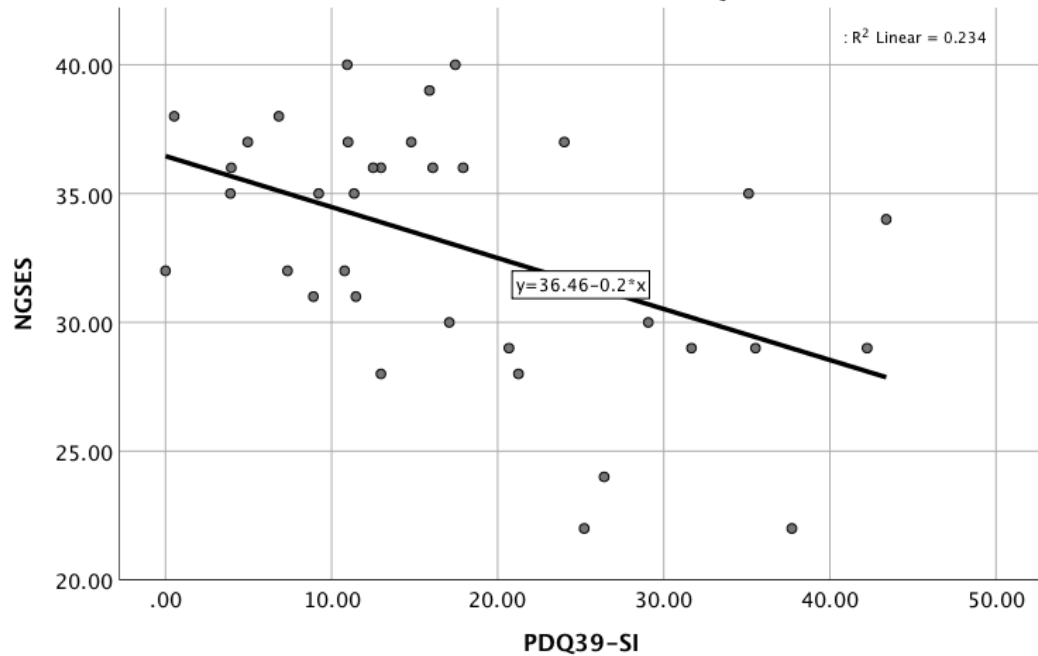
Correlation between NGSES and BDI scores



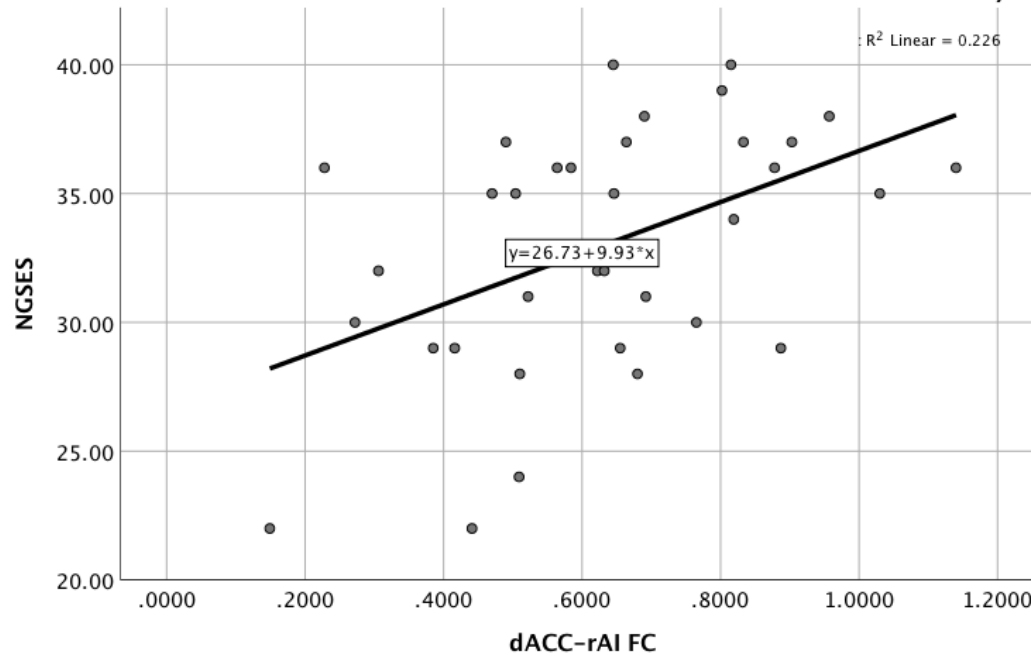
Correlation between NGSES and PFS-16 scores



