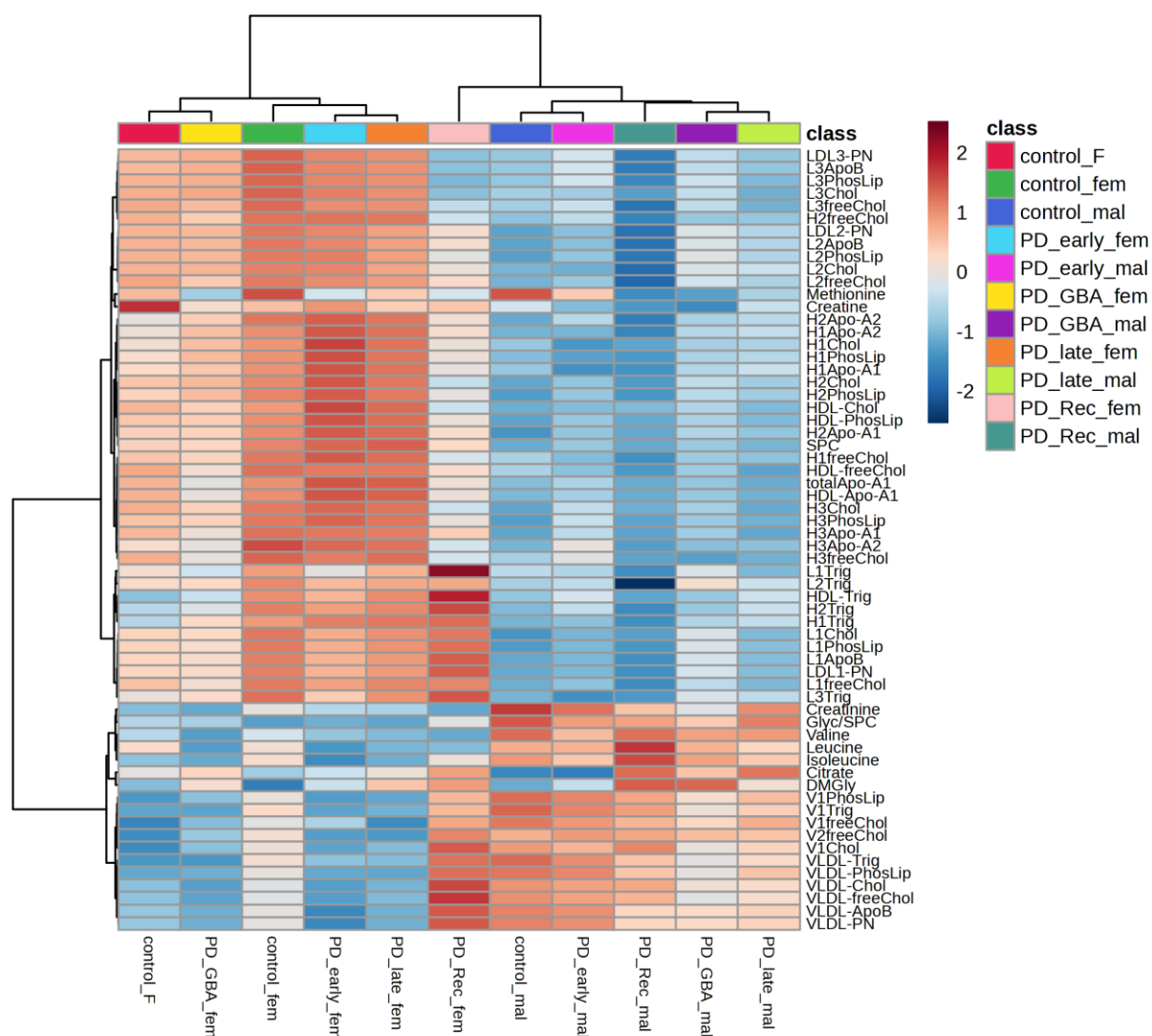
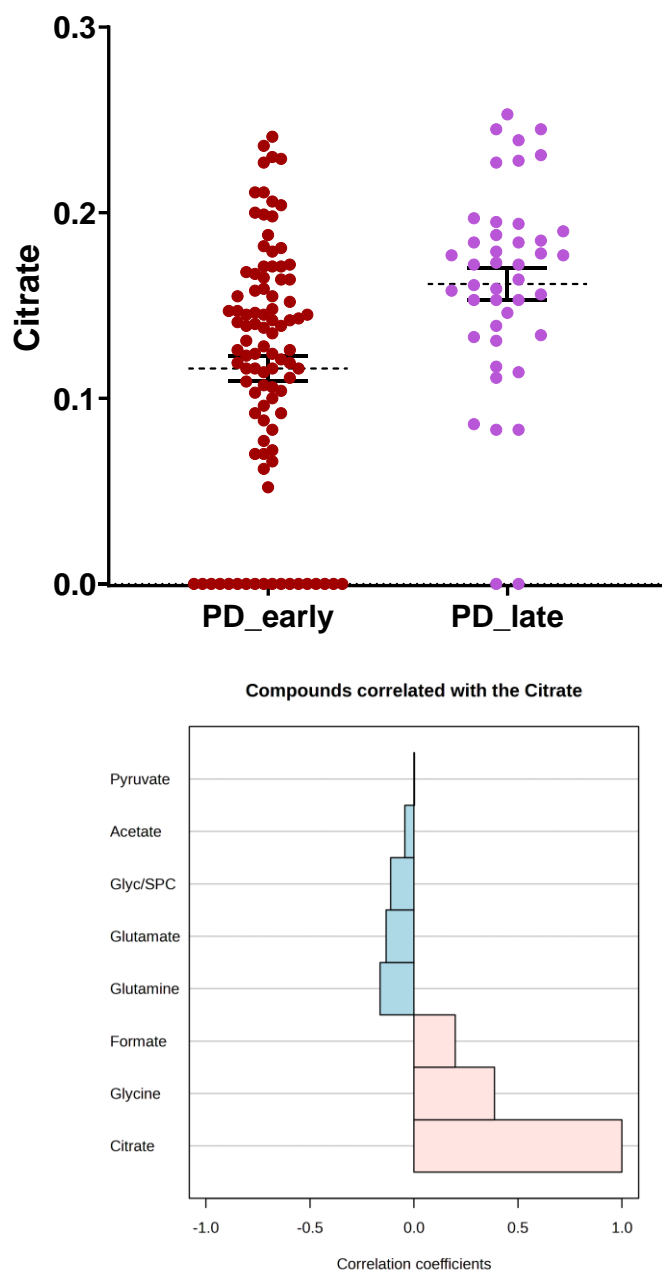


