Utility and validity of the Brief Psychiatric Rating Scale (BPRS) as a transdiagnostic scale

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ABSTRACT

The Brief Psychiatric Rating Scale (BPRS) was originally conceived to assess psychopathology in several psychiatric disorders, making it an appropriate candidate to be used as a transdiagnostic instrument. We analyzed the utility and validity of the BPRS in a diagnostically heterogeneous sample of 600 psychiatric inpatients. As a comparator, we chose the mini-ICF-APP, a scale used to measure functioning and impairment across the diagnostic spectrum. Both scales had good internal consistency. The BPRS and the mini-ICF-APP showed a moderate correlation, with good levels of agreement. We were able to identify general symptoms present across the diagnostic spectrum, influencing severity and a cluster of symptoms specific for each diagnosis. Our results show the utility and validity of the BPRS as a transdiagnostic assessment tool that could easily be introduced in routine clinical work.

1. Introduction

Due to the lack of reliable and readily available biological markers, the development and research of psychiatric treatment and, consequently, their outcomes are conducted mainly by assessing symptoms through psychometric measurement instruments (Moller, 2009; Salvi et al., 2005). Although a consistently increasing number of diagnosis-specific psychometric instruments have been developed over the past decades, including those designed to assess subsyndromal and symptom domains, instruments dimensionally measuring psychopathology across the diagnostic spectrum are still rare (Stanton et al., 2020). Furthermore, a discrepancy between the markedness of psychopathology and severity has constantly been identified, (Kapur et al., 1981; Michel et al., 2018; Reed et al., 2009) as functional disability remains the core indicator of severity (Gaebel et al., 2006; Maj, 2020; Zimmerman et al., 2018) .

Recent approaches regarding the taxonomy of psychopathology and psychiatric disorders challenge the current diagnostic systems which combine observable phenomena in diagnostic categories (Kendell and Jablensky, 2003; Millon, 1991), creating arbitrary boundaries to suit dimensional symptoms into these categories (Haslam et al., 2020; Krueger et al., 2018). This approach leads to a loss of information and, subsequently, reduced reliability and validity (Markon et al., 2011). It manifests in a low diagnostic stability over time, frequent co-occurrence (i.e., comorbidity) of diagnoses (Caspi et al., 2020; Caspi and Moffitt, 2018; Plana-Ripoll et al., 2019; Shea et al., 2002), and a high rate of unspecified diagnoses (Machado et al., 2007; Verheul and Widiger, 2004).

Current DSM and ICD diagnoses do not depict psychopathology accurately, therefore their validity in research and utility in clinical practice is questioned (Kotov et al., 2021). The Hierarchical Taxonomy of Psychiatric Disorders (HiTOP) proposes a classification model based on structural evidence (Kotov et al., 2021). It was developed following quantitative research that identified latent dimensions of psychopathology and includes features of current status (signs and symptoms) and enduring characteristics (maladaptive traits). The HiTOP identifies core

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dimensional spectra, they allow an informative and concise description of psychopathology but are agnostic regarding causes. Importantly, these dimensions are descriptive (Kotov et al., 2017, 2021).

The Brief Psychiatric Rating Scale (BPRS) was developed as a measurement instrument to assess the change (i.e., improvement or deterioration) in psychopathology in a wide variety of severe psychiatric disorders, namely depression with psychotic symptoms, bipolar affective disorder, and schizophrenia (Overall and Gorham, 1962; Shafer, 2005). In addition, a combination of BPRS items was used to infer recovery in patients with schizophrenia (Andreasen et al., 2005). Due to its psychometric properties, the BPRS has the potential to accurately assess symptomatology in non-psychotic disorders. Several clinical studies have used the BPRS to quantify psychopathology and evaluate intervention effectiveness in heterogeneous diagnostic populations (Heekeren et al., 2020; Kalisova et al., 2014; Kisely and Campbell, 2015; Lachar et al., 2001).

While there is research on the psychometric properties of the BPRS in psychotic disorders, such as schizophrenia, schizoaffective, or bipolar disorder, there is a lack of studies systematically analyzing the performance of the BPRS in other diagnostic groups (Shafer, 2005). Therefore, we designed a study to determine the validity (and therefore utility) of the BPRS as a measurement instrument of psychopathology in non-psychotic disorders. We hypothesized that the BPRS can assess the dimensional aspects of psychopathology in a heterogeneous diagnostic group of patients. Furthermore, we aim to evaluate the relationship of psychopathological symptoms and functional impairment across the diagnostic spectrum. We assume that there are unspecific diagnostic symptoms associated with functional impairment.

2. Methods

2.1. Study design, study population, and sample

The Department of Psychiatry, Psychotherapy and Psychosomatics, as part of the Psychiatric University Hospital of Zurich, is responsible for the treatment of adult patients (ages 18 to 65) in the city of Zurich, Switzerland, and its surroundings, with a catchment area of approximately 500.000 inhabitants. In its different treatment centers, it globally accounts for approximately 4000 hospitalizations per year. A series of psychometric measures to assess disorder severity and psychosocial functioning is performed for each patient upon admission and discharge to evaluate treatment quality and outcomes. Between January 1st, 2018, and December 31st, 2020, we systematically collected the admission BPRS and mini-ICF-APP in patients hospitalized for treatment.

