SUPPLEMENTARY MATERIAL

A network approach to lifestyle behaviors and health outcomes in people with mental illness: the MULTI+ study III

Short title: Lifestyle and health in mental illness (MULTI+ III): a network approach

Natascha M. den Bleijker[1,2], Myrthe M.E. van Schothorst[1,3], Tessa F. Blanken[4,5], Ingrid J.M. Hendriksen[6], Wiepke Cahn[2, 7], Jeroen Deenik[1,2,3]

Appendix 1 – Network Accuracy

To gain insight into the reliability and stability of the network estimates, we performed accuracy analyses according to the procedures described in Epskamp et al., (2018)[1]. We used the *bootnet R*-package version 1.5.3. To examine the stability of strength centrality we used case-dropping bootstrap based on 1000 samples. This method quantifies the stability of the order of strength centrality with the correlation stability coefficient (CS-coefficient). The CS-coefficient defines the maximum proportion of cases that can be dropped such that the correlation between the original strength estimate and the strength estimates based on the subsets is 0.7 or higher. Results of the stability of the order of the strength centrality indices can be found in Figure 1.

We evaluated the accuracy of edge weights with non-parametric bootstrapping. This method calculates the 95% bootstrapped confidence intervals (bCIs) around the edge weights. Wider bCIs indicate less accuracy in edge estimation, while narrower bCIs suggest a more reliable network.

Accuracy of the edge weights are displayed in Figure 2. Additionally, Figure 3 and Figure 4 show the results of the difference tests for the edge weights and strength estimates for different variables. We used the difference between bootstrap values of one edge weight or strength estimate and another, and constructed bCIs around these differences [2]. If the bCI of an edge weight or strength estimate included zero, they were not considered to be different from other edge weights or strength estimates. Interpretations of the results can be found in the captions below the figures.