Supplementary Material



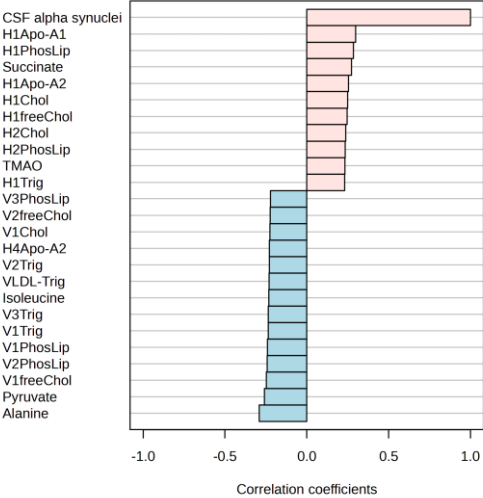
Supplementary Figure 1: Metabolomic and lipoprotein significant alterations in the whole cohort of participants' samples (averaged) analyzed. Heatmap of FDR-significant findings checked via ANOVA statistical testing ($p < 0.001$ shown) divided into female and male sub-cohorts.



Supplementary Figure 2: Two-group comparison of the Sporadic PD early and late patient samples via t-testing (FDR-adjusted; mean \pm SEM format) demonstrating elevation of citrate in the Sporadic PD late group. Pattern-wise correlation plot (Spearman's r) was also visualized to represent that our NMR-based citric acid recording correlated rather strongly to other metabolites, in boundaries of the KEGG's defined set of metabolites as Glyoxylate and dicarboxylate metabolism that includes citrate. Glyc/SPC represents a glycoprotein NMR-measured value of relevance to inflammation indication in patient blood.