We included diagnoses related to the three core dimensions of psychopathology into the analysis (i.e., internalizing, externalizing, and thought disorders) (Kotov et al., 2017, 2011). We excluded intellectual disability, neurodevelopmental, neurocognitive, and organic disorders (Sachdev et al., 2014). To avoid a disequilibrium at the moment of analysis, we compromised and included equal numbered samples in each diagnostic group with similar rates of comorbidity (Bringmann and Eronen, 2018). We report how we determined our sample size, all data exclusions, all manipulations, and all measures. The Ethics Committee of the Canton of Zurich authorized the use of the anonymized data for research and publication purposes (BASEC: 2018-01906).

2.2. Clinical assessment and diagnosis

Clinical ratings were carried out by attending psychiatrists, psychiatry residents, or clinical psychologists. In addition, relevant information was derived from clinical interviews and observation and information provided by nursing staff, social workers, and significant others. All raters received training (in workshops with case vignettes and live patient interviews) in psychopathology and in the use of the clinical rating tools included in the analysis. The status of a patient (i.e., diagnoses and clinical ratings) was not the result from a single interview, it contained the information collected during the admission (or discharge) process, thus it also reflected the diagnostic phase and clinical evolution through hospitalization. Thus, in contrast to psychopharmacological investigations, ratings were not derived from a single clinical interview conducted solely for this purpose (Lachar et al., 2001). Psychiatric diagnoses were made by the clinician responsible for the treatment according to the ICD-10 (WHO, 1992) criteria. According to our hospital standard procedures and legal regulations, the psychopathological status and clinical ratings were discussed with a senior board-certified psychiatrist who, after personally exploring the patient, confirmed (or corrected) the diagnoses and clinical ratings.

2.3. Diagnostic categories

We subsequently assigned all patients according to their treatment diagnoses to one of the three core dimensions of psychopathology (Kotov et al., 2017, 2021). The following ICD-10 diagnostic categories were included: Internalizing disorders, comprising of "Anxiety" (F4) and "Major Depressive Disorder" (F32 and F33); Externalizing Disorders, including "Alcohol Use Disorder" (F10) and Cluster B Personality Disorders ("Antisocial" F60.2; "Impulsive" F60.3; "Histrionic" F60.4 and "Narcissistic" F06.8); and finally, Thought Disorders, including "Mania" and "Bipolar Disorder" (F30 and F31) and "Schizophrenia Spectrum Disorder" (F2). In addition, we defined comorbid "Alcohol or Substance Use Disorder" (F1) or comorbid "Personality Disorder" (F6).

2.4. Clinical rating scales

The Brief Psychiatric Rating Scale (BPRS) was developed to measure changes in a comprehensive set of psychopathologic symptoms present in major psychiatric diagnoses (Overall and Gorham, 1962). Since its first publication, the scale has experienced further development. Today, several versions of the BPRS are in use (featuring 16 to 24 items), some versions include anchored definitions, others are designed as a semi-structured interview (Overall, 1974; Lukoff et al., 1986; Zanello et al., 2013). The anchored version shows improved psychometric properties, while the additional items seem redundant (Hafkenscheid, 1991). We decided to use the anchored version of the 18 items BPRS because of its excellent psychometric properties and widespread use (Cips, 1996; Maß et al., 1997). The items assess the following symptom domains: 1. somatic concern, 2. anxiety, 3. emotional withdrawal, 4. conceptual disorganization, 5. feelings of guilt, 6. tension, 7. mannerisms and posturing, 8. grandiosity, 9. depressive mood, 10. hostility, 11. suspiciousness, 12. hallucinatory behavior, 13. motor retardation, 14. uncooperativeness, 15. unusual thought content, 16. blunted affect, 17. excitement, and 18. disorientation. Each item is rated on a seven-point Likert like scale, ranging from "1" (not present) to "7" (extremely severe). Thus, the sum score ranges between 18 and 126, with a higher score indicating more severe symptomatology.

The mini-ICF-APP was developed as a short clinician-rated scale to assess the level of functioning in psychiatric disorders; anchored definitions warrant standardized ratings (Linden and Baron, 2005; Linden et al., 2009). The mini-ICF-APP has been validated in a series of studies, consistently showing good psychometric properties (Balestrieri et al., 2013; Baron and Linden, 2009; Linden and Baron, 2005; Molodynski et al., 2013). It has been used to evaluate functional impairment in several distinct disorders. It is also used to determine sick leave and work impairment (Habermeyer et al., 2017; Muschalla, 2019; Rosburg et al., 2021; Wciorka et al., 2020). The mini-ICF-APP evaluates thirteen functional domains: 1. adherence to regulations and routines, 2. planning and structuring of tasks, 3. flexibility, 4. competency/efficacy, 5. endurance, 6. assertiveness, 7. contact with others, 8. group integration, 9. family and intimate relationships, 10. leisure activities, 11. self-care, 12. mobility and 13. competence to judge and decide. Each item is rated on a five-point Likert-like scale from "0" (no disability) to "4" (total disability). The manual provides definitions for each item. Capabilities

have to be assessed in reference to a specific context (e.g., workplace, work in general, household). Added up, the scale ranges from 0 to 52 points, with higher scores indicating a reduced overall functionality.