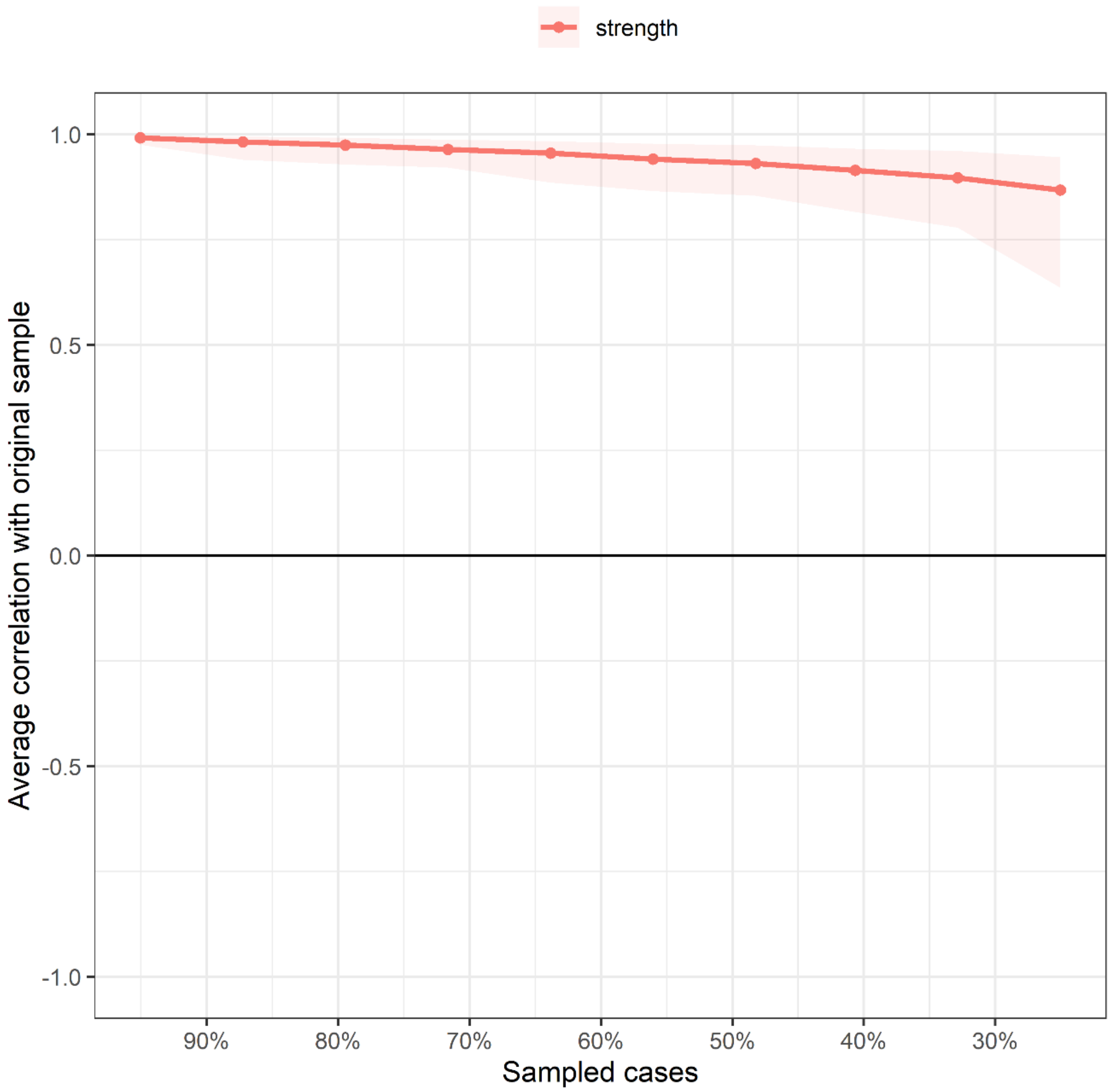

Figure 1. Node strength stability. We used a case-dropping bootstrap method, meaning that we re-estimated strength centrality while increasing the percentage of omitted cases from the data. The x-axis depicts the percentage of sampled cases, ranging from 0% to 100%. It reflects the proportion of cases included in the bootstrap procedure. At 100% all cases were retained, and at 0% all cases were dropped. The y-axis depicts the average correlation with the original sample. This is further quantified with the correlation stability coefficient (CS-coefficient). The CS-coefficient defines the percentage of cases that can be dropped while the correlation between the original strength estimate and the strength estimate based on the subsets remains 0.7 or higher. We found CS-coefficient of 0.75, which is considered reliable [1].