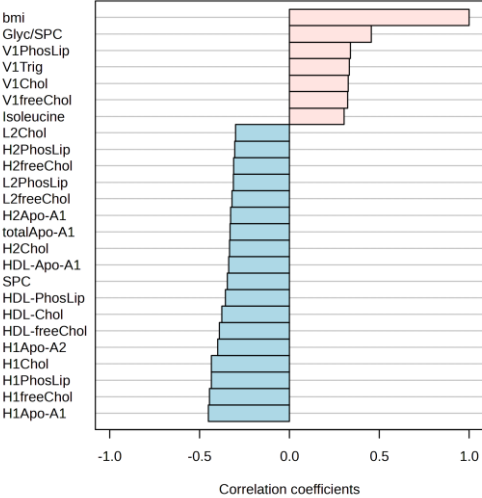
A

Top 25 compounds correlated with the CSF alpha synuclein tota



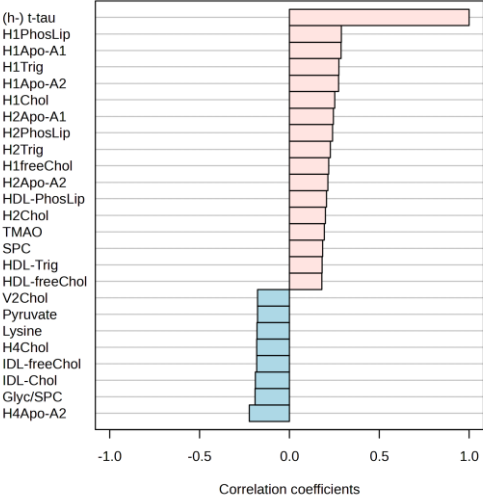
B

Top 25 compounds correlated with the bmi



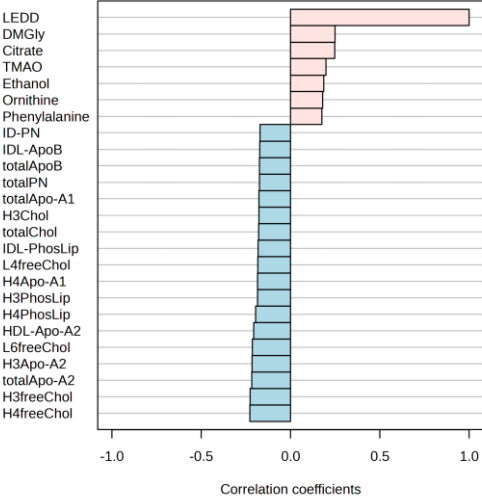