The Clinical Global Impression Scale is a brief, easy-to-use, pragmatic clinician-rated tool to assess the severity of a psychiatric disorder (CGI-S) (Guy, 1976). The CGI is considered a valid and reliable clinical outcome measure suitable for routine use (Berk et al., 2008). The CGI has been used to validate several other clinical rating instruments and to establish cut-off values for severity as well as benchmark ranges for change. The CGI uses seven-point Likert-like scale, ranging from 1 representing the "healthy subject" to 7 the "extremely ill subject".

2.5. Statistical analysis

We decided to analyze the BPRS and mini-ICF-APP scales using a network approach instead of a factorial analysis or latent class analysis. Firstly, because network models based on manifest variables seem to outperform latent variable models (McFarland, 2020). Secondly, because network analysis allows to explore the interrelation between psychopathology and psychosocial functionality (Jones et al., 2019). Considering that network analysis is susceptible to the influence of group composition as well as condition (Bringmann and Eronen, 2018), we decided to include equal number of patients in each of the distinctive psychopathological dimensions and diagnostic categories (Borsboom et al., 2018; Wichers et al., 2017).

Patients were classified according to their main treatment diagnosis as defined previously, patients not falling in one of these categories were discarded. We calculated the sample size to detect low effect sizes between six groups, with alpha of 0.05 and beta of 0.95. The calculated sample size was 563 participants. To have an equally sized sample, we selected patients within each main treatment diagnosis (matched for comorbid substance use disorder and comorbid personality disorder). The final sample size was determined by the smallest diagnostic group and the need to balance comorbidity across all diagnostic groups. Since the power analysis allowed for it, we decided to include 100 patients in each group to manage round numbers. To ensure a balanced sample, patients in the single groups were selected using a propensity score matching approach (Dehejia and Wahba, 2002). The sample's demographic and clinical characteristics were represented using descriptive statistics (percentage, mean, SD). Differences in proportions between groups were calculated using the Chi-square (χ^2) test. Differences in means were calculated using analysis of variance (ANOVA).

Internal consistency of the BPRS and mini-ICF-APP was examined using the Cronbach's alpha coefficient. Skewness and kurtosis of both scales were determined. Skewness is used to determine ceiling or floor effects. The BPRS sum score was correlated to the mini-ICF-APP sum score using Spearman's Rank Correlation. Considering the differences in the rating of the scales, we calculated the z-scores for both scales. The Concordance Correlation Coefficient was calculated using the z-scores to examine the level of accuracy and precision between two measures (King and Chinchilli, 2001; Lin, 1989). To evaluate the agreement between the two scales, we used the Bland-Altman Plot. The difference between both scales was plotted on the y-axis, while the mean was plotted on the x-axis. The confidence interval and the limits of agreement for both scales were calculated (Bland and Altman, 1986; Carkeet, 2015).

The network model of the scales (BPRS and mini ICF-APP) was calculated using an "Extended Bayesian Information Criterion" (EBIC) and the "Least Absolute Shrinkage and Selection operator" (LASSO) regularization method, implemented within a single Gaussian random fields network. For the degree of shrinking, we used a low hyperparameter (gamma = 0.0) to maximize the stability of the network and balance sensitivity and specificity (Epskamp et al., 2018). To test the accuracy and stability of the network parameters, we estimated confidence intervals on the edge-weights and the correlation stability coefficient using non-parametric bootstrapping (Epskamp and Fried, 2018).

Within the graphical representation, edges are the lines between the nodes representing regularized partial correlations, which help estimate the relationship between two variables while controlling for all other variables. An edge indicates a dependent relationship between variables; the absence indicates that they are conditionally independent. Blue edges are used to represent positive associations, while red edges represent negative associations. The wider and more saturated an edge is represented, the stronger the association. We calculated centrality indices (closeness, betweenness, and strength) and expected influence of each item within the respective symptom (BPRS) and functional (mini-ICF-APP) network. We also calculated a bridge-expected influence strength metric to quantify the influence of symptoms (BPRS) and functional domains (mini-ICF-APP) (Jones et al., 2019).

Analysis was performed using R Statistical Software (version 4.0.1). The packages "DescTools" (version 0.99.43) and "blandr" (version 0.5.1) were used for the calculation of the Concordance Correlation Coefficient, the Bland Altman Plot, and the limits of agreement. The package "MatchIt" (version 4.3.4) was used to calculate the propensity score. Network Analyses were created using the packages "NetworkTools" (version 1.3.0), "Bootnet" (version 1.43), and "qgraph" (version 1.6.9).

