# 1. Other Supplementary Materials: Methods

## 1.1. Criteria for Considering Studies for this Review

The present study aims to identify the current state of knowledge on networks in PDS. Hence, we set minimal constraints on the types of studies to be included. The selection criteria focus primarily on whether a symptom network was implemented in research on PDS, in the last 21 years. Therefore, the study must have been published between 01/06/2002 and the 30/04/2023. Because of the novelty of the network theory of psychological disorders we aimed to capture all symptom network studies that met the inclusion criteria to date. Furthermore, we included only people that had a confirmed primary diagnosis of schizophrenia, schizophreniform, or schizoaffective disorder, and not other disorders unless these conditions were comorbid or were presented in separate networks. Therefore, participants whom the network was reconstructed on needed at least one of these three diagnoses. Hence, if the network was reconstructed on PDS and people with substance induced psychotic disorder (but diagnosed with schizophrenia, schizoaffective disorder, and/or schizophreniform) we excluded these studies. We also allowed studies that used the same dataset (several studies used a common dataset such as from the CATIE trial; Keefe et al., 2003) so long as the variable set or treatment and control groups differed.

### 1.1.1. Inclusion Criteria

The inclusion criteria for study selection were as follows: (1) The network pertained to a treatment group with participants who had a Diagnostic and Statistical Manual (DSM) IV, DSM-5, International Classification of Diseases (ICD) 10, or ICD-11 diagnosis of schizophrenia, schizophreniform, or schizoaffective disorder, (2) the nodes in the networks contained at least one symptom from criterion A in the DSM-5 for a diagnosis of schizophrenia (differences between criterion A in the DSM-IV and DSM-5 pertain only to the examples of negative symptoms), (3) the publication was a peer reviewed journal article, (4) the study was original research and not a review or discussion piece, (5) the study was written in English, (6) a graphical network model was applied, (7) the study had quantitatively derived networks, (8) the network was based on human participants, (9) the human participants were living at the time of the research or of the assessment, (10) the data was observed as opposed to simulated, and (11) the record was available in the search engine (11) given the dataset, variables included, and methodology of the study, this study was not a replication of previous research.

### 1.1.2 Exclusion Criteria

The exclusion criteria for study selection were as follows: (1) Research on a mental disorder other than schizophrenia, schizophreniform, or schizoaffective disorder, where this disorder was not used as a comparison group to schizophrenia, schizoaffective, or schizophreniform, (2) participants did not meet the DSM-IV, DSM-5, ICD-10, or ICD-11 diagnostic criteria for schizophrenia, schizophreniform, or schizoaffective disorder, (3) the nodes in the networks did not contain at least one symptom from criterion A in the DSM-5 for a diagnosis of schizophrenia, (4) the publication was not a peer reviewed journal article, (5) the study was not original research or was a discussion piece, (6) the study was not written in English, (7) a graphical network model was not applied, (8) the study did not have quantitatively derived networks, (9) the network was not based on human participants, (10) the human participants were not living at the time of the research or of the assessment, (11) the data was simulated as opposed to observed, and (12) the record was not available in the search engine (12) the dataset, variables included, and statistical methodology of the study was a replication of previous research.

## 1.2. Search Methods for Identification of Studies

### 1.2.1. Information Sources

We followed the systematic review guidelines documented by Perestelo-Pérez (2013). Two differences between the guidelines and our implementation of the systematic review were: (1) We did not used the PICOS question framing tool and (2) only one person collected the data (KB). The PICOS question framing tool was not applicable to our study as we did not compare treatment and control groups, we included a wide variety of outcome assessments, and we did not specify any treatment effects. Additionally, to avoid bias or errors in the data collection process, each result reported was quality checked against the original publications by KB. This strategy was preferred due to the large amount of unused data collected and the extensive time needed for a second person to collect the data. We also aligned with the PRISMA reporting guidelines (Page et al., 2021), found in the supplementary material section: 3. Other Supplementary Materials: PRISMA Checklist.

KB searched five search engines to collate a list of publications for screening. The five search engines were (1) Medline and (2) CINAHL through EBSCO Host, (3) Scopus, (4) Psychoinfo through Ovid, and (5) Google Scholar (https://scholar.google.com/). The last search was undertaken on the 27th of June 2022 for Medline, CINAHL, Scopus, and Psychinfo, and the 08th of July 2022 for Google Scholar. Hand searching the reference lists of the articles in the full text review occurred on the 5th of August 2022. We updated the list from Medline, CINAHL, Scopus, and Psychinfo on the 08/05/2023 to ensure this systematic review is up to date with current research for publications between 01/06/2022 until 30/04/2023.

### 1.1.2. Search strategy

The search strategy was designed by KB and validated by a librarian (AS) and author (MS). The peer review process involved optimising the search strategy through identifying the number of articles that would likely be included in full text review from the first 20 citations found by EBSCO host. If approximately 60% of the articles would likely be designated for full text review in the first 20 citations found by the search engine, this would then be a reasonable search. Search terms were sequentially added and deleted to identify if the search term resulted in articles not previously discovered without this search term. The use of ‘Symptom’ being required along with other search terms was discussed and implemented to minimise retrieving articles that were only biological or social in nature, as opposed to clinical, such as fMRI network analysis or social network analysis.

For the databases Medline, CINAL, Scopus, Psychoinfo the following search terms were used: (Schizophrenia OR Schizophreniform OR Schizoaffective) AND (“network analys\*” OR “network Theor\*” OR “network based analy\*” OR “network model\*” OR “network science” OR “network medicine” OR “network approach\*” OR “network based approach\*” OR “network-based approach\*” OR “psycho\* network\*” OR “network perspective\*” OR “transdiagnostic network\*” OR “network\* framework\*” OR “network method\*” OR “disorder network\*” OR (network\* N2 symptom\*)), for publications between 01/06/2002 and the 31/05/2022. For searching Google Scholar, the first 200 journal articles listed were sent to the citations list for the screening stage using the following search terms: (Schizophrenia OR Schizophreniform OR Schizoaffective) AND (Symptom) AND (Network analysis OR Network Theory OR network based analysis OR network modelling OR network science OR network medicine OR network approach OR network based approach OR psychological network OR network perspective OR transdiagnostic network OR network framework OR network method OR disorder network) for publications of any time period. We updated the list from Medline, CINAHL, Scopus, and Psychinfo using the same search strategy for these search engines.

### 1.1.3. Selection Process

The search engines returned 2,211 studies, 975 of which were duplicates. A disagreement over 52 studies (5.3%; κ = .58) between KB and KA occurred in the screening phase and 16 (10.0%; κ =.58) between MS and KB in the screening phase for the updated list. A consensus was reached on each publication. During the full text review, there was disagreement between 17 studies between the reviewers KB and KA (25.8%, κ = 0.48) and consensus could not be reached on three studies between KB and KA. MS reviewed the three publications and accepted one publication and rejected two publications, in consultation with KB and KA. Between MS and KB, there was a disagreement between three studies in the full text review (13%, κ = .74) in the updated list. A consensus was reached for each disagreement between KB and MS. Information on the data collection process including data extraction, management and data items, a list of variables collected, risk of bias assessment, effect measures used in the study, and the synthesis method can be found in the supplementary materials section 1.3 Data Collection Process.

## 1.3. Data Collection Process

### 1.3.1. Data Extraction and Management and Data Items

The data for each of the 32 publications selected for inclusion in this systematic literature review were entered into a data collection sheet in Covidence. Author KB entered the data and cleaned the data in R Studio version 4.2.0. The information on the methodology of the study was collected including: The model applied to the network, the edge statistics, the optimisation algorithm, whether the network was static or dynamic, whether the network was directed, whether resampling took place, and whether parametric or non-parametric tests or confidence intervals were included on the network or network properties. Information of publication details, analysis method, node and edge features were also obtained for the purposes of this research. The centrality statistics betweenness, closeness, strength, and degree were collected as these were most common across the publications. Other metrics for networks were available but were not included because: (1) They did not fit within the aims of the study (such as the clustering coefficient or the shortest path length), and (2) were not commonly used within the selected articles. Definitions of the centrality and edge statistics can be found in the section 1.3.4 Effect Measures.

### 1.3.2. Other Variables Collected

Additional data was collected to allow for extended research on this systematic review of symptom networks in schizophrenia. This additional data was only collected for the search between the dates 01/06/2002 and the 31/05/2023. This included information from: (a) The title page and journal such as DOI, publication date, title, lead author contact information, study funding sources, conflicts of interest declarations, notes made by the authors; (b) the methods section on diagnostic method, diagnostic manual, diagnostic tools, data collection start date and end date, descriptive statistics on participants, experimental group participants, assessment of severity results, the method of recruitment, location of the study, the datasets they acquired, list of assessments that were included in the networks, the study design, the experimental design; (c) the analysis section of the methods section including the data type included in the network, whether goodness of fit indexes were presented, optimisation criteria; (d) the results section of the article including whether the parameters of the network were included, whether the network was graphically presented, a list of nodes in the network, the diagnostic symptoms included in the network, whether the network was grouped or ungrouped, a list of groups, whether the metrics were presented, a list of metrics; and (e), qualitative components in the discussion section such as the text stating support of hypotheses, the evidence linking the results to schizophrenia symptomatology, interpretations of node, edge, and network properties, notes on congruences or differences with other studies, notes on theoretical implications, notes on applied implications, notes on future research, and notes on the importance of findings.

### 1.3.3. Study Risk of Bias Assessment

All information used in the results of this study were quality checked against the original publications. Each article was appraised by adapting the McMaster’s Critical Review Form – Quantitative Studies (Law et al., 1998) for network studies. The McMaster’s Critical Review Form was selected as the included studies used a wide variety of designs, unlike other critical appraisal tools which have versions for randomised control trials, cohort studies, etc. No summation of the items was made to obtain a risk of bias total score. One person assessed each publication against the McMaster’s Critical Review Form and quality checked the results in this manuscript against the original research. More information can be found on the McMaster’s Critical Review Form from the McMaster’s university website (Law et al., 1998).