C

Top 25 compounds correlated with the (h-) t-tau



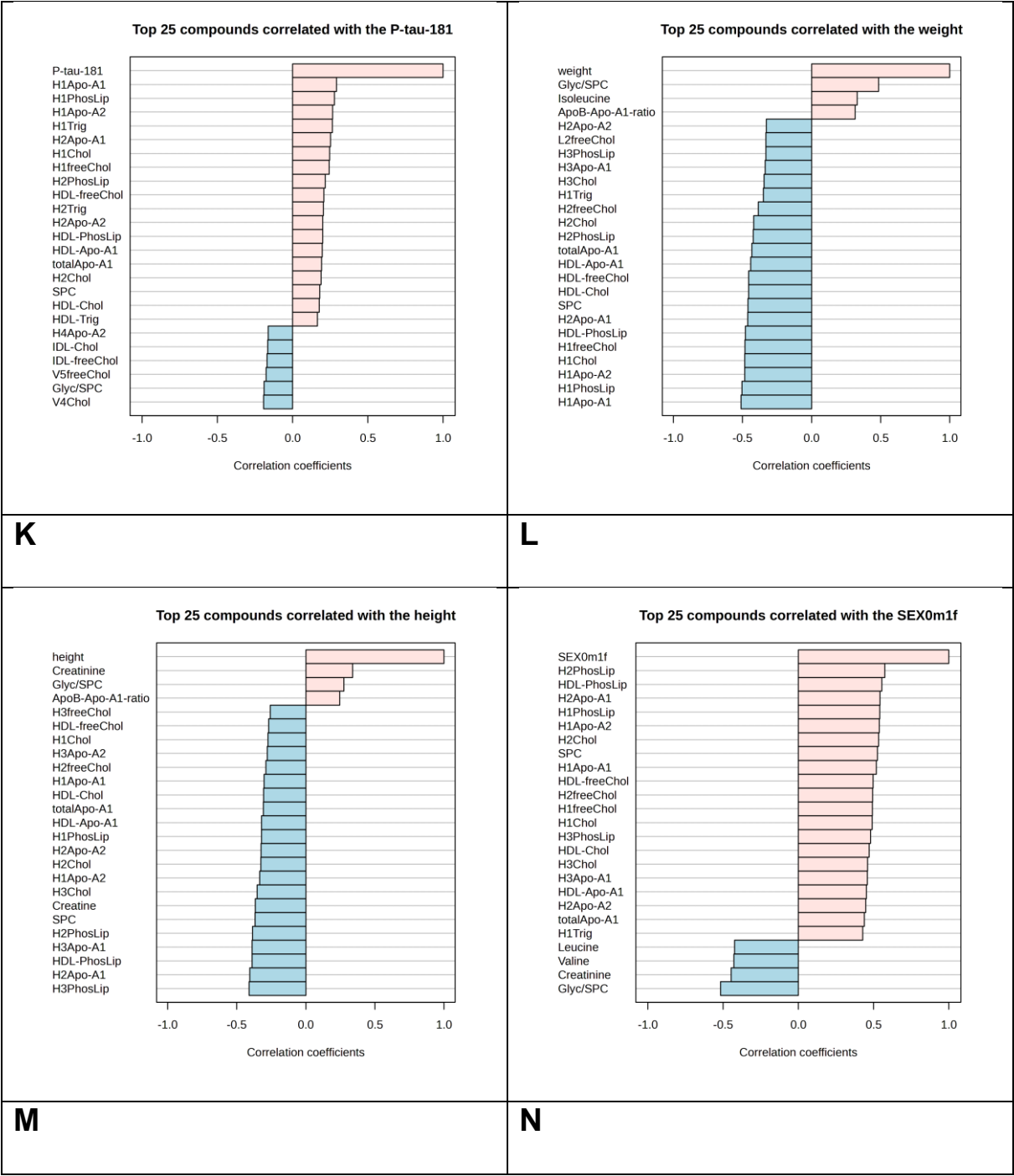
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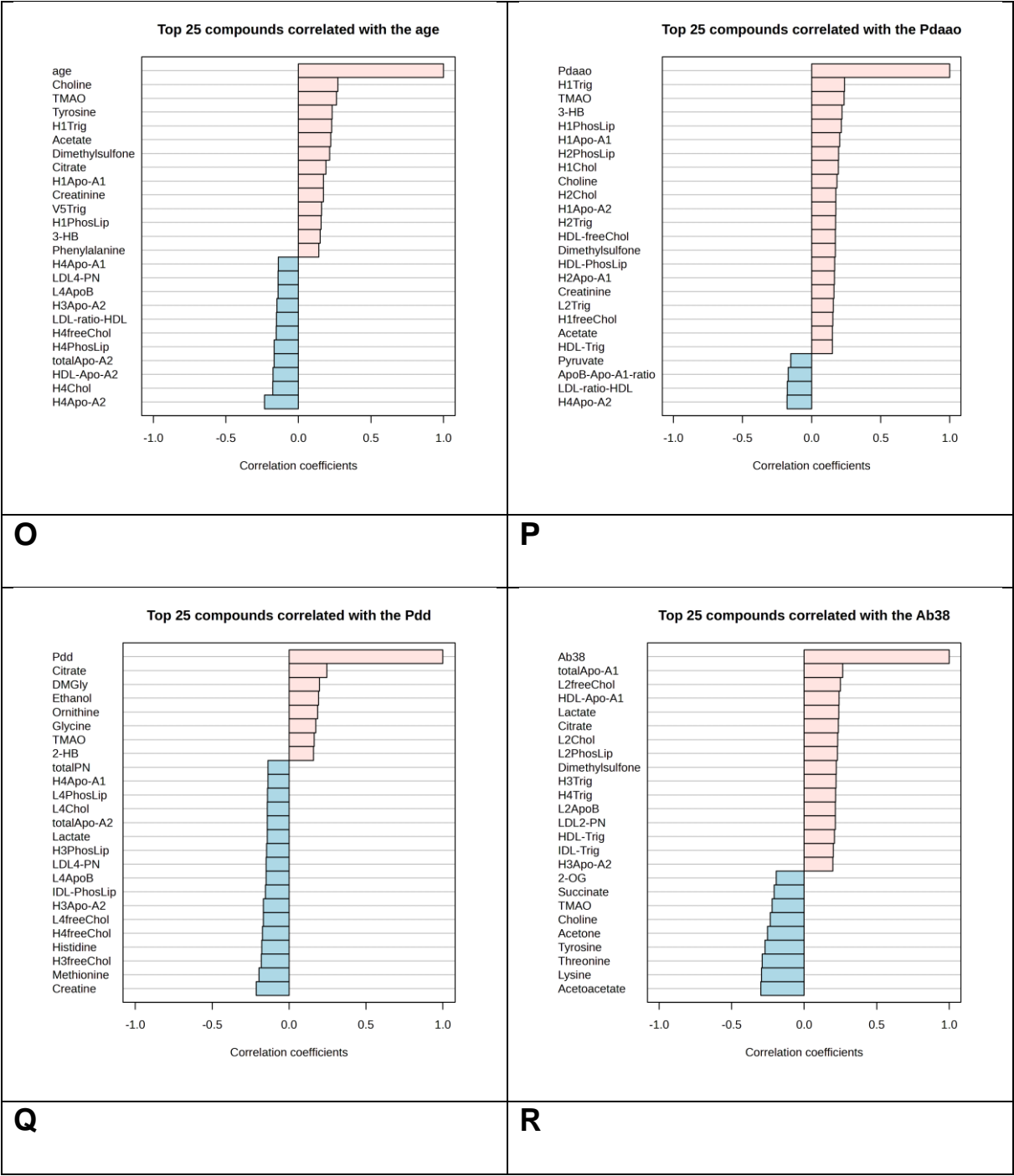
Top 25 compounds correlated with the LEDD