3. Results

During the observation period, we collected health related data of 1438 psychiatric patients, of which a total of 1173 had a diagnosis included in the study; further 184 patients had to be discarded due to a comorbid organic, neurocognitive or neurodevelopmental disorder (see Appendix). A total sample of 600 psychiatric inpatients, equally distributed among six diagnostic categories (alcohol use disorder, major depressive disorder, anxiety disorders, bipolar disorder, schizophrenia, and personality disorders) was analyzed. The mean age was 41.5 ($SD =$ 12.8, median 40, range 18−65) years. Women accounted for 45.5% ($n =$ 273) of the sample. The demographic characteristics of the sample are summarized in Table 1. Except for those with the diagnosis of a personality disorder, patients had similar age and gender distribution. Patients with a personality disorder were significantly younger, with a higher proportion of female patients (χ^2(5, 600) = 28.21, $p<$.001).

The mean BPRS sum score was 45.4 ($SD = 14.4$), the mean mini-ICF-APP sum score was 19.93 ($SD = 8.21$), and the mean CGI-S score was 5.55 ($SD = 0.84$), reflecting clinically "markedly ill" to "severely ill" patients. The BPRS and mini-ICF-APP sum scores progressively increased from patients diagnosed with alcohol use disorder, personality disorder, anxiety disorders, major depressive disorder, and bipolar disorder to schizophrenia spectrum disorders. The CGI-S score and severity categorization ("markedly ill") was similar among all diagnostic groups. The internal consistency ranged from good to excellent with the BPRS having a Cronbach's alpha of .87, whilst the mini-ICF-APP had a Cronbach's alpha of .92. The Pearson correlation coefficient for the BPRS and mini-ICF-APP scales was .53 (95% CI: .46 to .58, $t = 15.08$, $df = 598$, $p<$.001). The Concordance Correlation Coefficient was .52 (95%CI: .46 to .58). The Bland Altman Plot shows a good overlap between both scales, with just 2.5% ($n = 15$) outliers, a Lower Limit of Agreement of -1.91 (95% CI -2.04 to -1.77), and an Upper Limit of Agreement of 1.91 (95% CI: 1.77 to 2.04). For further details, see Table 2 and Fig. 1.

The calculated networks were highly stable. The BPRS and mini-ICF-APP networks had a correlation stability coefficient of .75, while the joint network featured a correlation stability of .67 (see Appendix). Both of them indicate a robust network (Epskamp et al., 2018; Epskamp and Fried, 2018). Thus, they allow to adequately determine and interpret the centrality, clustering, and influence of the single symptoms and functional domains for both scales and the bridges between symptoms (BPRS) and functional domains (mini-ICF-APP).

Regarding the BPRS symptoms, the highest centrality values were "unusual thought", "blunted affect", and "suspiciousness", in descending order. The symptoms with the strongest influence were "unusual

Table 1
Demographic characteristics of the sample.

		Internalizing Disorders		Externalizing Disorders		Thought Disorders		Test	p
Diagnostic Group	Total Sample	Anxiety	Major Depression	Alcohol Use Disorder	Personality Disorder	Bipolar Disorder	Schizophrenia		
n	600	100	100	100	100	100	100		
	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)		
Age	41.5 (12.8)	41.9 (12.9)	45.1 (12.9)	45.8 (12.4) *	31.1 (8.6) **	44.3 (12.3)	40.5 (11.5)*	$F(5, 594) = 21.20$	<.001
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
Female sex	273 (45.5)	36 (36.0)	39 (39.0)	36 (36.0)	54 (54.0) **	35 (35.0)	38 (38.0)	$\chi^2(5, 600) = 28.21$	<.001
Education								$\chi^2(20, 600) = 79.91$	<.001
Incomplete Schooling	46 (7.7)	8 (8.0)	6 (6.0)	5 (5.0)	16 (16.0)	4 (4.0)	7 (7.0)		
Regular School	264 (43.9)	31 (31.0)	37 (37.0)	28 (28.0)	43 (43.0)	61 (61.0)	64 (64.0)		
Apprenticeship	232 (38.7)	49 (49.0)	46 (46.0)	54 (54.0)	35 (35.0)	25 (25.0)	23 (23.0)		
College/University	58 (9.7)	12 (12.0)	11 (11.0)	13 (13.0)	6 (6.0)	10 (10.0)	6 (6.0)		
Marital Status								$\chi^2(20, 600) = 66.36$	<.001
Single	380 (63.4)	62 (62.0)	58 (58.0)	51 (51.0)	85 (85.0)	53 (53.0)	71 (71.0)		
Married	82 (13.7)	16 (16.0)	13 (13.0)	24 (24.0)	10 (10.0)	10 (10.0)	9 (9.0)		
Separated/ Divorced	116 (19.3)	20 (20.0)	26 (26.0)	21 (21.0)	4 (4.0)	33 (33.0)	12 (12.0)		
Widowed	8 (1.3)	2 (2.0)	2 (2.0)	2 (2.0)	0 (0.0)	0 (0.0)	2 (2.0)		
Unknown/Other	14 (2.3)	0 (0.0)	1 (1.0)	2 (2.0)	1 (1.0)	4 (4.0)	6 (6.0)		

* Alcohol Use Disorder < Schizophrenia.
** Personality Disorder > all others.