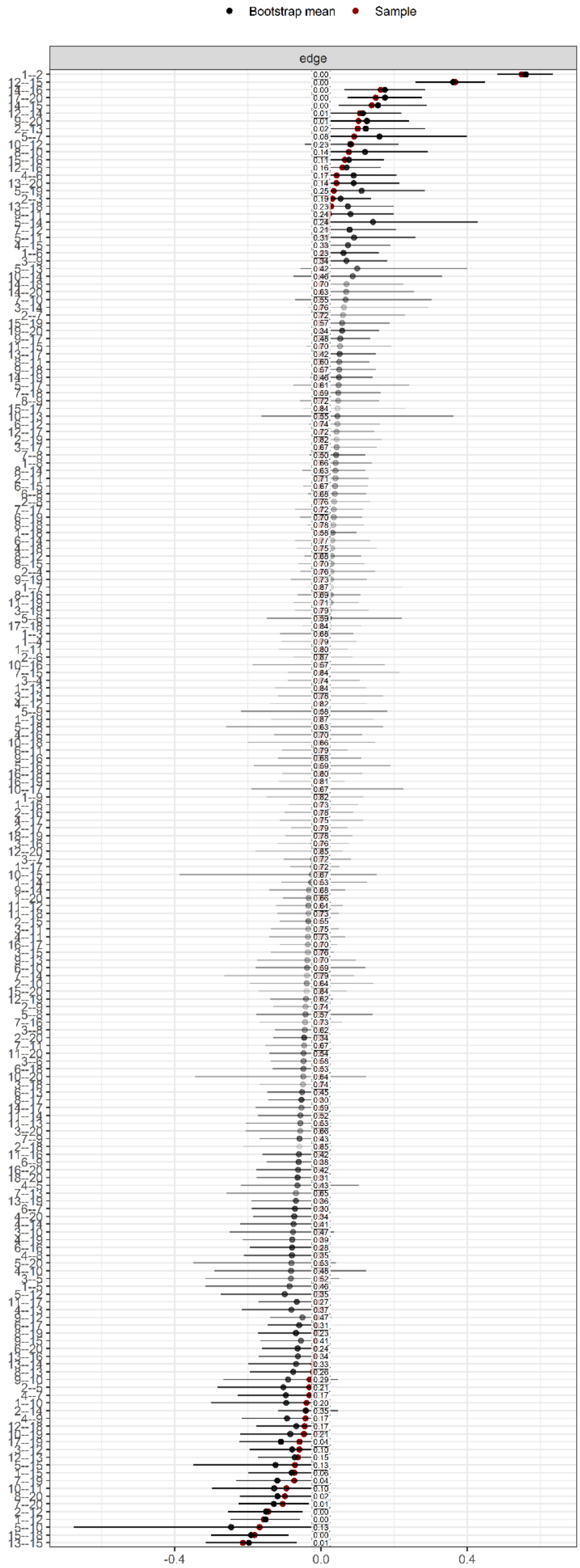

Figure 2. Bootstrapped confidence intervals of edge weights. The x-axis depicts standardized edge estimation when parameters were non-zero, and the y-axis depicts edges. The boxes indicate how often the parameter was set to zero. They are ordered from the strongest edge in the top, to weakest edge in the bottom. Red dots represent edge weights from our estimated network, black dots represent the bootstrapped means, and lines

represent the CIs around the edge weights. This figure shows that most of the strongest edges, for example (1–2) were never set to zero in 1000 bootstrap samples. Large bCIs and indicate that the reliability of the majority of the edges is low.