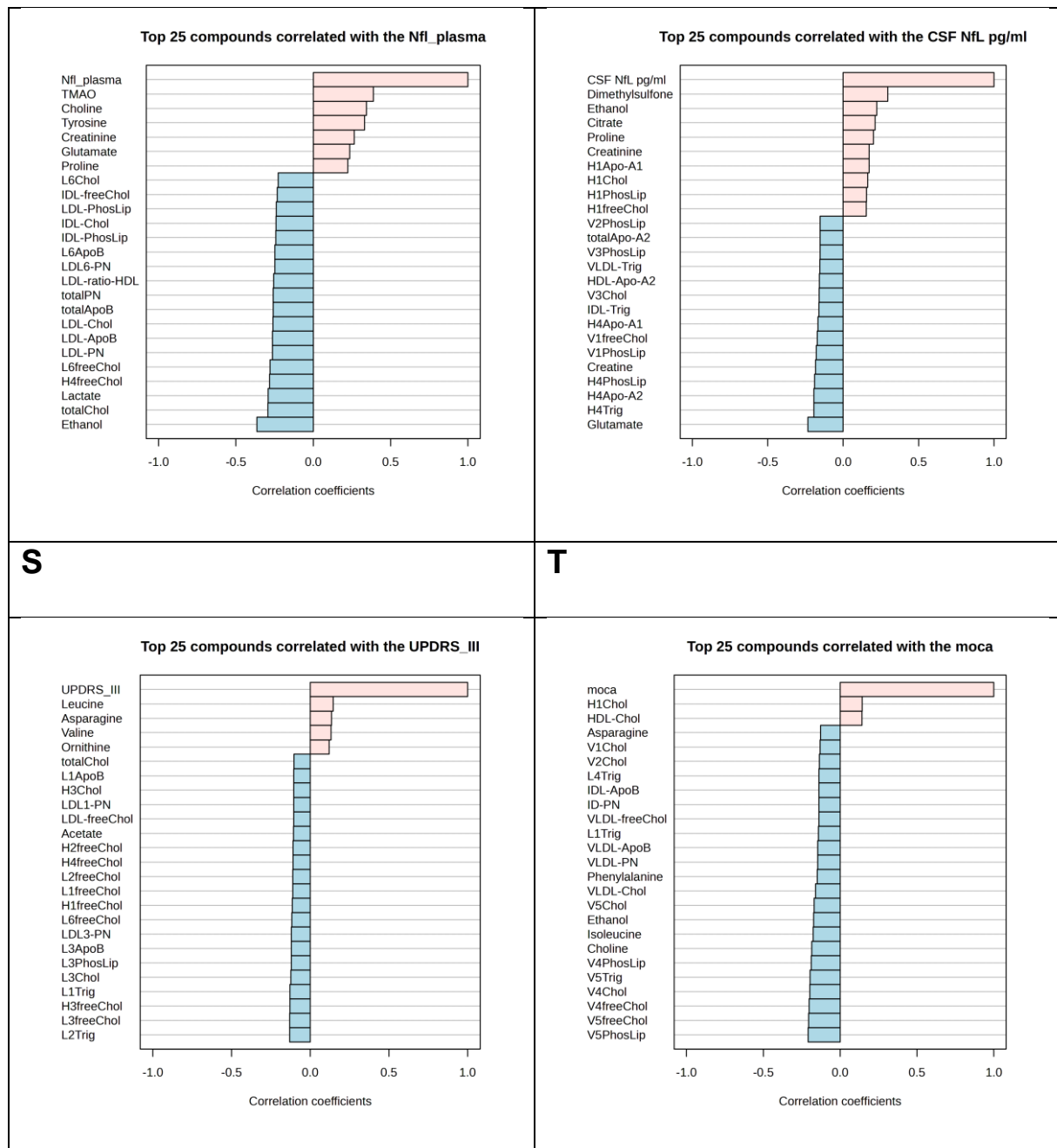


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