Table 2
Clinical characteristics of the sample.

		Internalizing Disorders		Externalizing Disorders		Thought Disorders		Test	p
Diagnostic Group	Total Sample	Anxiety	Major Depression	Alcohol Use Disorder	Personality Disorder	Bipolar Disorder	Schizophrenia		
n	600	100	100	100	100	100	100		
Comorbidity	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)		
Alcohol/Substance Use Disorder	72 (12.0)	12 (12.0)	12 (12.0)	12 (12.0)	12 (12.0)	12 (12.0)	12 (12.0)	$\chi^2(5, 600) = 0$	1
Personality Disorder	30 (5.0)	10 (10.0)	3 (3.0)	6 (6.0)	0 (0.0)	6 (6.0)	5 (5.0)	$\chi^2(5, 600) = 1.18$	.38
Rating Scales	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)		
CGI-S	5.6 (0.8)	5.5 (0.8)	5.5 (0.8)	5.6 (0.7)	5.4 (1.0)	5.7 (0.9)	5.6 (0.9)	$F(5, 594) = 1.18$	.31
BPRS	45.4 (14.4)	42.06 (13.0) *	46.4 (15.8) **	38.6 (14.5) *	40.1 (11.7)	51.2 (15.2) */**	52.5 (15.5) */**	$F(5, 594) = 14.71$	<.001
mini-ICF-APP	19.9 (8.2)	18.1 (8.8)	19.2 (8.6)	17.7 (9.6) ***	18.6 (5.8)	21.2 (8.2) ***	22.1 (8.4) ***	$F(5, 594) = 3.87$	.002
Distribution Indices									
Skewness BPRS	0.67	0.91	0.61	1.17	0.81	0.20	0.17		
Kurtosis BPRS	2.64	3.39	2.48	3.96	3.58	2.03	1.99		
Skewness mini-ICF-APP	0.05	0.15	-0.16	-0.04	0.24	0.29	-0.10		
Kurtosis mini-ICF-APP	2.49	2.16	2.82	2.11	2.96	1.81	2.49		

* Anxiety, Personality Disorder and Alcohol Use Disorder < Bipolar Disorder and Schizophrenia.
** Major Depression < Bipolar Disorder and Schizophrenia.
*** Alcohol Use Disorder < Bipolar Disorder and Schizophrenia.

thought", "uncooperativeness", and "suspiciousness" (see Fig. 2). We detected three clusters of symptoms corresponding to the externalizing, internalizing, and thought disturbance domains. The externalizing cluster included items evaluating tension, mannerisms and posturing, hostility, uncooperativeness, and excitement. The internalizing cluster had two cores, the first including anxiety and guilt, the second encompassing emotional withdrawal, depressive mood, motor retardation and blunted affect. The thought disturbance cluster included conceptual disorganization, suspiciousness, hallucinations, and unusual thought content, with disorientation orbiting this cluster. Somatic concern fluctuated between the externalizing and internalizing clusters, while grandiosity fluctuated between the externalizing and thought content clusters (see Fig. 2).