Modifications to the McMaster’s Critical Review Form were required to ensure that the form was relevant to network studies. Hence, the following changes were made to the McMaster’s Critical Review Form: (1) The purpose needs to be stated as an aim at least once in the abstract or in the introduction section, (2) For relevant literature to be reviewed, symptom network of schizophrenia or other conditions needed to be mentioned in the introduction, (3) for whether the sample size was justified, the sample within the network could be derived from the methods section in the article or the methods section of previous studies referred to within the article, (4) any mention of reliability and validity of an assessment used in the study is sufficient for whether reliability or validity was addressed, (5) analysis methods were appropriate if an algorithm was used to derive the network, (6) clinical implications were reported if the author(s) ever reported a practical implication of the results, (7) conclusions were appropriate if they described direction or causation when the methods allowed for these inferences.

### 1.3.4. Effect Measures

For the purposes of this study, betweenness is defined as how well a node acts as a connecting point by using the number of paths through that node to any other pair of nodes (Hevey, 2018). As in the publication by Boldi and Vigna (2014), betweenness is represented by the formula:

$\sum\_{y, z \ne x, σ\_{y,z}\ne 0}^{}\frac{σ\_{yz}(x)}{σ\_{yz}}$ (1)

 Where $σ\_{yz}$ is the number of shortest paths from y to z and $σ\_{yz}(x)$ is the number of these paths that pass through $x$. Closeness is defined as how close a node is to all other nodes using the average partial correlation of the paths from or to that node (Hevey, 2018). It is given by the formula provided in Boldi and Vigna (2014):

$\frac{1}{\sum\_{y}^{}d(y,x)}$ (2)

Where distance $d(y,x)$ is the shortest path from y to x. Strength as the sum of all partial correlations (or other edge weight) from that node, and degree is the number of edges of a node (Hevey, 2018).

### 1.3.5. Synthesis methods

The results of the 32 studies were included in the results section with information on analysis methods, betweenness, closeness, strength, and degree as reported in the original articles. Within each study, there was a diversity of assessments included as far as the networks presented across the studies were concerned. For the results in in Figure 2 and Table 5A, we recoded every variable included in each network. To do this we retained the meaning of the subscale based on the validation sample of the assessment. We also excluded items of subscales, or the subscales themselves, that measured general psychopathology. Following this we only included domains that were frequently present across the networks included in this study. These five domains were: Cognition, functioning, positive symptoms, negative symptoms, and depression. Hence, items that assess anxiety or stigma were not included in the results as these were only present in a minority of networks. To construct Figure 2, we looked at the centrality statistics of each article and selected the top three most central (Ranked) items or subscales that were represented by these domains. Variables in other domains were excluded in this ranking process. Ties between the ranks of the variables in the networks were allowed. In Figure 2, if a variable in a network was ranked more than once in the top three for a centrality statistic, only the highest rank was preserved. Hence, if two variables assessing cognition had the highest betweenness and second highest betweenness, we only report that cognition was most central in Figure 2. The conversion table to recode of items and subscales into domains can be found in the Supplementary Materials: Recoding of Variables section.

In the results in Table 5B, we excluded centrality and edge statistics on assessments that were: (1) Study design variables, (2) biological factors or medication related factors, (3) environmental factors, or (4) social factors acting on the person. Hence, in this review we included variables that can be considered internal to a person, were not impacted by an external influence, and were not biological variables.

Metrics within studies are usually reported graphically, where the results have been reported as standardised or unstandardized. We used the three top ranked nodes and edges across each metric: Betweenness, closeness, strength, and degree. Ranks were used due to the heterogeneity in the values of the metrics reported across the 32 studies. In the case where there were ties in the results, both tied nodes and edges were included. We did not omit or segregate results based on different data types. We collected the data by visually inspecting the plots in figures for all studies to identify which node or edge had the larger metric. No corresponding authors were contacted to clarify their results. Although there were missing values reported in some studies, no data imputation strategy took place. The missing values were often associated with the study design and therefore are not likely to be missing at random. Some of the results collected were illegible, possibly due to the publication process, and this is reported in the results section.

In this study we do not report the metrics using a chart and all results are provided in a table format. Study descriptions, the analysis methods of the 32 studies, and the quality appraisal are presented. Items of the quality appraisal assessment were reported as present, absent, not addressed, or not available, in addition to the study’s sample size and the design of the study.

# 2. Other Supplementary Materials: Gaps in the Literature

Table 2A presents information about the analysis method for each retrieved document. Most studies implemented a static network (*N* = 30), and two studies implemented a dynamic network of symptoms. Dynamic networks on longitudinal data was used in Badal et al. (2021) who used ecological momentary assessment data, and Moffa et al. (2021) who applied a dynamic Bayesian network to schizophrenia symptoms and depressive symptoms. Only three studies were fully directed networks (Abplanalp et al., 2023; Bak et al., 2016; Moffa et al., 2021) and two studies were partially directed (Amore et al., 2020; Badal et al., 2021). Furthermore, many of the studies used Gaussian graphical models to examine the relationship between symptoms (some did not state the method although they used GLASSO, EBIC, and the package qgraph in R; Epskamp et al. (2012)), partial correlations for the degree of associations between variables, and the GLASSO algorithm to optimise the network. Furthermore, most studies used resampling methods to identify network properties, such as edge weights, or for non-parametric hypothesis testing.

**Table 2A**

*Methods of included studies*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Author | Network model | Statistics | Optimization | Optimization criteria | Dynamic | Directed | Resampling | Parametric tests / confidence Intervals | Non-Parametric tests / confidence Intervals |
| Abplanalp et al. (2023) | Bayesian network | Conditional dependency | Hill climbing | BIC | Static | Directed | Yes | No | No |
| Amore et al. (2020) | GGM; BN | Partial correlation | GLASSO; Hill climbing | EBIC; BIC | Static | Undirected; Partially directed | Yes | No | Yes |
| Badal et al. (2021) | Causal network analysis | Partial correlation | MCI | Conditional independence | Dynamic | Partially directed | No | No | No |
| Bak et al. (2016) | Not stated | Spearman's partial correlation | Not stated | None | Static | Directed | No | No | No |
| Brasso et al. (2023) | Not stated | Correlation | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Charernboon (2021) | Not stated | Partial correlation | GLASSO | Not stated | Static | Undirected | Yes | No | Yes |
| Choi et al. (2022) | Not stated | Polychoric correlation | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Dal Santo et al. (2022) | GGM | Patrial correlation | GLASSO | Not stated | Static | Undirected | Yes | No | Yes |
| Demyttenaere, Anthonis, et al. (2022) | Not stated | Partial correlation coefficient | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Demyttenaere, Leenaerts, et al. (2022) | Not stated | Polychoric partial correlation coefficient | GLASSO | EBIC | Static | Undirected | Yes | Yes | Yes |
| Esfahlani et al. (2017) | None | Absolute value of Pearson’s partial correlations | None | None | Static | Undirected | No | No | Yes |
| Esfahlani et al. (2018) | None | Absolute value of partial correlation | None | None | Static | Undirected | Yes | No | No |
| Galderisi et al. (2018) | Not stated | Nonparametric partial correlations | GLASSO | Not stated | Static | Undirected | Yes | No | Yes |
| Galderisi et al. (2020) | Not stated | Not stated | GLASSO | EBIC | Static | Undirected | Yes | Yes | Yes |
| Hajdúk et al. (2019) | GGM | Partial correlation | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Hasson-Ohayon et al. (2018) | Not stated | Partial correlation | GLASSO | EBIC | Static | Undirected | No | No | No |
| Hopkins et al. (2022) | Not stated | Partial correlation | GLASSO | EBIC | Static | Undirected | Yes | No | No |
| Hu et al. (2022) | GGM | Partial correlation | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Levine and Leucht (2016) | Not stated | Partial polychoric correlation | GLASSO | Not stated | Static | Undirected | Yes | No | Yes |
| Li et al. (2022) | Not stated | Correlation | eLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Moffa et al. (2021) | DBN | Conditional independence | MCMC | Not stated | Dynamic | Directed | No | No | No |
| Monteleone et al. (2021) | Not stated | Partial correlation | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Monteleone et al. (2022) | Not stated | Partial correlation | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Park et al. (2020) | Not stated | Not stated | GLASSO | EBIC | Static | Undirected | No | No | No |
| Peralta et al. (2020) | Not stated | Partial correlation | GLASSO, Walktrap | EBIC | Static | Undirected | Yes | Yes | Yes |
| Strauss, Esfahlani, Galderisi, et al. (2019) | None | Mutual information | None | None | Static | Undirected | No | Yes | No |
| Strauss, Esfahlani, Kirkpatrick, et al. (2019) | None | Normalized mutual information | None | None | Static | Undirected | No | Yes | No |
| Strauss et al. (2020) | None | Cosine similarity | Not stated | None | Static | Undirected | No | Yes | No |
| Sun et al. (2023) | Not stated | Spearman’s correlations | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| van Rooijen et al. (2018) | GGM | L1-regularized partial correlation | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Wang et al. (2023) | GGM | Partial correlation | GLASSO | EBIC | Static | Undirected | Yes | No | Yes |
| Yan et al. (2022) | Not stated | Partial correlation | Not stated | Not stated | Static | Undirected | No | No | No |

Note. GGM = Gaussian graphical model; BN = Bayesian networks; DBN = Dynamic Bayesian networks; GLASSO = Graphical least absolute shrinkage and selection operator; MCI = Momentary Conditional Independence; MCMC = Markov chain Monte Carlo; EBIC = Extended Bayesian information criterion; BIC = Bayesian information criterion.