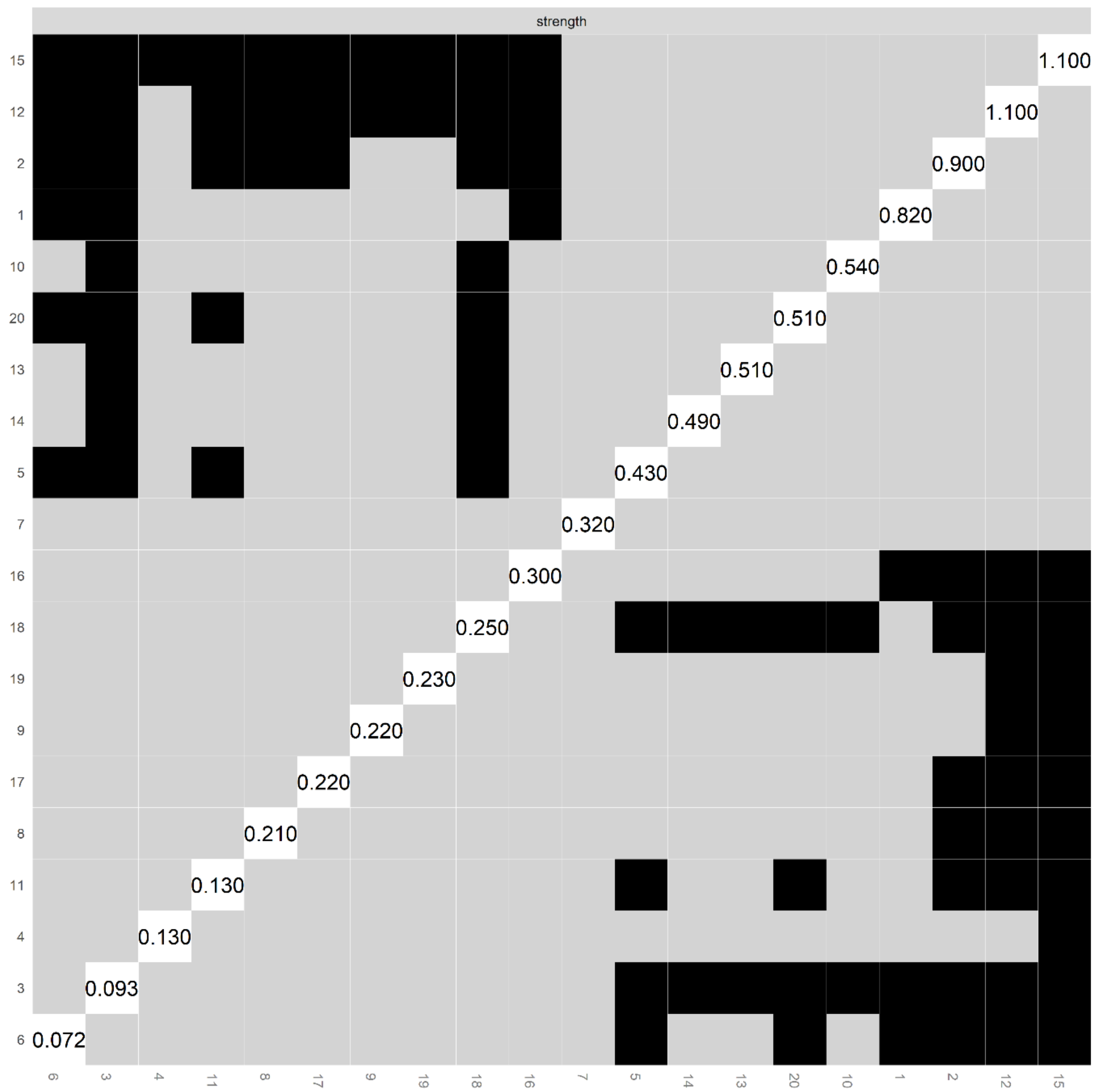

Figure 3. Bootstrapped difference test (α = 0.05) for strength indices. Gray boxes indicate no significant difference between nodes, while black boxes indicate a significant difference between nodes. White boxes in the diagonal represent the value of node strength. Strong nodes (e.g., 15, 12, 2) differ from approximately half of the other nodes. However, most of the nodes do not differ significantly from one another.