Focusing on the mini-ICF-APP network, the functional domains with the highest centrality were "relationships", "assertiveness", and "competency", in descending order. The functional domains with the highest influence were "group interactions", "relationships", and "competency" (for further details, see Fig. 3). Within the mini-ICF-APP network, we could identify four clusters. The first addresses interpersonal relations, contact with others, group integration, relationships, and leisure activities. The second cluster includes daily activities, consisting of self-care, mobility, and competence to judge and decide. The third cluster entails working capabilities, planning, and structuring of tasks, flexibility, competency/efficacy, and endurance. A central cluster involves
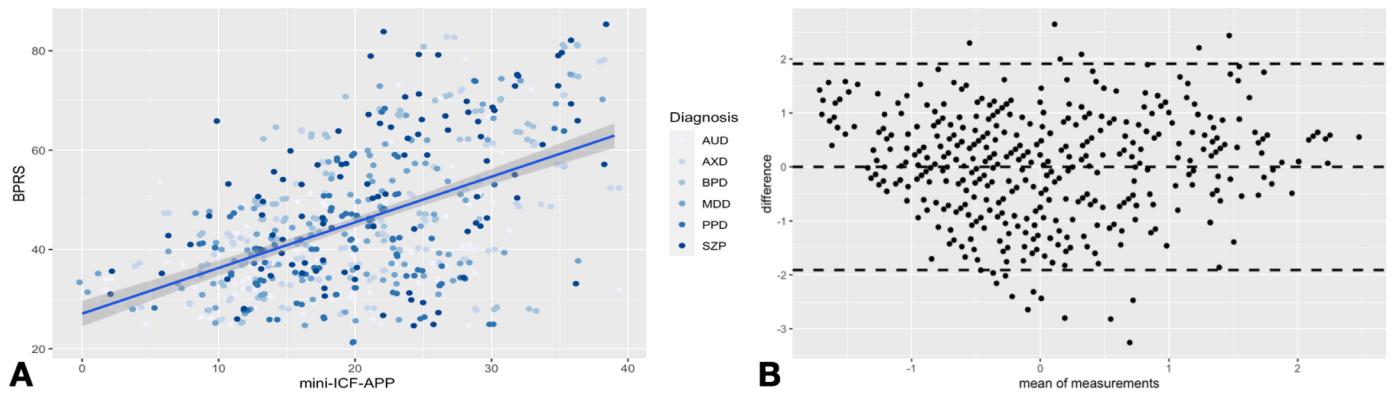
Fig. 1. (A). Correlation analysis plot modelling the BPRS and mini-ICF-APP scales, corresponding to the diagnostic group
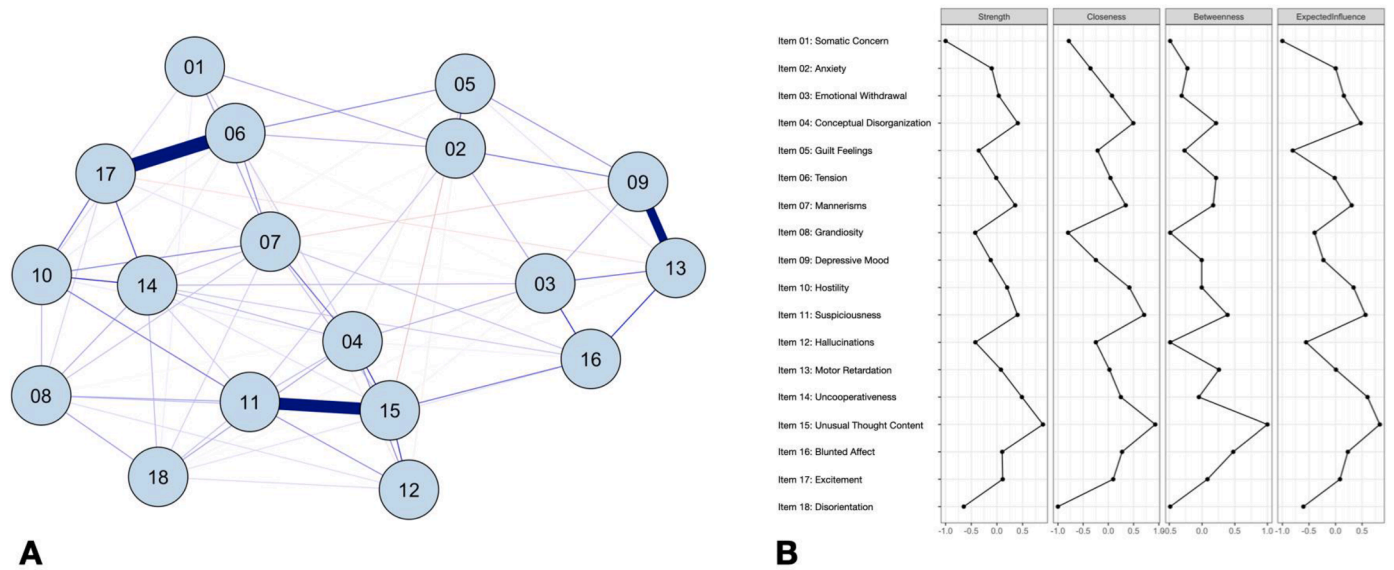(B). Bland Altman Plot using z-scores of the BPRS and mini-ICF-APP scales.

Fig. 2. Network analysis for the Brief Psychiatric Rating Scale (BPRS).
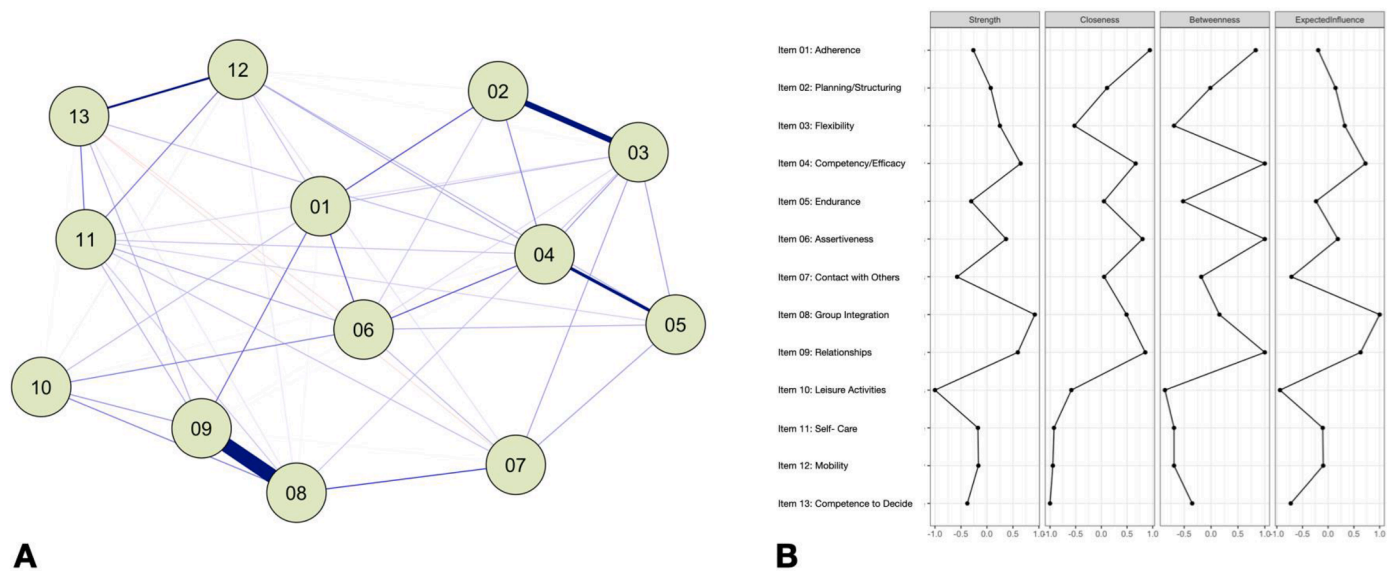