# 3. Other Supplementary Materials: PRISMA Checklist

**Table 3A**

*PRISMA Checklist*

| **Section and Topic**  | **Item #** | **Checklist item**  | **Location where item is reported**  |
| --- | --- | --- | --- |
| **TITLE**  |  |
| Title  | 1 | Identify the report as a systematic review. | Title |
| **ABSTRACT**  |  |
| Abstract  | 2 | See the PRISMA 2020 for Abstracts checklist. | Abstract |
| **INTRODUCTION**  |  |
| Rationale  | 3 | Describe the rationale for the review in the context of existing knowledge. | Introduction |
| Objectives  | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | Introduction |
| **METHODS**  |  |
| Eligibility criteria  | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | Methods |
| Information sources  | 6 | Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | Other Supplementary Materials |
| Search strategy | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | Other Supplementary Materials |
| Selection process | 8 | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | Other Supplementary Materials |
| Data collection process  | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | Other Supplementary Materials |
| Data items  | 10a | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | Other Supplementary Materials |
| 10b | List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | Other Supplementary Materials |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | Other Supplementary Materials |
| Effect measures  | 12 | Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results. | Other Supplementary Materials |
| Synthesis methods | 13a | Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)). | Other Supplementary Materials |
| 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | Other Supplementary Materials |
| 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | Other Supplementary Materials |
| 13d | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | Other Supplementary Materials |
| 13e | Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression). | NA |
| 13f | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | NA |
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | NA |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | NA |
| **RESULTS**  |  |
| Study selection  | 16a | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram. | Results |
| 16b | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. |  |
| Study characteristics  | 17 | Cite each included study and present its characteristics. | Results |
| Risk of bias in studies  | 18 | Present assessments of risk of bias for each included study. | Results |
| Results of individual studies  | 19 | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots. | NA |
| Results of syntheses | 20a | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | NA |
| 20b | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | Results |
| 20c | Present results of all investigations of possible causes of heterogeneity among study results. | NA |
| 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | NA |
| Reporting biases | 21 | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | NA |
| Certainty of evidence  | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | NA |
| **DISCUSSION**  |  |
| Discussion  | 23a | Provide a general interpretation of the results in the context of other evidence. | Discussion |
| 23b | Discuss any limitations of the evidence included in the review. | Discussion |
| 23c | Discuss any limitations of the review processes used. | Discussion |
| 23d | Discuss implications of the results for practice, policy, and future research. | Discussion |
| **OTHER INFORMATION** |  |
| Registration and protocol | 24a | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | Registration and Protocol |
| 24b | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | Registration and Protocol |
| 24c | Describe and explain any amendments to information provided at registration or in the protocol. | Registration and Protocol |
| Support | 25 | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review. | Support and Conflicts of Interest |
| Competing interests | 26 | Declare any competing interests of review authors. | Support and Conflicts of Interest |
| Availability of data, code and other materials | 27 | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | NA |

# 4. Other Supplementary Materials: List of Assessments

**Table 4A**

*List of assessments by exclusion reason*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Abbreviation | Assessment name | N Studies | Internal variables | Domain |
| PANSS | Positive and negative symptom scale | 18 | Y | Psychopathology |
| BNSS | Brief negative symptom scale | 10 | Y | Psychopathology |
| CDSS | Calgary depression rating scale for schizophrenia | 9 | Y | Psychopathology |
| MATRICS | Measurement and treatment research to improve cognition in schizophrenia | 5 | Y | Cognition |
| FEIT | Facial emotion identification test | 3 | Y | Socio-emotional |
| ISMI | Internalised stigma of mental illness | 3 | N | Socio-emotional |
| SANS | Scale for the assessment of negative symptoms | 3 | Y | Psychopathology |
| BPRS | Brief psychiatric rating scale | 2 | Y | Psychopathology |
| EMA | Ecological momentary assessment | 2 | Y | Other |
| SLOF | Specific level of functioning scale | 3 | Y | Functioning |
| UPSA-B | UCSD performance-based skills assessment—brief | 2 | Y | Functioning |
| SOFAS | Social and occupational functioning assessment | 2 | Y | Functioning |
| TASIT | The awareness of social inference test | 2 | Y | Socio-emotional |
| SES | Service engagement scale | 2 | N | Other |
| RSA | Resilience scale for adults | 2 | N | Other |
| PSP  | Personal social performance scale | 2 | Y | Functioning |
| MSCEIT | Mayer-Salovey-Caruso emotional intelligence Test | 2 | Y | Socio-emotional |
| SHRS | St Hans rating sale | 2 | N | Other |
| MAS | Metacognition assessment scale | 2 | Y | Other |
| SAPS | Scale for the assessment of positive symptoms | 1 | Y | Psychopathology |
| CAINS | Clinical assessment interview for negative symptoms | 1 | Y | Psychopathology |
| PS | Paranoia scale | 1 | Y | Psychopathology |
| CLANG | Clinical language disorder rating scale | 1 | Y | Other |
| CASH | Comprehensive assessment of symptoms and history | 1 | Y | Psychopathology |
| SFS | Social functioning scale | 1 | Y | Functioning |
| ACE III | Addenbrookes cognitive examination version III | 1 | Y | Cognition |
| FT | Faces test | 1 | Y | Other |
| REMT | Reading the mind in the eyes test | 1 | Y | Other |
| HT | Hinting task | 1 | Y | Other |
| BLERT | Bell–Lysaker emotional recognition task | 1 | Y | Socio-emotional |
| SAT | Social attributions test | 1 | Y | Other |
| PST | Picture sequencing task | 1 | Y | Other |
| HI | Hollingshead index | 1 | N | Other |
| PDD | Perceived devaluation and discrimination scale | 1 | N | Socio-emotional |
| SAS | Simpson-Angus extrapyramidal side effects scale | 1 | N | Other |
| BARS | Barnes akathisia rating scale | 1 | N | Other |
| IPH | Indiana psychiatric illness interview | 1 | Y | Psychopathology |
| SNS | Self-Evaluation of Negative Symptoms Scale | 1 | Y | Psychopathology |
| Clinical interview | Clinical interview | 1 | Y | Other |
| Medical record | Medical record | 1 | Y | Other |
| Duration | Illness duration | 1 | Y | Other |