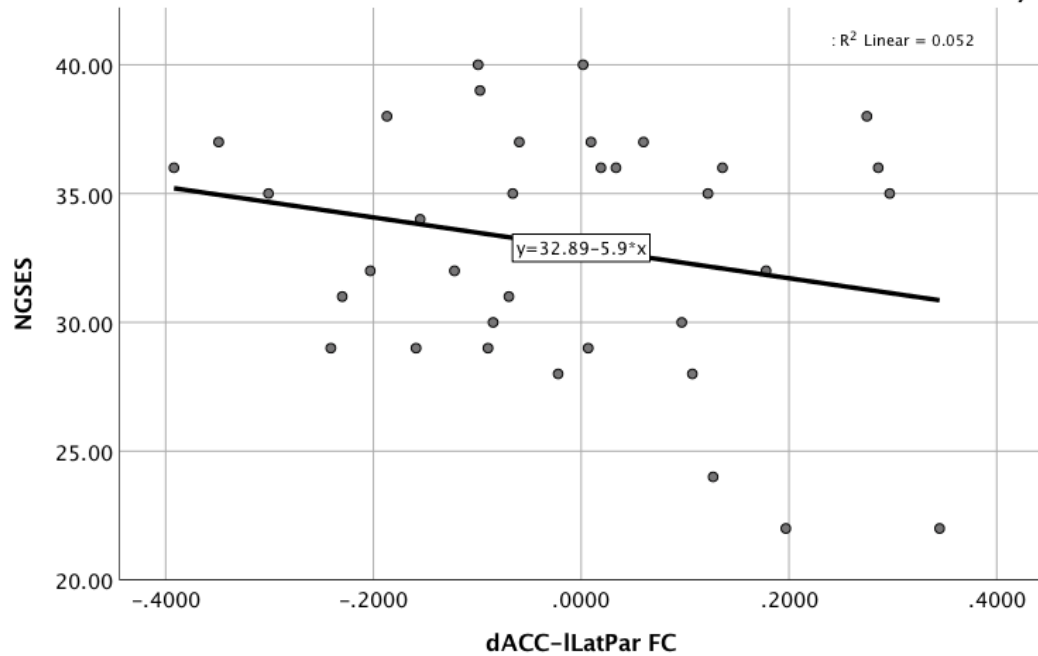
Correlation between NGSES and PDQ39-SI scores



Correlation between NGSES scores and dACC-rAI functional connectivity



Correlation between NGSES scores and dACC-ILatPar functional connectivity



Motion in resting-state fMRI data:

The maximum and mean translational movements averaged across the x, y, and z directions were 0.91 ± 0.76 mm and 0.18 ± 0.08 mm, respectively, indicating overall minimal head movement in our PD cohort during resting-state fMRI scans.

New General Self-Efficacy Scale [6]:

1. I will be able to achieve most of the goals that I have set for myself.
2. When facing difficult tasks, I am certain that I will accomplish them.
3. In general, I think that I can obtain outcomes that are important to me.
4. I believe I can succeed at most any endeavor to which I set my mind.
5. I will be able to successfully overcome many challenges.
6. I am confident that I can perform effectively on many different tasks.
7. Compared to other people, I can do most tasks very well.
8. Even when things are tough, I can perform quite well.

Self-Regulation Scale [20]:

1. I can concentrate on one activity for a long time, if necessary.
2. If I am distracted from an activity, I don't have any problem coming back to the topic quickly.
3. If an activity arouses my feelings too much, I can calm myself down so that I can continue with the activity soon.
4. If an activity requires a problem-oriented attitude, I can control my feelings.
5. It is difficult for me to suppress thoughts that interfere with what I need to do.
6. I can control my thoughts from distracting me from the task at hand.
7. When I worry about something, I cannot concentrate on an activity.
8. After an interruption, I don't have any problem resuming my concentrated style of working.
9. I have a whole bunch of thoughts and feelings that interfere with my ability to work in a focused way.
10. I stay focused on my goal and don't allow anything to distract me from my plan of action.

Note: The scores for questions 5,7, and 9 are reversed.