Fig. 3. Network analysis for the mini-ICF-APP.

adherence to routines and assertiveness (see Fig. 3).

The symptoms (BPRS) and the functionality domains (mini-ICF-APP) showed a close interplay. The highest bridge influence could be measured for "uncooperativeness", "hostility", and "conceptual disorganization" on the BPRS side, and "adherence", "relationships", and "competence to judge" on the mini-ICF-APP side (See Fig. 4). Functional domains showed a greater bridge strength. Adherence to routines was the most influential node, followed by competency/efficacy, self-care, and competence to judge and decide. Nodes on the symptom network with the most bridge strength included somatic concern, conceptual disorganization, tension, mannerism, and uncooperativeness. The bridge formed between "adherence to routines" and "uncooperativeness" has a central position in the joint network of symptoms and functional domains (See Fig. 4).

4. Discussion

The results from our analysis show the validity of the BPRS as a transdiagnostic measurement tool, capable of reliably capturing both general and disorder-specific psychopathological symptoms in a wide range of diagnostic categories. We were also able to corroborate previous findings regarding the utility and feasibility of the mini-ICF-APP as a transdiagnostic measurement instrument. The results from the network analysis strengthen the notion that there is a close interplay between symptoms and functionality domains, with special focus on some pivotal elements on both sides. Therefore, these findings strengthen the concept that a certain psychopathological (and functional impairment) threshold has to be achieved before help-seeking behavior is triggered (Michel et al., 2018). Thus, we were able to partially disentangle the overall manifestation of psychopathological symptoms from the severity of functional impairment of a psychiatric disorder.

The BPRS was capable of capturing the dimensional nature of psychopathology from several diagnoses and simultaneously delimiting the characterizing symptoms and clusters for every single diagnosis (Shafer, 2005). Further, BPRS appears to function as a suitable dimensional and

transdiagnostic measurement instrument depicting psychopathology (Stanton et al., 2020). The degree of centrality of certain symptoms and functional domains involving thought and judgement capabilities, assertiveness and self-efficacy, the ability to relate to others, as well as the aptitude to adhere to routines, conventions, and rules, denotes their pivotal role in the network. Furthermore, these domains represent how a psychiatric disorder becomes self-evident, namely in taking care and sustaining of oneself, fulfilling obligations, and maintaining relationships (Caspi and Moffitt, 2018; Plana-Ripoll et al., 2019).

The markedness of psychopathological symptoms seems to determine the severity and maintenance of a mental disorder (Galderisi et al., 2018, 2020; Izquierdo et al., 2021; Jimeno et al., 2020), therefore, distinct psychiatric disorders can lead (at least temporarily) to similar degrees of functional impairment (Borsboom and Cramer, 2013; Zimmerman et al., 2018). By including several distinctive diagnostic groups, our results show that general psychopathology factors are present along different diagnostic categories (Garcia-Velazquez et al., 2017). The BPRS is thus able to reflect general psychopathology as well as diagnostic specific symptoms. The clusters of symptoms we found on the BPRS scale overlap with the previously reported factorial structure of the BPRS for several disorders and conditions (Shafer, 2005).