|  |  |
| --- | --- |
|  |  |

# 5. Other Supplementary Materials: Tables

**Table 5A**

*Node Metrics for all variables included in the domains, text version.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Author | Betweenness | Closeness | Strength | Degree |
| Amore et al. (2020) ; Depressive symptoms and insight |  |  | 1. Depression (CDSS; F) |  |
|  |  | 2. Hopelessness (CDSS; F) |  |
|  |  | 3. Observed depression (CDSS; F) |  |
| Amore et al. (2020) ; Extended network |  |  | 1. Depression (CDSS; F) |  |
|  |  | 2. Social cognition (Factor analysis; F) |  |
|  |  | 3. Positive (PANSS; F) |  |
| Bak et al. (2016); Stable state | 1. Down (EMA; I) | 1. Down (EMA; I) | 1. Down (EMA; I) |  |
| 2. Paranoia (EMA; I) | 2. Paranoia (EMA; I) | 2. Paranoia (EMA; I) |  |
| 3. Loss of control (EMA; I) =  | 3. Loss of control (EMA; I) =  | 3. Hearing voices (EMA; I) |  |
|  | Hearing voices (EMA; I) |  Hearing voices (EMA; I) |  |  |
| Bak et al. (2016); Impending relapse | 1. Paranoia (EMA; I) | 1. Paranoia (EMA; I) | 1. Paranoia (EMA; I) |  |
| 2. Down (EMA; I) | 2. Down (EMA; I) | 2. Down (EMA; I) |  |
| 3. Loss of control (EMA; I) = | 3. Loss of control (EMA; I) | 3. Hearing voices (EMA; I) |  |
| Hearing voices (EMA; I) |  |  |  |
| Bak et al. (2016); Full relapse state | 1. Paranoia (EMA; I) | 1. Paranoia (EMA; I) | 1. Paranoia (EMA; I) |  |
| 2. Loss of control (EMA; I) | 2. Hearing voices (EMA; I) | 2. Hearing voices (EMA; I) |  |
| 3. Down (EMA; I) | 3. Loss of control (EMA; I) | 3. Down (EMA; I) |  |
| Brasso et al. (2023); Duration of illness < 5 years | 1. Visual learning (MATRICS; F) | 1. Visual learning (MATRICS; F) |  | 1. Speed of Processing (MATRICS; F) = |
| 2. Speed of processing (MATRICS; F) | 2. SLOF (SLOF; F) |  | Avolition (BNSS; F) |
| 3. Avolition (BNSS; F) | 3. Working memory (MATRICS; F); Meta cognition (MAS; F) |  | 3. Expressive deficit (BNSS; F) |
| Brasso et al. (2023); Duration of illness > 5 years | 1. Working memory (MATRICS; F) | 1. Working memory (MATRICS; F) |  | 1. Working memory (MATRICS; F) |
| 2. Verbal learning (MATRICS; F) | 2. Verbal learning (MATRICS; F) |  | 2. Verbal learning (MATRICS; F) |
| 3. Visual learning (MATRICS; F) | 3. Visual learning (MATRICS; F) |  | 3. Meta cognition (MAS; F) |
| Charernboon (2021) | 1. Total (PSP; F) | 1. Total (PSP; F) | 1. Total (PSP; F) |  |
|  | 2. Total (ACE-III; F) | 2. Asocial (SANS; F) | 2. Alogia (SANS; F) |  |
|  | 3. Asocial (SANS; F) | 3. Avolition (SANS; F) | 3. Avolition (SANS; F) |  |
| Choi et al. (2022) | 1. Depressed mood (BPRS; I) | 1. Depressed mood (BPRS; I) | 1. Motor retardation (BPRS; I) |  |
|  | 2. Motor retardation (BPRS; I) | 2. Motor retardation (BPRS; I) | 2. Depressed mood (BPRS; I) |  |
|  | 3. Unusual thought content (BPRS; I) | 3. Unusual thought content (BPRS; I) | 3. Unusual thought content (BPRS; I) |  |
| Dal Santo et al. (2022) |  |  | 1. Delusions (PANSS; I) |  |
|  |  |  | 2. Emotional withdrawal (PANSS; I) |  |
|  |  |  | 3. Depression (CDSS; I) |  |
| Demyttenaere, Anthonis, et al. (2022) | 1. Delusions (PANSS; I) | 1. Depression (CDSS; I) | 1. Depression (CDSS; I) |  |
| 2. Suspiciousness (PANSS; I) | 2. Suspiciousness (PANSS; I) | 2. Delusions (PANSS; I) |  |
| 3. Excitement (PANSS; I) | 3. Conceptual disorganization (PANSS; I) | 3. Conceptual disorganization (PANSS; I) |  |
| Demyttenaere, Leenaerts, et al. (2022); Acute population | 1. Delusions (PANSS; I) | 1. Delusions (PANSS; I) | 1. Delusions (PANSS; I) |  |
| 2. Suspiciousness (PANSS; I) | 2. Suspiciousness (PANSS; I) | 2. Suspiciousness (PANSS; I) |  |
| 3. Excitement (PANSS; I) | 3. Poor rapport (PANSS; I) | 3. Poor rapport (PANSS; I) |  |
| Demyttenaere, Leenaerts, et al. (2022); Predominant negative symptoms | 1. Hostility (PANSS; I) | 1. Hostility (PANSS; I) | 1. Hostility (PANSS; I) |  |
| 2. Delusions (PANSS; I) | 2. Grandiosity (PANSS; I) | 2. Delusions (PANSS; I) |  |
| 3. Grandiosity (PANSS; I) | 3. Stereotyped thinking (PANSS; I) | 3. Grandiosity (PANSS; I) |  |
| Esfahlani et al. (2018); Treatment resistant |  | 1. Suspiciousness (PANSS; I) |  | 1. Hostility (PANSS; I) |
|  | 2. Poor rapport (PANSS; I) |  | 2. Delusions (PANSS; I) |
|  | 3. Hostility (PANSS; I) |  | 3. Poor rapport (PANSS; I) |
| Esfahlani et al. (2018); Treatment responsive |  | 1. Excitement (PANSS; I) |  | 1. Blunted affect (PANSS; I) |
|  | 2. Delusions (PANSS; I) |  | 2. Lack of spontaneity and flow of conversation (PANSS; I) |
|  | 3. Blunted affect (PANSS; I) |  | 3. Delusions (PANSS; I) |
| Galderisi et al. (2018) | 1. Everyday life skills (SLOF; F) | 1. Everyday life skills (SLOF; F) | 1. Working memory (MATRICS; F) |  |
|  | 2. Total (UPSA-B; F) | 2. Total (UPSA-B; F) | 2. Everyday life skills (SLOF; F) |  |
|  | 3. Total (TASIT-1; F) | 3. Work skills (SLOF; F) | 3. Total (TASIT-2; F) |  |
| Galderisi et al. (2020); Baseline | 1. Total (UPSA-B; F) | 1. Total (UPSA-B; F) |  | 1. Working memory (MATRICS; F) |
|  | 2. Everyday life skills (SLOF; F) | 2. Everyday life skills (SLOF; F) |  | 2. Everyday life skills (SLOF; F) |
|  | 3. Working memory (MATRICS; F) | 3. Working memory (MATRICS; F) |  | 3. Total (TASIT-2; F) |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Galderisi et al. (2020); Follow-up | 1. Work skills (SLOF; F) | 1. Work skills (SLOF; F) |  | 1. Working memory (MATRICS; F) |
|  | 2. Everyday life skills (SLOF; F) | 2. Everyday life skills (SLOF; F) |  | 2. Everyday life skills (SLOF; F) |
|  | 3. Total (UPSA-B; F) | 3. Total (UPSA-B; F) |  | 3. Total (TASIT-2; F) |
| Galderisi et al. (2020); Not recovered | 1. Work skills (SLOF; F) | 1. Work skills (SLOF; F) |  | 1. Working memory (MATRICS; F) |
| 2. Interpersonal relationships (SLOF; F) | 2. Everyday life skills (SLOF; F) |  | 2. Everyday life skills (SLOF; F) |
| 3. Everyday life skills (SLOF; F) | 3. Total (UPSA-B; F) |  | 3. Total (TASIT-2; F) |
| Galderisi et al. (2020); Recovered | 1. Working memory (MATRICS; F) |  |  | 1. Total (TASIT-2; F) |
| 2. Attention (MATRICS; F) |  |  | 2. Working memory (MATRICS; F) |
| 3. Verbal learning (MATRICS; F) |  |  | 3. Total (TASIT-1; F) |
| Hajdúk et al. (2019) | 1. P17 (PS; I) | 1. P17 (PS; I) | 1.P14 (PS; I) |  |
|  | 2. IR07 (SLOF; I) | 2. P14 (PS; I) | 2. P18 (PS; I) |  |
|  | 3. P03 (PS; I) = P14 (PS; I) | 3. P18 (PS; I) | 3. P19 (PS; I) |  |
| Hasson-Ohayon et al. (2018) | 1. Cognitive (PANSS; F) | 1. Cognitive (PANSS; F) | 1. Cognitive (PANSS; F) |  |
|  | 2. Working memory (MATRICS; F) | 2. Working memory (MATRICS; F) | 2. Visual learning (MATRICS; F) |  |
|  | 3. Mastery (MAS; F) | 3. Social cognition (BLERT; F) | 3. Working memory (MATRICS; F) |  |
| Hu et al. (2022); Symptom dimension | 1. Positive (PANSS; F) | 1. Positive (PANSS; F) | 1. Total (SOFAS; F) |  |
| 2. Expressivity (CAINS; F) | 2. Expressivity (CAINS; F) | 2. Motivation and pleasure (CAINS; F) |  |
| 3. Total (SOFAS; F) | 3. Total (SOFAS; F) | 3. Positive (PANSS; F) |  |
| Hu et al. (2022); Item level | 1. Total (SOFAS; F) | 1. Total (SOFAS; F) | 1. Total (SOFAS; F) |  |
|  | 2. Delusions (PANSS; I) | 2. Vocational, motivation (CAINS; I) | 2. Expression, speech (CAINS; I) |  |
|  | 3. Recreation, motivation (CAINS; I) | 3. Delusions (PANSS; I) | 3. Expression, vocal prosody (CAINS; I) |  |
| Levine and Leucht (2016); Baseline | 1. Poverty of speech (SANS; I) | 1. Decreased spontaneous movements (SANS; I) =  | 1. Decreased spontaneous movements (SANS; I) |  |
| 2. Paucity expressive gestures (SANS; I) | Paucity expressive gestures (SANS; I) =  | 2. Paucity expressive gestures (SANS; I) |  |
| 3. Decreased spontaneous movements (SANS; I) | Poverty of speech (SANS; I) =  | 3. Relationships with friends & peers (SANS; I) |  |
|  |  | Poverty of content of speech (SANS; I) |  |  |
| Levine and Leucht (2016); Endpoint | 1. Increased response latency (SANS; I) | 1. Increased response latency (SANS; I) =  | 1. Decreased spontaneous movements (SANS; I) |  |
| 2. Test inattentiveness (SANS; I) | Social inattentiveness (SANS; I) =  | 2. Ability feel intimacy & closeness (SANS; I) |  |
| 3. Social inattentiveness (SANS; I) | Test inattentiveness (SANS; I) | 3. Poverty of speech (SANS; I) |  |
| Levine and Leucht (2016); Change | 1. Inappropriate affect (SANS; I) | 1. Inappropriate affect (SANS; I) | 1. Poverty of speech (SANS; I) =  |  |
| 2. Physical anergia (SANS; I) | 2. Lack vocal inflections (SANS; I) = | Poverty of content of speech (SANS; I) |  |
| 3. Increased response latency (SANS; I) | Blocking (SANS; I) =  | 3. Decreased spontaneous movements (SANS; I) =  |  |
|  | Affective nonresponsivity (SANS; I) | Paucity expressive gestures (SANS; I) |  |
| Li et al. (2022) |  |  | 1. Social and occupational dysfunction (Clinical interview; I) |  |
|  |  | 2. Hallucinations (Clinical interview; I) |  |
|  |  | 3. Negative symptoms (Clinical interview; I) |  |
|  |  |  |  |
|  |  |  |  |
| Strauss, Esfahlani, Kirkpatrick, et al. (2019); Male and female | 1. Quantity of speech (BNSS, I) |  |  | 1. Quantity of speech (BNSS; I) |
| 2. Avolition inner experience (BNSS; I) |  |  | 2. Asociality inner experience (BNSS; I) =  |
| 3. Spontaneous elaboration (BNSS; I) |  |  | Avolition inner experience (BNSS; I) |
| Strauss, Esfahlani, Kirkpatrick, et al. (2019); Male | 1. Quantity of speech (BNSS, I) |  |  | 1. Quantity of speech (BNSS, I) |
| 2. Spontaneous elaboration (BNSS, I) |  |  | 2. Spontaneous elaboration (BNSS, I) |
| 3. Facial expression (BNSS, I) |  |  | 3. Asociality inner experience (BNSS, I) |
| Strauss, Esfahlani, Kirkpatrick, et al. (2019); Female | 1. Vocal expression (BNSS, I) |  |  | 1. Vocal expression (BNSS, I) |
| 2. Asociality inner experience (BNSS, I) |  |  | 2. Asociality inner experience (BNSS, I) |
| 3. Avolition behavior (BNSS, I) |  |  | 3. Facial expression (BNSS, I) |
| Strauss et al. (2020); Treatment |  | 1. Frequency of pleasurableactivities (BNSS; I) |  | 1. Frequency of pleasurable activities (BNSS; I) |
|  | 2. Intensity of pleasure during activities (BNSS; I) |  | 2. Intensity of pleasure during activities (BNSS; I) |
|  | 3. Avolition behavior (BNSS; I) |  | 3. Avolition behavior (BNSS; I) |
| Strauss et al. (2020); Placebo |  | 1. Intensity of pleasure during activities (BNSS; I) |  | 1. Intensity of pleasure during activities (BNSS; I)  |
|  | 2. Avolition behavior (BNSS; I)  |  | 2. Asociality behavior (BNSS; I) = |
|  | 3. Asociality behavior (BNSS; I) |  | Avolition behavior (BNSS; I) |
| Sun et al. (2023); t1 |  |  | 1. Emotional withdrawal (PANSS; I) |  |
|  |  | 2. Lack of spontaneity and flow of conversation (PANSS; I) |  |
|  |  | 3. Difficulty in abstract thinking (PANSS; I) |  |
| Sun et al. (2023); t2 |  |  | 1. Delusions (PANSS; I) |  |
|  |  | 2. Emotional withdrawal (PANSS; I) |  |
|  |  | 3. Excitement (PANSS; I) |  |
| Sun et al. (2023); t3 |  |  | 1. Delusions (PANSS; I) |  |
|  |  | 2. Excitement (PANSS; I) |  |
|  |  | 3. Lack of spontaneity and flow of conversation (PANSS; I) |  |
| Sun et al. (2023); t4 |  |  | 1. Excitement (PANSS; I) |  |
|  |  | 2. Emotional withdrawal (PANSS; I) |  |
|  |  | 3. Delusions (PANSS; I) |  |
| Sun et al. (2023); resistant |  |  | 1. Excitement (PANSS; I) |  |
|  |  | 2. Delusions (PANSS; I) |  |
|  |  | 3. Emotional withdrawal (PANSS; I) |  |
| Sun et al. (2023); response |  |  | 1. Delusions (PANSS; I) |  |
|  |  | 2. Emotional withdrawal (PANSS; I) |  |
|  |  | 3. Difficulty in abstract thinking (PANSS; I) |  |
| van Rooijen et al. (2018) | 1. Delusions (PANSS; I) | 1. Delusions (PANSS; I) | 1. Delusions (PANSS; I) =  |  |
|  | 2. Poor rapport (PANSS; I) | 2. Poor rapport (PANSS; I) | Depressed mood (CDSS; I) |  |
|  | 3. Stereotyped thinking (PANSS; I) | 3. stereotyped thinking (PANSS; I) | 3. Emotional withdrawal (PANSS; I) |  |
| Wang et al. (2023) | 1. Avolition-apathy (SANS; F) | 1. Avolition-apathy (SANS; F) | 1. Anhedonia-asociality (SANS; F) | 1. Anhedonia-asociality (SANS; F) |
| 2. Avolition (BNSS; F) | 2. Anhedonia-asociality (SANS; F) | 2. Affective flattening (SANS; F) | 2. Affective flattening (SANS; F) |
| 3. Anhedonia-asociality (SANS; F) | 3. Alogia (SANS; F) | 3. Alogia (SANS; F) | 3. Alogia (SANS; F) |
| Yan et al. (2022); BPRS |  |  |  | 1. Anergia (BPRS; F) |
|  |  |  |  | 2. Anxious depression (BPRS; F) |
| Yan et al. (2022); PANSS |  |  |  | 1. Negative (PANSS, F) |
|  |  |  |  | 2. Cognitive (PANSS, F) |
|  |  |  |  | 3. Depressive (PANSS, F) |