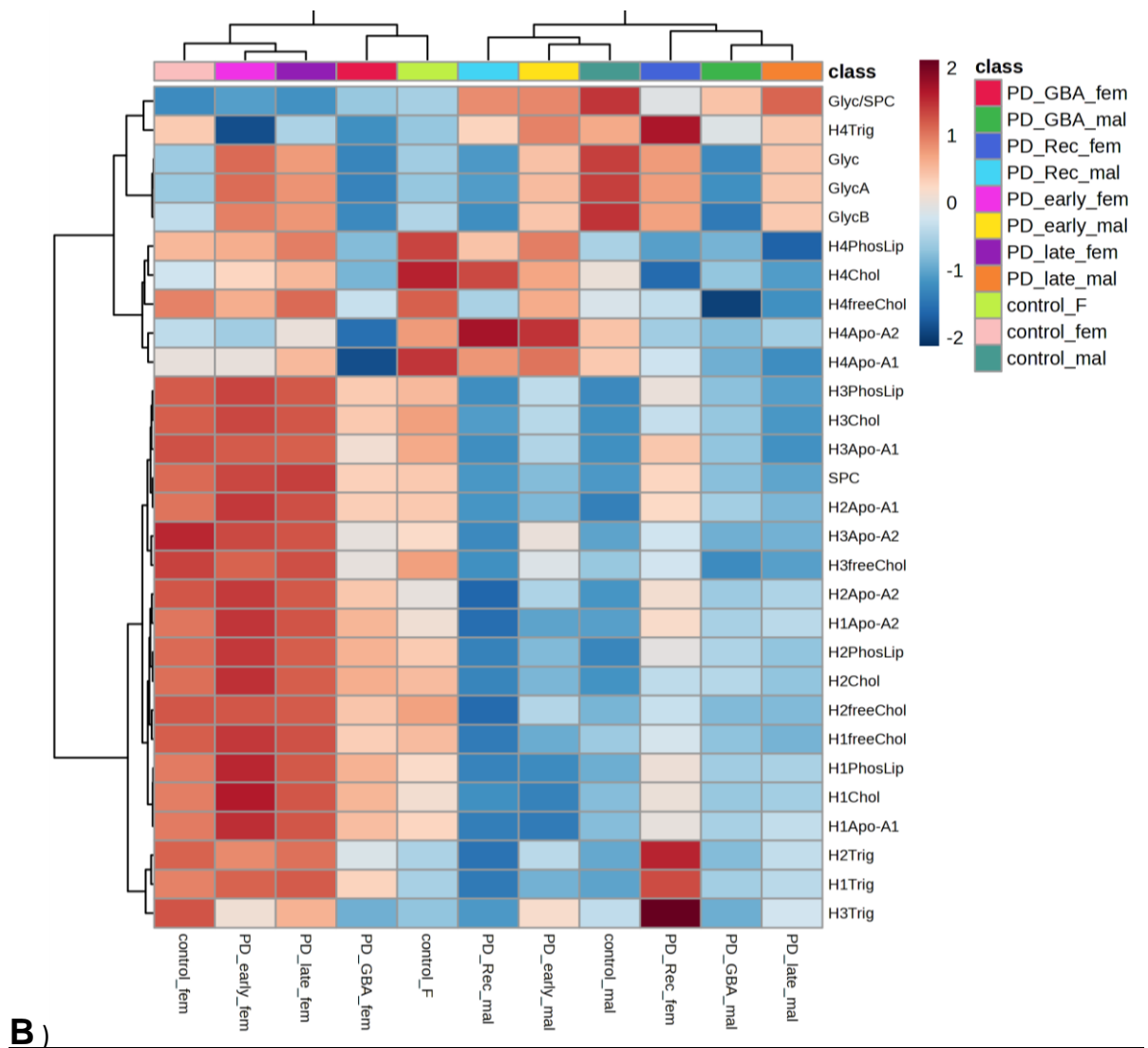
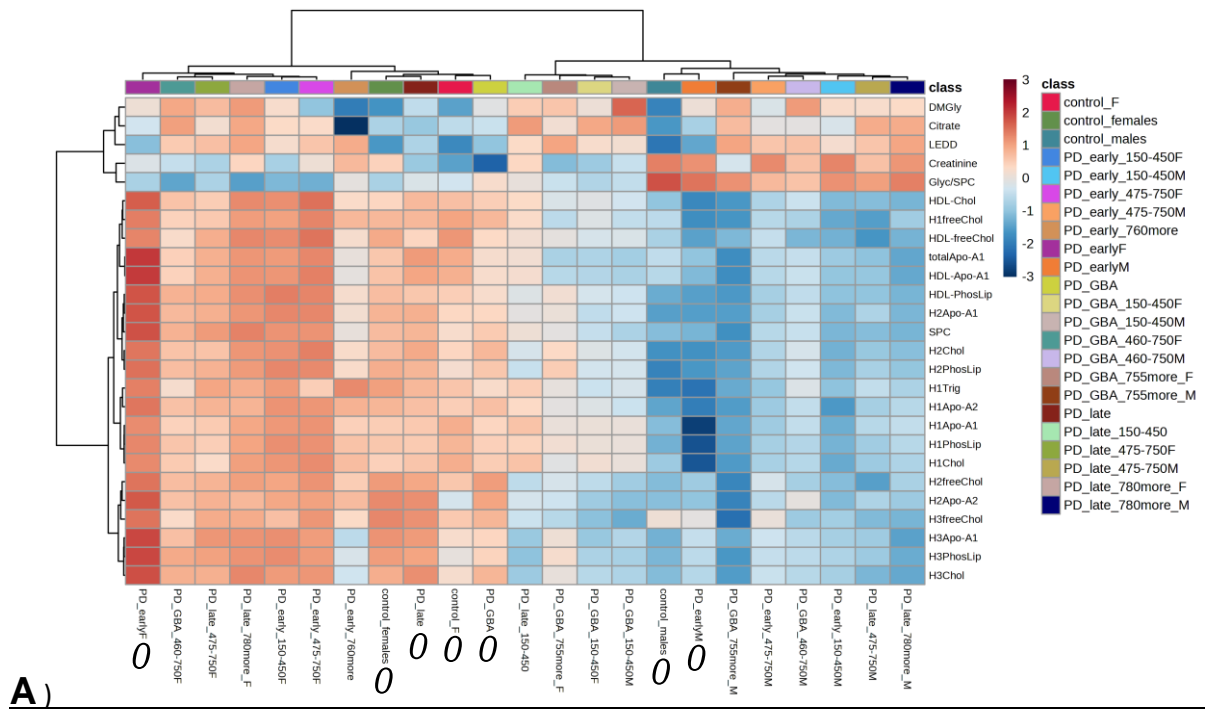
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