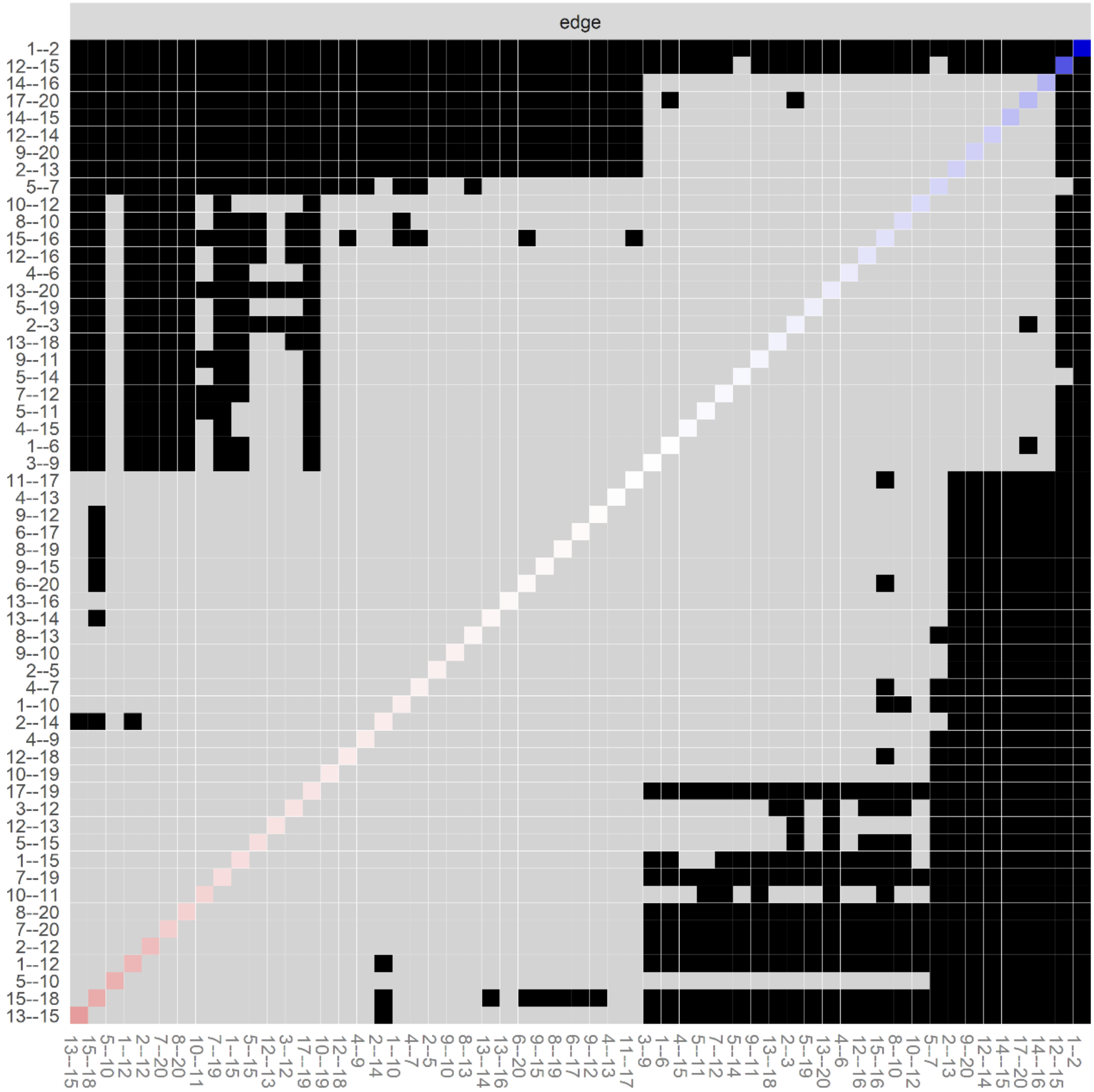

Figure 4. Bootstrapped difference test (α = 0.05) for edges that were non-zero in the network model depicted in figure 2. Gray boxes indicate no significant difference between edges, while black boxes indicate a significant difference between edges. Coloured boxes correspond to the colours of the edges in the visualisation of the network model. Blue boxes indicate a positive association, red boxes indicate a negative association. No correction for multiple testing was applied.