Note: Purple cells = items or subscales that measure cognition; Green cells = items or subscales that measure functioning; Red cells = items or subscales that measure positive symptoms; Yellow = represent items or subscales that measure negative symptoms; Blue cells = items or subscales that measure depression; I = item; F = Factor; ACE III = Addenbrookes cognitive examination version III; BLERT = Bell–Lysaker Emotional Recognition Task; BNSS = Brief negative symptom scale; BPRS = Brief psychiatric rating scale; CAINS = Clinical assessment interview for negative symptoms; CDSS = Calgary depression rating scale for schizophrenia; EMA = Ecological momentary assessment; MATRICS = Measurement and treatment research to improve cognition in schizophrenia; PANSS = Positive and negative syndrome scale; PS = Paranoia scale; PSP = Personal social performance scale; SANS = Scale for the assessment of negative symptoms; SLOF = Specific level of functioning scale; SOFAS = Social and occupational functioning assessment scale; TASIT = The awareness of social inference test; UPSA-B = UCSD Performance-Based Skills Assessment—Brief.

**Table 5B**

*Node Metrics for all Included Assessments*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Author | Betweenness | Closeness | Strength | Degree |
| Amore et al. (2020) ; Depressive symptoms and insight |  |  | 1. Depressed mood (CDSS; i) |  |
|  |  | 2. Hopelessness (CDSS; I) |  |
|  |  | 3. Observed depression (CDSS; I) |  |
| Amore et al. (2020) ; Extended network |  |  | 1. Depressed mood (CDSS; I) |  |
|  |  | 2. Disorganization (PANSS; F) |  |
|  |  | 2. Social cognition (Factor analysis; F) |  |
| Bak et al. (2016); Stable state | 1. Down (EMA; I) | 1. Relaxed (EMA; I) | 1. Down (EMA; I) |  |
| 2. Paranoia (EMA; I) | 2. Down (EMA; I) | 2. Relaxed (EMA; I) |  |
| 3. Relaxed (EMA; I) | 3. Paranoia (EMA; I) | 3. Paranoia (EMA; I) |  |
| Bak et al. (2016); Impending relapse | 1. Down (EMA; I) | 1. Paranoia (EMA; I) | 1. Paranoia (EMA; I)) |  |
| 2. Paranoia (EMA; I) | 2. Down (EMA; I) | 2. Relaxed (EMA; I) |  |
| 3. Loss of control (EMA; I) =  | 3. Loss of control (EMA; I) | 3. Down (EMA; I) |  |
|  | Hearing voices (EMA; I) = |  |  |  |
|  | Relaxed (EMA; I) |  |  |  |
| Bak et al. (2016); Full relapse state | 1. Paranoia (EMA; I) | 1. Paranoia (EMA; I) | 1. Paranoia (EMA; I) |  |
| 2. Loss of control (EMA; I) | 2. Hearing voices (EMA; I) | 2. Hearing voices (EMA; I) |  |
| 3. Down (EMA; I) | 3. Relaxed (EMA; I) | 3. Down (EMA; I) |  |
| Brasso et al. (2023); Duration of illness < 5 years | 1. Disorganization (PANSS; F) | 1. Disorganization (PANSS; F) |  | 1. Avolition (BNSS; F) = |
| 2. Visual learning (MATRICS; F) | 2. Visual learning (MATRICS; F) |  |  Speed of processing (MATRICS; F) |
| 3. Speed of processing (MATRICS; F) | 3. Total (SLOF; F) |  | 3. Expressive deficit (BNSS; F) |
| Brasso et al. (2023); Duration of illness > 5 years | 1. Working memory (MATRICS; F) | 1. Working memory (MATRICS; F) |  | 1. Working memory (MATRICS; F) |
| 2. Disorganization (PANSS; F) | 2. Verbal learning (MATRICS; F) |  | 2. Disorganization (PANSS; F) |
| 3. Verbal learning (MATRICS; F) | 3. Visual learning (MATRICS; F) |  | 3. Verbal learning (MATRICS; F) |
| Charernboon (2021) | 1. Total (PSP; F) | 1. Total (PSP; F) | 1. Total (PSP; F) |  |
|  | 2. Total (ACE-III; F) | 2. Asocial (SANS; F) | 2. Alogia (SANS; F) |  |
|  | 3. Asocial (SANS; F) | 3. Avolition (SANS; F) | 3. Avolition (SANS; F) |  |
| Choi et al. (2022) | 1. Depressive mood (BPRS; I) | 1. Excitement (BPRS; I) | 1. Motor retardation (BPRS; I) |  |
|  | 2. Motor retardation (BPRS; I) | 2. Depressive mood (BPRS; I) | 2. Depressive mood (BPRS; I) |  |
|  | 3. Unusual thought content (BPRS; I) | 3. Grandiosity (BPRS; I) | 3. Unusual thought content (BPRS; I) |  |
| Dal Santo et al. (2022) |  |  | 1. Depression (PANSS; I) |  |
|  |  | 2. Delusions (PANSS; I) |  |
|  |  | 3. Emotional withdrawal (PANSS; I) |  |
| Demyttenaere, Anthonis, et al. (2022) | 1. Anxiety (PANSS; I) | 1. Anxiety (PANSS; I) | 1. Depression (PANSS; I) |  |
| 2. Tension (PANSS; I) | 2. Tension (PANSS; I) | 2. Depression (CDSS; I) |  |
| 3. Lack of judgement and insight (PANSS; I) | 3. Lack of judgement and insight (PANSS; I) | 3. Anxiety (PANSS; I) |  |
| Demyttenaere, Leenaerts, et al. (2022); Acute population | 1. Motor retardation (PANSS; I) | 1. Motor retardation (PANSS; I) | 1. Delusions (PANSS; I) |  |
| 2. Delusions (PANSS; I) | 2. Delusions (PANSS; I) | 2. Uncooperativeness (PANSS; I) |  |
| 3. Depression (PANSS; I) | 3. Suspiciousness (PANSS; I) | 3. Active social avoidance (PANSS; I) |  |
| Demyttenaere, Leenaerts, et al. (2022); Predominant negative symptoms | 1. Hostility (PANSS; I) | 1. Hostility (PANSS; I) | 1. Hostility (PANSS; I) |  |
| 2. Preoccupation (PANSS; I) | 2. Guilt feelings (PANSS; I) | 2. Delusions (PANSS; I) |  |
| 3. Delusions (PANSS; I) | 3. Grandiosity (PANSS; I) | 3. Tension (PANSS; I) |  |
| Esfahlani et al. (2018); Treatment resistant |  | 1. Suspiciousness (PANSS; I) |  | 1. Preoccupation (PANSS; I) |
|  | 2. Depression (PANSS; I) |  | 2. Hostility (PANSS; I) |
|  | 3. Preoccupation (PANSS; I) =  |  | 3. Delusions (PANSS; I) |
|  | Anxiety (PANSS; I) |  |  |
| Esfahlani et al. (2018); Treatment responsive |  | 1. Excitement (PANSS; I) |  | 1. Blunted affect (PANSS; I) |
|  | 2. Delusions (PANSS; I) |  | 2. Lack of spontaneity and flow of conversation (PANSS; I) |
|  | 3. Blunted affect (PANSS; I) |  | 3. Delusions (PANSS; I) |
| Galderisi et al. (2018) | 1. Everyday life skills (SLOF; F) | 1. Everyday life skills (SLOF; F) | 1. Working memory (MATRICS; F) |  |
|  | 2. Total (UPSA-B; F) | 2. Total (UPSA-B; F) | 2. Everyday Life skills (SLOF; F) |  |
|  | 3. Total (TASIT-1; F) | 3. Work skills (SLOF; F) | 3. Total (TASIT-2; F) |  |
| Galderisi et al. (2020); Baseline | 1. Total (UPSA-B; F) | 1. Total (UPSA-B; F) |  | 1. Working memory (MATRICS; F) |
| 2. Everyday life skills (SLOF; F) | 2. Everyday life skills (SLOF; F) |  | 2. Everyday life skills (SLOF; F) |
| 3. Working memory (MATRICS; F) | 3. Working memory (MATRICS; F) |  | 3. Total (TASIT-2; F) |
| Galderisi et al. (2020); Follow-up | 1. Work skills (SLOF; F) | 1. Work skills (SLOF; F) |  | 1. Working memory (MATRICS; F) |
| 2. Everyday life skills (SLOF; F) | 2. Everyday life skills (SLOF; F) |  | 2. Everyday life skills (SLOF; F) |
| 3. Total (UPSA-B; F) | 3. Total (UPSA-B; F) |  | 3. Total (TASIT-2; F) |
|  |  |  |  |  |
|  |  |  |  |  |
| Galderisi et al. (2020); Not recovered | 1. Work skills (SLOF; F) | 1. Work skills (SLOF; F) |  | 1. Working memory (MATRICS; F) |
| 2. Interpersonal relationships (SLOF; F) | 2. Everyday life skills (SLOF; F) |  | 2. Everyday life skills (SLOF; F) |
| 3. Everyday life skills (SLOF; F) | 3. Total (UPSA-B; F) |  | 3. Total (TASIT-2; F) |
| Galderisi et al. (2020); Recovered | 1. Working memory (MATRICS; F) |  |  | 1. Total (TASIT-2; F) |
| 2. Attention (MATRICS; F) |  |  | 2. Working memory (MATRICS; F)  |
| 3. Verbal learning (MATRICS; F) |  |  | 3. Total (TASIT-1; F) |
| Hajdúk et al. (2019) | 1. P17 (PS; I) | 1. P17 (PS; I) | 1. P14 (PS; I) |  |
| 2. IR07 (SLOF; I) | 2. P14 (PS; I) | 2. P18 (PS; I) |  |
| 3. P14 (PS; I) =  | 3. P18 (PS; I) | 3. P19 (PS; I) |  |
| P3 (PS; I) |  |  |  |
| Hasson-Ohayon et al. (2018) | 1. Cognition (PANSS; F) | 1. Cognition (PANSS; F) | 1. Cognition (PANSS; F) |  |
|  | 2. Working memory (MATRICS; F) | 2. Working memory (MATRICS; F) | 2. Visual learning (MATRICS; F) |  |