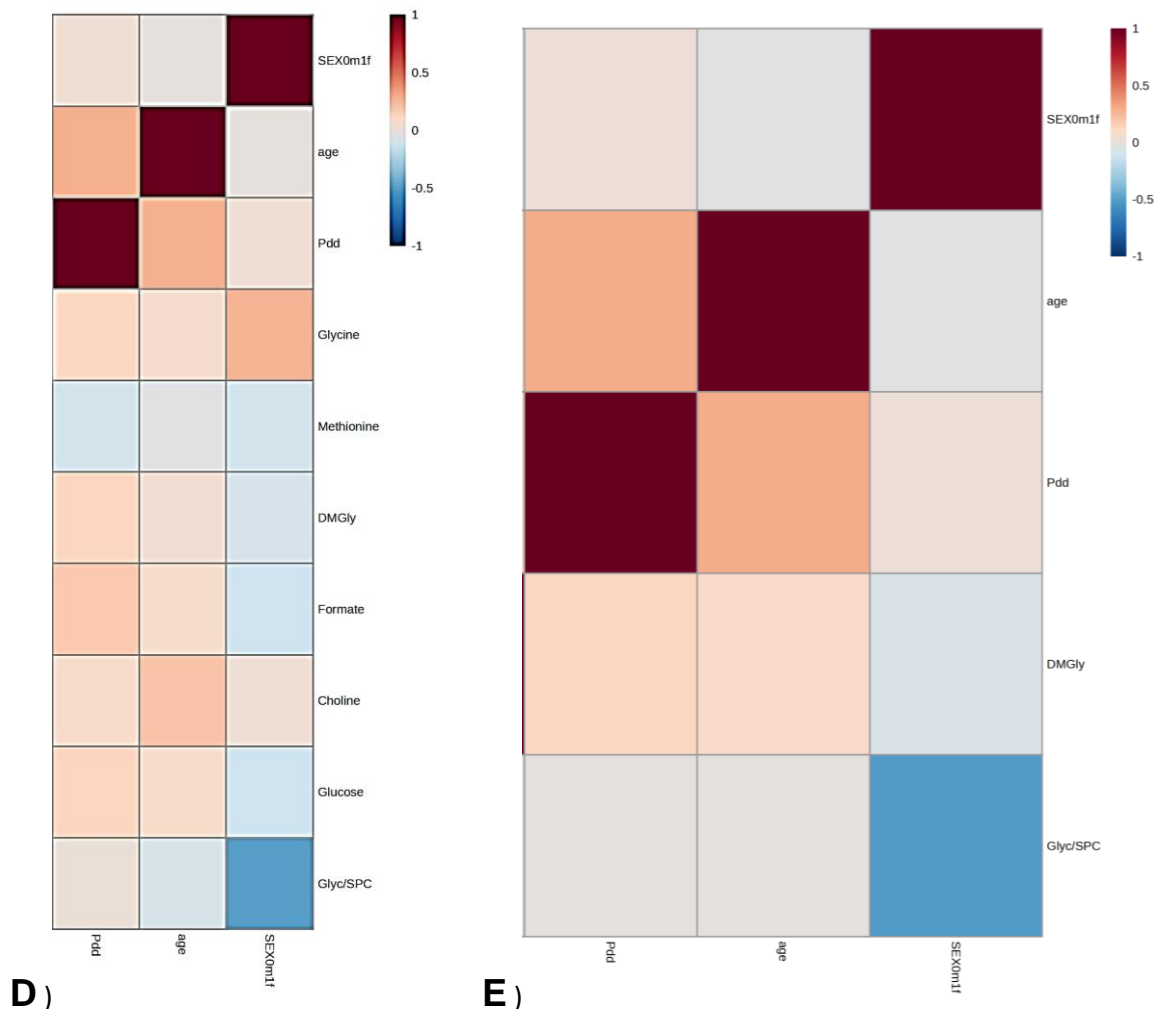
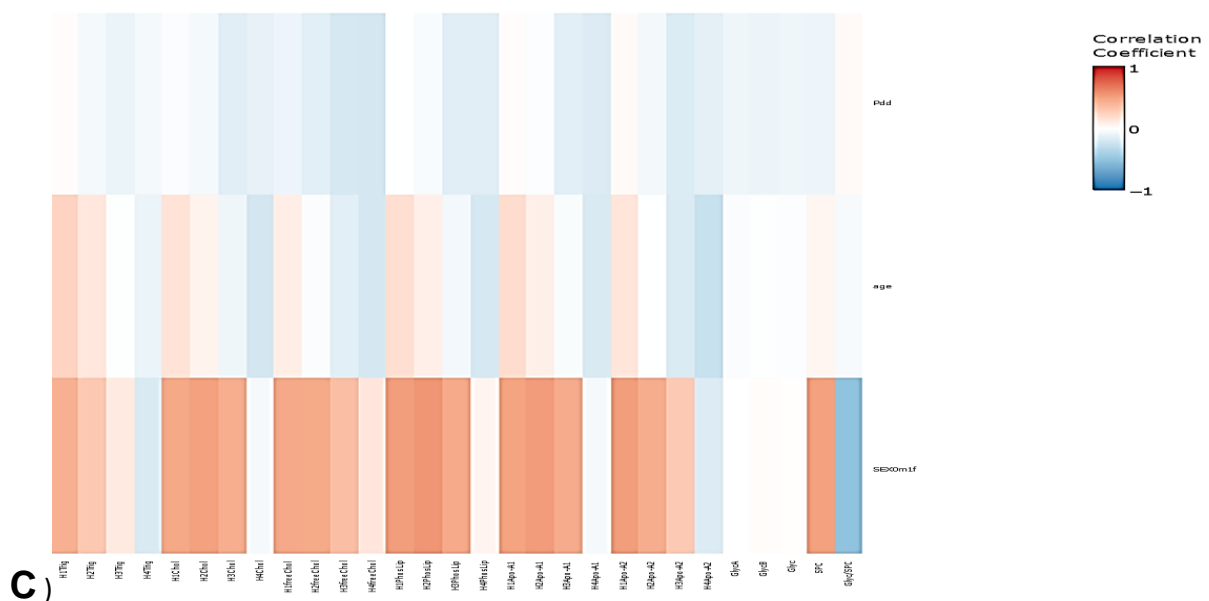