Appendix 2 – Sensitivity analyses

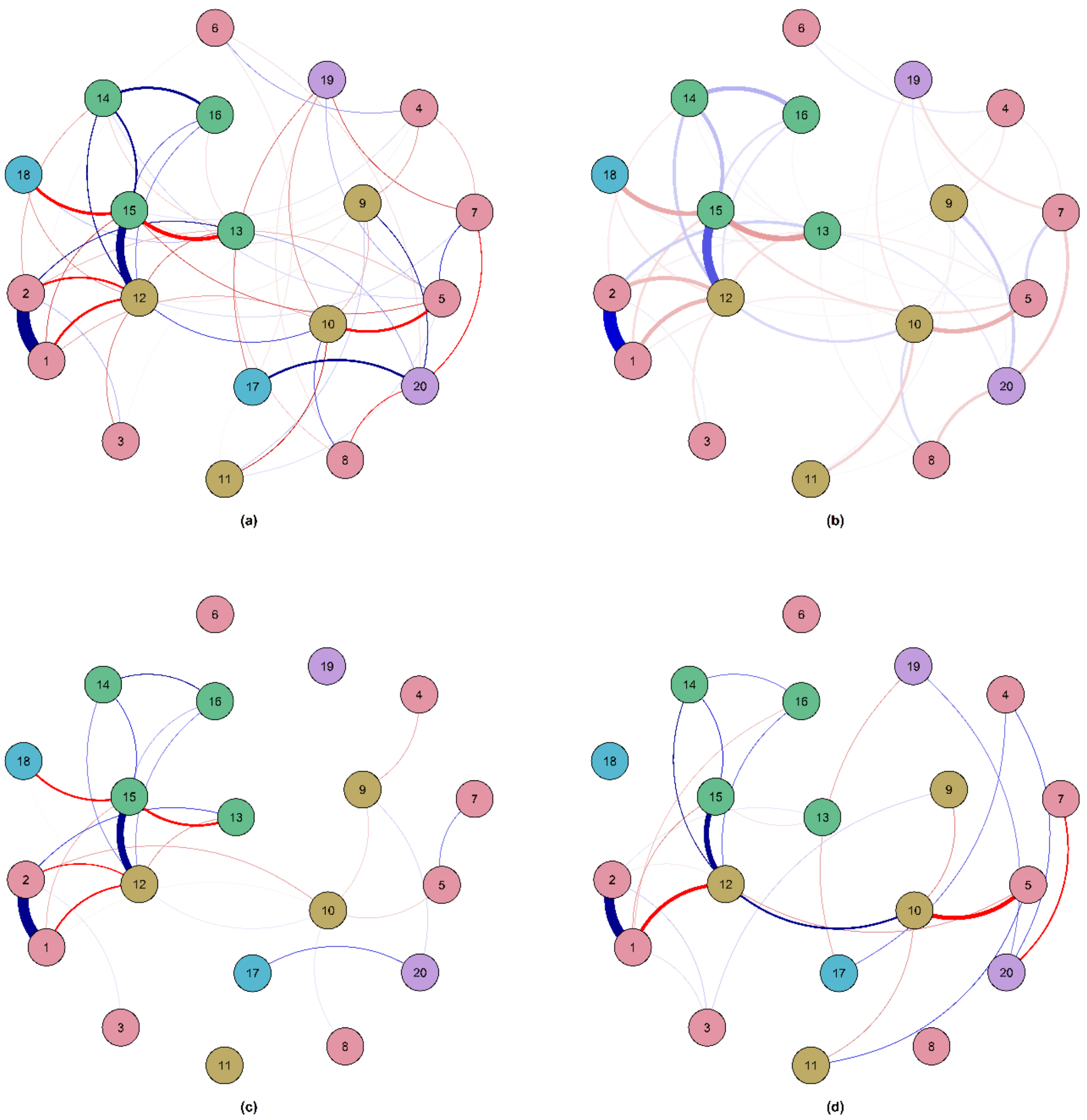

Figure 5. Visualisation of sensitivity analyses. See Table 1 for node names. Image (a) is the original network as depicted in the main manuscript. Blue edges indicate a positive conditional association, red edges indicate a negative conditional association. Thickness and saturation of edges is proportional to the strength of the conditional association. When visualizing these post hoc network estimations, we maintained the layout of the original network and set the same maximum value of the strongest edge (maximum = 0.55) from the original estimated edges to ensure that the thickness and colour intensity are comparable

across network visualizations. Image (b) represents the network without taking the dosage of antipsychotic medication into account. Visualisation of the network indicates that additional analyses focusing on specific types of medication in this network may not add substantial value, as the overall influence of antipsychotic medication use does not seem to impact the identified relationships in the original network. Image (c) represents people aged 65 and younger, and image (d) represents people with schizophrenia and other psychotic disorders. It is important to recognize that differences in network structure in these analyses may be difficult to interpret due to sampling variation and different sample sizes, even if the underlying network is similar. Nonetheless, as can be seen from the networks, most of the links are similar across networks. To quantify this, we computed correlation coefficients between the edge-weight matrices of the original network (a) and the post hoc networks (c) and (d). Correlation for network (b) could not be computed because this network consists of one fewer node than the original network. Correlations are high ($r = 0.93$ between (a) and (c); $r = 0.81$ between (a) and (d)). These results indicate that the network structure remains relatively consistent across subgroups.

Table 1. Node names	
1.	Overall sleep quality
2.	Nighttime sleep problems
3.	Daytime sleep problems
4.	Smoking behavior
5.	Percentage of healthy food intake
6.	Sedentary behavior
7.	Walking
8.	Moderate-vigorous physical activity
9.	Body mass index
10.	Cholesterol ratio
11.	Mean arterial pressure
12.	Physical quality of life
13.	Global severity index

14.	Environmental quality of life
15.	Psychological quality of life
16.	Social quality of life
17.	Daily dose of antipsychotics
18.	Daily dose of antidepressants
19.	Age
20.	Length of hospital stay

References

[1] Epskamp S, Borsboom D, Fried EI. Estimating psychological networks and their accuracy: A tutorial paper. Behav Res 2018;50:195–212. https://doi.org/10.3758/s13428-017-0862-1.

[2] Epskamp S, Waldorp LJ, Mõttus R, Borsboom D. The Gaussian Graphical Model in Cross-Sectional and Time-Series Data. Multivariate Behavioral Research 2018;53:453–80. https://doi.org/10.1080/00273171.2018.1454823.