|  | 3. Mastery and decentration (MAS-A; F) | 3. Social cognition (BLERT; F) | 3. Working memory (MATRICS; F) |  |
| Hu et al. (2022); Symptom dimension | 1. Positive (PANSS; F) | 1. Illness duration (I) | 1. Total (SOFAS; F) |  |
| 2. Illness duration (I) | 2. Positive (PANSS; F) | 2. Motivation and pleasure (CAINS; F) |  |
| 3. Expressivity (CAINS; F) | 3. Expressivity (CAINS; F) | 3. Positive (PANSS; F) |  |
| Hu et al. (2022); Item level | 1. Total (SOFAS; F) | 1. Total (SOFAS; F) | 1. Total (SOFAS; F) |  |
|  | 2. Illness duration (I) | 2. Illness duration (I) | 2. Expression, speech (CAINS; I) |  |
|  | 3. Delusions (PANSS; I) | 3. Vocational, motivation (CAINS; I) | 3. Expression, vocal prosody (CAINS; I) |  |
| Levine and Leucht (2016); Baseline | 1. Poverty of speech (SANS; I) | 1. Poverty of speech (SANS; I) =  | 1. Decreased spontaneous movements (SANS; I) |  |
| 2. Paucity expressive gestures (SANS; I) | Poverty of content of speech (SANS; I) = | 2. Paucity expressive gestures (SANS; I) |  |
| 3. Decreased spontaneous movements (SANS; I) | Decreased spontaneous movements (SANS; I) =  | 3. Relationships with friends & peers (SANS; I) |  |
|  | Paucity expressive gestures (SANS; I) |  |  |
| Levine and Leucht (2016); Endpoint | 1. Increased response latency (SANS; I) | 1. Increased response latency (SANS; I) =  | 1. Decreased spontaneous movements (SANS; I) |  |
| 2. Test inattentiveness (SANS; I) | Social inattentiveness (SANS; I) =  | 2. Ability feel intimacy & closeness (SANS; I) |  |
| 3. Social inattentiveness (SANS; I) | Test inattentiveness (SANS; I) | 3. Poverty of speech (SANS; I) |  |
| Levine and Leucht (2016); Change | 1. Inappropriate affect (SANS; I) | 1. Inappropriate affect (SANS; I) | 1. Poverty of speech (SANS; I) =  |  |
| 2. Physical anergia (SANS; I) | 2. Lack vocal inflections (SANS; I) =  | Poverty of content of speech (SANS; I) |  |
| 3. Increased response latency (SANS; I) | Blocking (SANS; I) =  | 3. Decreased spontaneous movements (SANS; I) =  |  |
|  | Affective no responsivity (SANS; I) | Paucity expressive gestures (SANS; I) |  |
| Li et al. (2022) |  |  | 1. Verbal aggression (Clinical interview; I) |  |
|  |  | 2. Social and occupational dysfunction (Clinical interview; I) |  |
|  |  | 3. Hallucinations (Clinical interview; I) |  |
| Park et al. (2020) | 1. Poverty of speech (CLANG; I) | 1. Disclosure failure (CLANG; I) | 1. Disclosure failure (CLANG; I) |  |
|  | 2. Dysarthria (CLANG; I) | 2. Aprosodic speech (CLANG; I) | 2. Excess syntactic constrains (CLANG; I) |  |
|  | 3. Disclosure failure (CLANG; I) | 3. Referential failure (CLANG; I) | 3. Abnormal prosody (CLANG; I) |  |
| Strauss, Esfahlani, Kirkpatrick, et al. (2019); Both genders | 1. Quantity of speech (BNSS, I) |  |  | 1. Quantity of speech (BNSS; I) |
| 2. Avolition inner experience (BNSS; I) |  |  | 2. Asociality inner experience (BNSS; I) =  |
| 3. Spontaneous elaboration (BNSS; I) |  |  | Avolition inner experience (BNSS; I) |
| Strauss, Esfahlani, Kirkpatrick, et al. (2019); Male | 1. Quantity of speech (BNSS, I) |  |  | 1. Quantity of speech (BNSS, I) |
| 2. Spontaneous elaboration (BNSS, I) |  |  | 2. Spontaneous elaboration (BNSS, I) |
| 3. Facial expression (BNSS, I) |  |  | 3. Asociality inner experience (BNSS, I) |
| Strauss, Esfahlani, Kirkpatrick, et al. (2019); Female | 1. Vocal expression (BNSS, I) |  |  | 1. Vocal expression (BNSS, I) |
| 2. Asociality inner experience (BNSS, I) |  |  | 2. Asociality inner experience (BNSS, I) |
| 3. Avolition behavior (BNSS, I) |  |  | 3. Facial expression (BNSS, I) |
| Strauss et al. (2020); Treatment |  | 1. Frequency of pleasurableactivities (BNSS; I) |  | 1. Frequency of pleasurable activities (BNSS; I) |
|  | 2. Intensity of pleasure during activities (BNSS; I) |  | 2. Intensity of pleasure during activities (BNSS; I) |
|  | 3. Avolition behavior (BNSS; I) |  | 3. Avolition behavior (BNSS; I) |
| Strauss et al. (2020); Placebo |  | 1. Intensity of pleasure during activities (BNSS; I) |  | 1. Intensity of pleasure during activities (BNSS; I)  |
|  | 2. Avolition behavior (BNSS; I)  |  | 2. Asociality behavior (BNSS; I) = |
|  | 3. Asociality behavior (BNSS; I) |  | Avolition behavior (BNSS; I) |
| Sun et al. (2023); t1 |  |  | 1. Emotional withdrawal (PANSS; I) |  |
|  |  | 2. Uncooperativeness (PANSS; I) |  |
|  |  | 3. Lack of spontaneity and flow of conversation (PANSS; I) |  |
| Sun et al. (2023); t2 |  |  | 1. Delusions (PANSS; I) |  |
|  |  | 2. Poor impulse control (PANSS; I) |  |
|  |  | 3. Emotional withdrawal (PANSS; I) |  |
| Sun et al. (2023); t3 |  |  | 1. Delusions (PANSS; I) |  |
|  |  | 2. Excitement (PANSS; I) |  |
|  |  | 3. Anxiety (PANSS; I) |  |
|  |  |  |  |  |
| Sun et al. (2023); t4 |  |  | 1. Excitement (PANSS; I) |  |
|  |  | 2. Emotional withdrawal (PANSS; I) |  |
|  |  | 3. Delusions (PANSS; I) |  |
| Sun et al. (2023); resistant |  |  | 1. Excitement (PANSS; I) |  |
|  |  | 2. Delusions (PANSS; I) |  |
|  |  | 3. Emotional withdrawal (PANSS; I) |  |
| Sun et al. (2023); response |  |  | 1. Delusions (PANSS; I) |  |
|  |  | 2. Emotional withdrawal (PANSS; I) |  |
|  |  | 3. Difficulty in abstract thinking (PANSS; I) |  |
| van Rooijen et al. (2018) | 1. Delusions (PANSS; I) | 1. Delusions (PANSS; I) | 1. Delusions (PANSS; I) =  |  |
|  | 2. Poor rapport (PANSS; I) | 2. Poor rapport (PANSS; I) | Depression (CDSS; I) |  |
|  | 3. Stereotyped thinking (PANSS; I) | 3. stereotyped thinking (PANSS; I) | 3. Emotional withdrawal (PANSS; I) |  |
| Wang et al. (2023) | 1. Avolition-apathy (SANS; F) | 1. Avolition-apathy (SANS; F) | 1. Anhedonia-asociality (SANS; F) | 1. Anhedonia-asociality (SANS; F) |
| 2. Avolition (BNSS; F) | 2. Anhedonia-asociality (SANS; F) | 2. Affective flattening (SANS; F) | 2. Affective flattening (SANS; F) |
| 3. Anhedonia-asociality (SANS; F) | 3. Alogia (SANS; F) | 3. Alogia (SANS; F) | 3. Alogia (SANS; F) |
| Yan et al. (2022); BPRS |  |  |  | 1. Total (BPRS; F) |
|  |  |  |  | 2. Hostility Suspiciousness (BPRS; F) |
|  |  |  |  | 3. Anergia (BPRS; F) |
| Yan et al. (2022); PANSS |  |  |  | 1. Negative (PANSS, F) |
|  |  |  |  | 2. Cognitive (PANSS, F) = |
|  |  |  |  | Excited (PANSS, F) =  |
|  |  |  |  | Total (PANSS, F) |

Note: Purple cells = items or subscales that measure cognition; Green cells = items or subscales that measure functioning; Red cells = items or subscales that measure positive symptoms; Yellow = represent items or subscales that measure negative symptoms; Blue cells = items or subscales that measure depression; I = item; F = Factor; ACE III = Addenbrookes cognitive examination version III; BLERT = Bell–Lysaker Emotional Recognition Task; BNSS = Brief negative symptom scale; BPRS = Brief psychiatric rating scale; CAINS = Clinical assessment interview for negative symptoms; CDSS = Calgary depression rating scale for schizophrenia; CLANG = Clinical language disorder rating scale; EMA = Ecological momentary assessment; MAS = Metacognition assessment scale; MATRICS = Measurement and treatment research to improve cognition in schizophrenia; PANSS = Positive and negative syndrome scale; PS = Paranoia scale; PSP = Personal social performance scale; SANS = Scale for the assessment of negative symptoms; SLOF = Specific level of functioning scale; SOFAS = Social and occupational functioning assessment scale; TASIT = The awareness of social inference test; UPSA-B = UCSD Performance-Based Skills Assessment—Brief.