Supplementary Figure 3: NMR-measured metabolites and lipoprotein parameters correlated with different factors. Spearman's correlations are plotted, the inquired parameters are also shown at the top of each graphic with the projected correlation coefficient of $r = 1.00$. (a) CSF alpha-synuclein, (b) BMI index, (c) human (h-) total (t-) tau, (d) LEDD, (e) MoCA (Control and PD recessive groups only), (f) BDI-II, (g) A β 1-40, (h) A β 1-42, (i) P-tau-181, (j) weight, (k) height, (l) sex (binary), (m) age, (n) aao (age on onset of PD), (o) PDdd (PD disease duration), (p) A β 1-38, (q) NfL plasma, (r) CSF NfL, (s) MDS UPDRS-III, (t) MoCA (all entries).



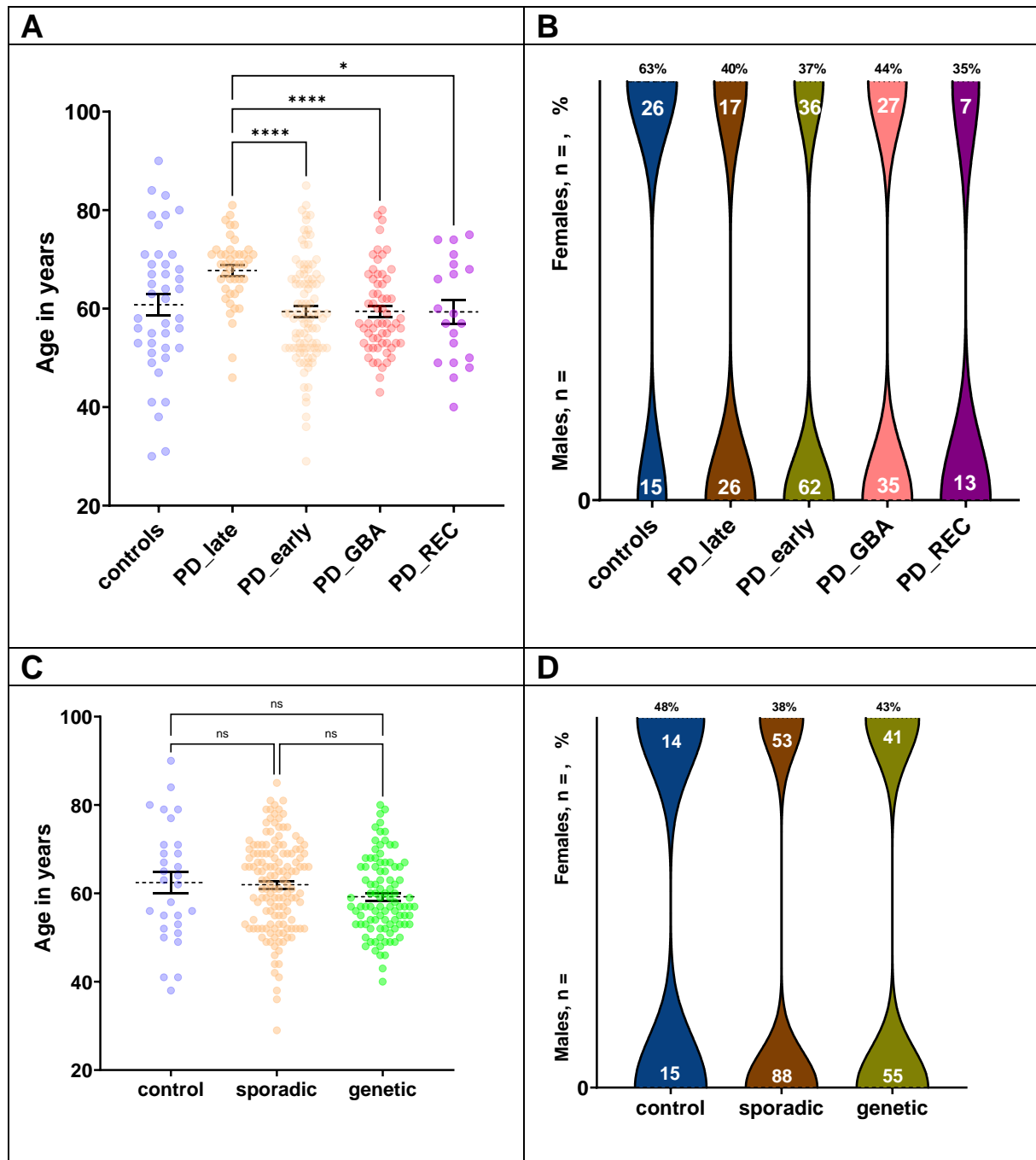


Supplementary Figure 4: Correlation and Heatmap plots.

- (a)** Sorted PD patients (averaged) into groups based on how much L-Dopa they take each day to see if there are any links between metabolic differences and drug treatment.
- (b) & (c)** Correlation analysis and Heatmap plots of the HDL subfractions of lipoproteins and the inflammatory markers (Glyc; SPC) in males and females to see how inflammation and metabolic

changes are connected.

- (d) An integrated (correlation) analysis of blood methionine, DMGly and formate levels to check for any abnormalities in one-carbon metabolism in people with PD. Additional parameters were included.
- (e) Correlation analysis in search for a connection between DMGly and LEDD in both GBA mutation positive and sporadic PD groups to work out if DMGly changes can be affected by dopaminergic treatment.



Supplementary Figure 5: Unchanged controls (by sex) in age group distribution closer and further group characteristics onto sporadic and genetic super groups. (a) Describtlonal (mean \pm SEM format) statistics plot on age, whereas the old (all subject samples) of the control groups patients were utilized; (b) Describtlonal statistics on sex, in which a balance coridor of 40% \pm 10% among groups was not reached. (c) Describtlonal (mean \pm SEM format) statistics plot on age, whereas the groups of controls, sporadic, and genetic were used; (d) Describtlonal statistics on sex for the given three groups, in which a balance coridor of 40% \pm 10% among groups is observed.