# 6. Recoding of Variables to Domains

**Table 6A**

*Recoding of Variables to Domains*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Assessment | Factor / Item | Variables | Domain | Reference | Assessment | Factor / Item | Variables | Domain | Reference |
| ACE-III | Factor | Total | Cognition |  | MATRICS | Factor | Reasoning and problem solving | Cognition |  |
| BARS | Factor | Side effects | Side effects |  | MATRICS | Factor | Speed of processing | Cognition |  |
| BLERT | Factor | Social cognition | Cognition |  | MATRICS | Factor | Verbal learning | Cognition |  |
| BNSS | Factor | Alogia | Negative symptoms |  | MATRICS | Factor | Verbal and Spatial learning | Cognition |  |
| BNSS | Factor | Anhedonia | Negative symptoms |  | MATRICS | Factor | Visual learning | Cognition |  |
| BNSS | Factor | Asociality | Negative symptoms |  | MATRICS | Factor | Working memory | Cognition |  |
| BNSS | Factor | Avolition | Negative symptoms |  | MSCEIT | Factor | Managing emotion section | Cognition |  |
| BNSS | Factor | blunted affect | Negative symptoms |  | MSCEIT | Factor | Social Cognition | Cognition |  |
| BNSS | Factor | Expressive deficits | Negative symptoms |  | MSCEIT | Factor | Social cognition 1 | Cognition |  |
| BNSS | item | Asociality Behavior  | Negative symptoms |  | MSCEIT | Factor | Social cognition 2 | Cognition |  |
| BNSS | item | Asociality internal experience  | Negative symptoms |  | PANSS | Factor | Cognitive | Cognition | Mohr et al. (2004) |
| BNSS | item | Avolition Behavior  | Negative symptoms |  | PANSS | Factor | Depressive | Depression |  |
| BNSS | item | Avolition internal experience  | Negative symptoms |  | PANSS | Factor | Disorganisation | Disorganisation | Dollfus et al. (1991) |
| BNSS | item | Body gestures  | Negative symptoms |  | PANSS | Factor | Emotional discomfort | Emotional discomfort | Bell et al. (1994) |
| BNSS | item | Facial expression  | Negative symptoms |  | PANSS | Factor | Excited | Excited | Park et al. (2020) |
| BNSS | item | Frequency of pleasurable activities  | Negative symptoms |  | PANSS | Factor | Hostility | Hostility suspiciousness | Mohr et al. (2004) |
| BNSS | item | Intensity of future pleasure  | Negative symptoms |  | PANSS | Factor | Negative | Negative symptoms | Kay et al. (1987) |
| BNSS | item | Intensity of pleasurable activities  | Negative symptoms |  | PANSS | Factor | Positive | Positive symptoms | Kay et al. (1987) |
| BNSS | item | Lack of normal distress  | Negative symptoms |  | PANSS | Factor | General | General psychopathology | Kay et al. (1987) |
| BNSS | item | Quantity of speech  | Negative symptoms |  | PANSS | Factor | Total | Other | Kay et al. (1987) |
| BNSS | item | Spontaneous elaboration  | Negative symptoms |  | PANSS | Item | Active social avoidance | General psychopathology |  |
| BNSS | item | Vocal expression  | Negative symptoms |  | PANSS | Item | Anxiety | General psychopathology |  |
| BNSS | Item | Avolition | Negative symptoms |  | PANSS | Item | Blunted affect | Negative symptoms |  |
| BNSS | Item | Poor emotional expression | Negative symptoms |  | PANSS | Item | Conceptual disorganisation | Positive symptoms |  |
| BPRS | Factor | Activation | Activation | Yan et al. (2022) | PANSS | Item | Delusions | Positive symptoms |  |
| BPRS | Factor | Anergia | Negative symptoms | Yan et al. (2022) | PANSS | Item | Depression | General psychopathology |  |
| BPRS | Factor | Anxious depression | Depressive | Yan et al. (2022) | PANSS | Item | Difficulty in abstract thinking | Negative symptoms |  |
| BPRS | Factor | Hostility suspiciousness | Hostility suspiciousness | Yan et al. (2022) | PANSS | Item | Disorientation | General psychopathology |  |
| BPRS | Factor | Total | General Psychopathology |  | PANSS | Item | Disturbance in volition | General psychopathology |  |
| BPRS | Item | Anxiety | Anxiety | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Emotional withdrawal | Negative symptoms |  |
| BPRS | Item | Blunted affect | Negative symptoms | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Excitement | Positive symptoms |  |
| BPRS | Item | Conceptual disorganisation | Positive symptoms | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Grandiosity | Positive symptoms |  |
| BPRS | Item | Depressive mood | Depression | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Guilt feelings | General psychopathology |  |
| BPRS | Item | Disorientation | Other | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Hallucinatory behaviour | Positive symptoms |  |
| BPRS | Item | Emotional withdrawal | Negative symptoms | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Hostility | Positive symptoms |  |
| BPRS | Item | Excitement | Other | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Lack of judgement and insight | General Psychopathology |  |
| BPRS | Item | Grandiosity | Other | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Lack of spontaneity and flow of conversation | Negative symptoms |  |
| BPRS | Item | Guilt feelings | Depression | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Mannerisms and posturing | General Psychopathology |  |
| BPRS | Item | Hallucinatory behaviour | Positive symptoms | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Motor retardation | General Psychopathology |  |
| BPRS | Item | Hostility | Hostility suspiciousness | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Passive/apathetic social withdrawal | Negative symptoms |  |
| BPRS | Item | Mannerisms and posturing | Other | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Poor attention | General Psychopathology |  |
| BPRS | Item | Motor retardation | Negative symptoms | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Poor impulse control | General Psychopathology |  |
| BPRS | Item | Somatic concern | Other | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Poor rapport | Negative symptoms |  |
| BPRS | Item | Suspiciousness | Hostility suspiciousness | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Preoccupation | General Psychopathology |  |
| BPRS | Item | Tension | Other | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Somatic concern | General Psychopathology |  |
| BPRS | Item | Uncooperativeness | Hostility suspiciousness | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Stereotyped thinking | Negative symptoms |  |
| BPRS | Item | Unusual thought content | Positive symptoms | Overall, 1967, as cited in Shafer (2005) | PANSS | Item | Suspiciousness/persecution | Positive symptoms |  |
| CAINS | Factor | Expressivity | Negative symptoms |  | PANSS | Item | Tension | General Psychopathology |  |
| CAINS | Factor | Motivation and Pleasure | Negative symptoms |  | PANSS | Item | Uncooperativeness | General Psychopathology |  |
| CAINS | item | Social, family relationships | Negative symptoms |  | PANSS | Item | Unusual thought content | General Psychopathology |  |
| CAINS | item | Social, friendships | Negative symptoms |  | PDD | Factor | Perceived Discrimination | Social |  |
| CAINS | item | Social, past-week pleasure | Negative symptoms |  | PS | Item | P1 | Positive symptoms |  |
| CAINS | item | Social, expected pleasure | Negative symptoms |  | PS | Item | P10 | Positive symptoms |  |
| CAINS | item | Vocational, motivation | Negative symptoms |  | PS | Item | P11 | Positive symptoms |  |
| CAINS | item | Vocational, expected pleasure | Negative symptoms |  | PS | Item | P12 | Positive symptoms |  |
| CAINS | item | Recreation, motivation | Negative symptoms |  | PS | Item | P13 | Positive symptoms |  |
| CAINS | item | Recreation, past-week pleasure | Negative symptoms |  | PS | Item | P14 | Positive symptoms |  |
| CAINS | item | Recreation, expected pleasure | Negative symptoms |  | PS | Item | P15 | Positive symptoms |  |
| CAINS | item | Expression, facial | Negative symptoms |  | PS | Item | P16 | Positive symptoms |  |
| CAINS | item | Expression, vocal prosody | Negative symptoms |  | PS | Item | P17 | Positive symptoms |  |
| CAINS | item | Expression, gestures | Negative symptoms |  | PS | Item | P18 | Positive symptoms |  |
| CAINS | item | Expression, speech | Negative symptoms |  | PS | Item | P19 | Positive symptoms |  |
| CASH | item | Affective flattening | Negative symptoms | Peralta et al. (2020) | PS | Item | P2 | Positive symptoms |  |
| CASH | item | Alogia | Negative symptoms | Peralta et al. (2020) | PS | Item | P20 | Positive symptoms |  |
| CASH | item | Anhedonia/Asociality | Negative symptoms | Peralta et al. (2020) | PS | Item | P3 | Positive symptoms |  |
| CASH | item | Attentional disturbances | Positive symptoms | Peralta et al. (2020) | PS | Item | P4 | Positive symptoms |  |
| CASH | item | Avolition/Apathy | Negative symptoms | Peralta et al. (2020) | PS | Item | P5 | Positive symptoms |  |
| CASH | item | Bizarre Behavior | Positive symptoms | Peralta et al. (2020) | PS | Item | P6 | Positive symptoms |  |
| CASH | item | Catatonia | Positive symptoms | Peralta et al. (2020) | PS | Item | P7 | Positive symptoms |  |
| CASH | item | Change in appetite or weight | Depression | Peralta et al. (2020) | PS | Item | P8 | Positive symptoms |  |
| CASH | item | Decreased need for sleep | Mania | Peralta et al. (2020) | PS | Item | P9 | Positive symptoms |  |
| CASH | item | Delusions | Positive symptoms | Peralta et al. (2020) | PSP | Factor | Total | Functioning |  |
| CASH | item | Depressive mood | Depression | Peralta et al. (2020) | PSP | Item | Disturbing and aggressive behaviour | Functioning |  |
| CASH | item | Distractibility | Mania | Peralta et al. (2020) | PSP | Item | Personal and social relationships | Functioning |  |
| CASH | item | Euphoric mood | Mania | Peralta et al. (2020) | PSP | Item | self care | Functioning |  |
| CASH | item | Feelings of worthlessness | Depression | Peralta et al. (2020) | PSP | Item | Socially useful activities | Functioning |  |
| CASH | item | Formal thought disorders | Positive symptoms | Peralta et al. (2020) | PST | Factor | Total | Functioning |  |
| CASH | item | Hallucinations | Positive symptoms | Peralta et al. (2020) | RMET | Factor | Total | Cognition |  |
| CASH | item | Inability to think or concentrate | Depression | Peralta et al. (2020) | RSA | factor | Family cohesion | Social |  |
| CASH | item | Increase in activity | Mania | Peralta et al. (2020) | RSA | factor | Perception of future | Social |  |
| CASH | item | Inflated self-esteem | Mania | Peralta et al. (2020) | RSA | factor | Perception of self | Social |  |
| CASH | item | Insomnia or hypersomnia | Depression | Peralta et al. (2020) | RSA | factor | Social competence | Social |  |
| CASH | item | Loss of energy | Depression | Peralta et al. (2020) | SANS | Factor | Alogia | Negative symptoms |  |
| CASH | item | Loss of interest or pleasure | Depression | Peralta et al. (2020) | SANS | Factor | Anhedonia | Negative symptoms |  |
| CASH | item | Poor judgment | Mania | Peralta et al. (2020) | SANS | Factor | Anhedonia-asociality | Negative symptoms |  |
| CASH | item | Psychomotor agitation | Depression | Peralta et al. (2020) | SANS | Factor | Asociality | Negative symptoms |  |
| CASH | item | Psychomotor retardation | Negative symptoms | Peralta et al. (2020) | SANS | Factor | Attention | Negative symptoms |  |
| CASH | item | Racing thoughts | Mania | Peralta et al. (2020) | SANS | Factor | Avolition | Negative symptoms |  |
| CASH | item | Suicide thoughts/Behavior | Depression | Peralta et al. (2020) | SANS | Factor | Avolition-apathy | Negative symptoms |  |
| CASH | item | Talkativeness/pressure of speech | Mania | Peralta et al. (2020) | SANS | Factor | Blunted affect | Negative symptoms |  |
| CDSS | Factor | Depression | Depression |  | SANS | item | Unchanged facial expression | Negative symptoms |  |
| CDSS | Factor | Total | Depression |  | SANS | item | Decreased spontaneous movements | Negative symptoms |  |
| CDSS | Item | Depression | Depression |  | SANS | item | Paucity expressive gestt | Negative symptoms |  |
| CDSS | Item | Early awakening | Depression |  | SANS | item | Lack vocal inflections | Negative symptoms |  |
| CDSS | Item | Guilt ideas of reference | Depression |  | SANS | item | Blocking | Negative symptoms |  |
| CDSS | Item | Hopelessness | Depression |  | SANS | item | Increased response latency | Negative symptoms |  |
| CDSS | Item | Morning depression | Depression |  | SANS | item | Poor eye contact | Negative symptoms |  |
| CDSS | Item | Observed depression | Depression |  | SANS | item | Affective nonresponsivity | Negative symptoms |  |
| CDSS | Item | Pathological guilt | Depression |  | SANS | item | Inappropriate affect | Negative symptoms |  |
| CDSS | Item | Self-depreciation | Depression |  | SANS | item | Recreational interests and activities | Negative symptoms |  |
| CDSS | Item | Suicide | Depression |  | SANS | item | Sexual interest and activity | Negative symptoms |  |
| CLANG | item | Excess phonetic association | Thought disorder |  | SANS | item | Ability feel intimacy and closeness | Negative symptoms |  |
| CLANG | item | Abnormal syntax | Thought disorder |  | SANS | item | Relationship with friends and peers | Negative symptoms |  |
| CLANG | item | Excess syntactic constrains | Thought disorder |  | SANS | item | Grooming & hygiene | Negative symptoms |  |
| CLANG | item | Lack of semantic association | Thought disorder |  | SANS | item | Impersistence at work or school | Negative symptoms |  |
| CLANG | item | Referential failures | Thought disorder |  | SANS | item | Physical anergia | Negative symptoms |  |
| CLANG | item | Disclosure failure | Thought disorder |  | SANS | item | Poverty of speech | Negative symptoms |  |
| CLANG | item | Excess details | Thought disorder |  | SANS | item | poverty content of speech | Negative symptoms |  |
| CLANG | item | Lack of details | Thought disorder |  | SANS | item | social inattentiveness | Negative symptoms |  |
| CLANG | item | Aprosodic speech | Thought disorder |  | SANS | item | Test inattentiveness | Negative symptoms |  |
| CLANG | item | Abnormal prosody | Thought disorder |  | SAPS | Factor | Total | Positive symptoms |  |
| CLANG | item | Pragmatics disorder | Thought disorder |  | SAS | Factor | Side effects | Side effects |  |
| CLANG | item | Dysfluency | Thought disorder |  | SAT | Factor | Social cognition attribution | Cognition |  |
| CLANG | item | Dysarthria | Thought disorder |  | SES | factor | Total | Social |  |
| CLANG | item | Poverty of speech | Thought disorder |  | SFS | Factor | Communication | Functioning |  |
| CLANG | item | Pressure of speech | Thought disorder |  | SFS | Factor | Prosocial activities | Functioning |  |
| CLANG | item | Neologisms | Thought disorder |  | SFS | Factor | Social engagement/withdrawal | Functioning |  |
| CLANG | item | Paraphasic error | Thought disorder |  | SHRS | Item | extrapyramidal side effect | Side effects |  |
| Clinical Interview | Item | Affective symptoms | General psychopathology |  | SLOF | Factor | Functioning | Functioning |  |
| Clinical Interview | Item | Delusions | Positive symptoms |  | SLOF | Factor | Total | Functioning |  |
| Clinical Interview | Item | Disorganised speech | Thought disorder |  | SLOF | Factor | Everyday life skills | Functioning |  |
| Clinical Interview | Item | Grossly disorganised or catatonic behaviour | Other |  | SLOF | Factor | Interpersonal relationships | Functioning |  |
| Clinical Interview | Item | Hallucinations | Positive symptoms |  | SLOF | factor | Work skills | Functioning |  |
| Clinical Interview | Item | Negative symptoms | Negative symptoms |  | SLOF | item | IR01 | Functioning |  |
| Clinical Interview | Item | Physical aggression | Hostility suspiciousness |  | SLOF | item | IR02 | Functioning |  |
| Clinical Interview | Item | Social and occupational dysfunction | Functioning |  | SLOF | item | IR03 | Functioning |  |
| Clinical Interview | Item | Verbal aggression | Hostility suspiciousness |  | SLOF | item | IR04 | Functioning |  |
| Illness duration | item | Illness duration | Other |  | SLOF | item | IR05 | Functioning |  |
| EMA | Item | Down | Depression |  | SLOF | item | IR06 | Functioning |  |
| EMA | Item | Loss of control | Positive symptoms |  | SLOF | item | IR07 | Functioning |  |
| EMA | Item | Relaxed | Anxiety |  | SLOF | item | SA01 | Functioning |  |
| EMA | Item | Paranoia | Positive symptoms |  | SLOF | item | SA02 | Functioning |  |
| EMA | Item | Hearing voices | Positive symptoms |  | SLOF | item | SA03 | Functioning |  |
| FEIT | Factor | Total | Cognition |  | SLOF | item | SA04 | Functioning |  |
| FT | Factor | Total | Cognition |  | SLOF | item | SA05 | Functioning |  |
| HT | Factor | Total | Cognition |  | SLOF | item | SA06 | Functioning |  |
| ISMI | Factor | Stigma | Social |  | SNS | Factor | Anhedonia | Negative symptoms |  |
| ISMI | factor | Total | Social |  | SNS | Factor | Avolition | Negative symptoms |  |
| MAS | Factor | Awareness of the other | Cognition |  | SNS | Factor | Diminished emotional range | Negative symptoms |  |
| MAS | Factor | Decentration | Cognition |  | SNS | Factor | social withdrawal | Negative symptoms |  |
| MAS | Factor | Mastery | Cognition |  | SOFAS | Factor | Total | Functioning |  |
| MAS | Factor | Self-reflectivity | Cognition |  | TASIT-1 | Factor | Total | Cognition |  |
| MAS | Factor | Meta cognition | Cognition |  | TASIT-2 | Factor | Total | Cognition |  |
| MATRICS | Factor | Attention | Cognition |  | TASIT-3 | Factor | Total | Cognition |  |
| MATRICS | Factor | Managing emotions | Cognition |  | UPSA-B | Factor | Total | Functioning |  |
| MATRICS | Factor | Neurocognitive factor | Cognition |  |  |  |  |  |  |

Note. Reference provided if the factor structure applied differed over the studies included; ACE III = Addenbrookes cognitive examination version III; BARS = Barnes Akathisia Rating Scale; BLERT = Bell–Lysaker Emotional Recognition Task; BNSS = Brief negative symptom scale; BPRS = Brief psychiatric rating scale; CAINS = Clinical assessment interview for negative symptoms; CASH = Comprehensive assessment of symptoms and history; CDSS = Calgary depression rating scale for schizophrenia; CLANG = Clinical language disorder rating scale; EMA = Ecological momentary assessment; FEIT = Facial emotion identification test; FT = Faces test; HT = Hinting task; ISMI = Internalised stigma of mental illness; MAS = Metacognition assessment scale; MATRICS = Measurement and treatment research to improve cognition in schizophrenia; MSCEIT = Mayer-Salovey-caruso emotional intelligence Test; PANSS = Positive and negative syndrome scale; PDD = Perceived devaluation and discrimination scale; PS = Paranoia scale; PSP = Personal social performance scale; PST = Picture Sequencing Task; REMT = Reading the mind in the eyes test; RSA = Resilience scale for adults; SANS = Scale for the assessment of negative symptoms; SAPS = Scale for the assessment of positive symptoms; SAS = Simpson-Angus Extrapyramidal Side Effects Scale; SAT = Social Attributions Test; SES = Service engagement scale; SFS = Social functioning scale; SHRS = St Hans rating sale; SLOF = Specific level of functioning scale; SNS = Self-Evaluation of Negative Symptoms Scale; SOFAS = Social and occupational functioning assessment scale; TASIT = The awareness of social inference test; UPSA-B = UCSD Performance-Based Skills Assessment—Brief

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