The symptoms and functional domains we found to be central within the network structure are among the first targets of any psychiatric or psychotherapeutic intervention, namely the building of a common language and understanding as well as the establishment of confidence in relationships and a trustworthy therapeutic alliance (Jimeno et al., 2020; Lincoln et al., 2007; Rummel-Kluge et al., 2013). Our results reinforce the notion that psychiatric disorders affect thought processes (and thus language and communication) (Aristodemou and Fried, 2020; Caspi et al., 2014; Smith et al., 2020). Therefore, mental health disorders require a primary approach for diagnosis as well as for treatment through speech and dialogue. An elemental and unspecific therapeutic goal includes the reestablishment of assertiveness and adherence to routines. The successful activation of these functional domains further unfolds therapeutic options that should specifically address the core
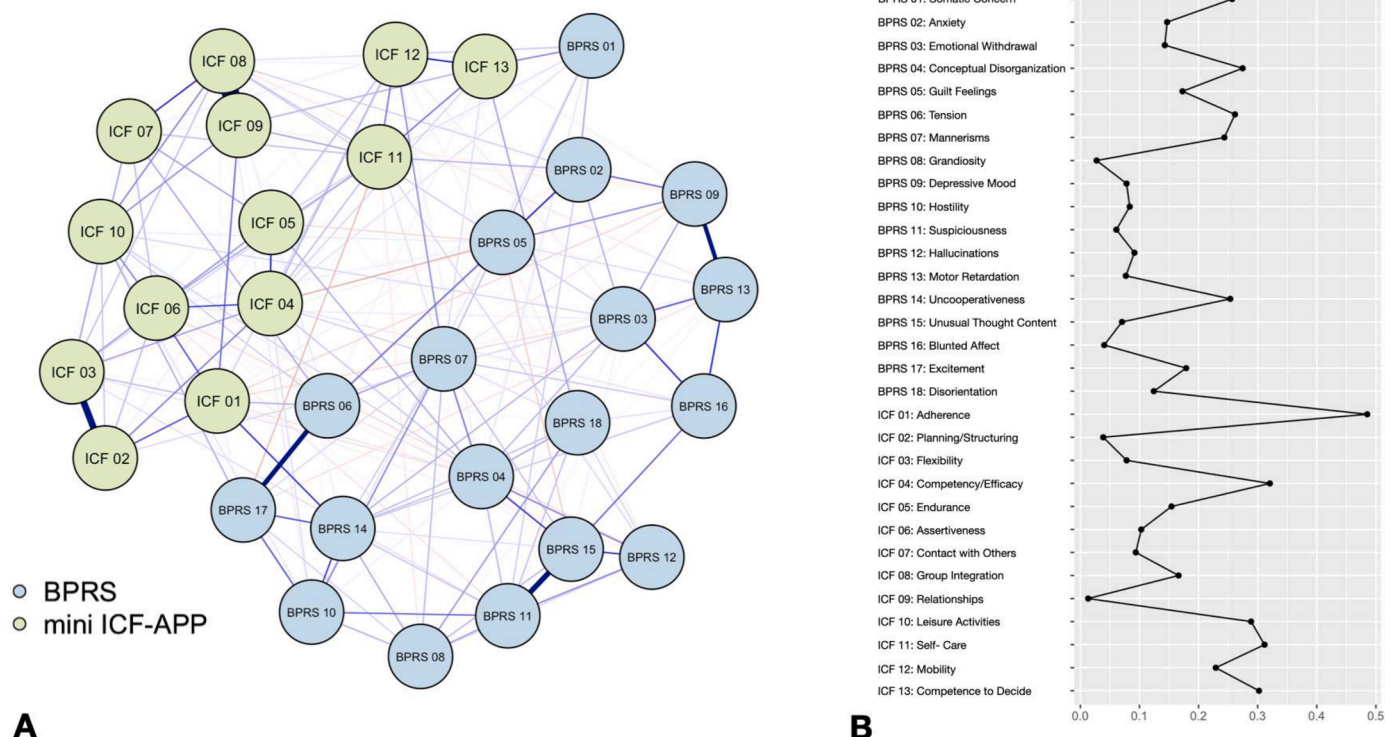

Fig. 4. Joint network analysis for the BPRS and the mini-ICF-APP scales.

symptoms of the distinct psychiatric disorders. Once psychiatric disorders severely impair the ability to communicate, cooperate, and maintain proper bonding, as well as in the presence of danger (to the patients themselves or others), coercive measures may be needed (Hofmann et al., 2022; Miteva et al., 2022).

One strength of our analysis is the large, sample equally representing major psychiatric diagnostic groups which allowed us to perform robust statistical analysis. To assess the scales' validity, we used two complementary methods, one approach to measure correlation, another one to measure agreeability. The results of both methods were satisfactory and corroborated each other. For the analysis of the properties of the scales, we used a network approach which allows us to estimate the influence of a single item (i.e., either a symptom or a functional domain) on the network structure of its own scale, as well as on the neighbor scale. Since network analysis is susceptible to the influence of group composition as well as condition, we included an equal number of patients with distinctive dimensions and diagnoses (Borsboom et al., 2018; Wichers et al., 2017).

Despite its strengths, our study has some limitations. Our sample data is derived from routine clinical practice and the clinical details provided can differ to those obtained in controlled trials (Lachar et al., 2001; Smeets et al., 2011). On the other hand, disabling psychopathology is not necessary to justify their hospitalization (Nelson et al., 2000). We only included the main treatment diagnosis for our analysis and therefore lost sharpness regarding the degree of comorbidity. We sought to compensate for this by including the common comorbidity of alcohol and substance use disorder as well as comorbid personality disorder. The design of our study allows to evaluate the capability of the BPRS and mini-ICF-APP as instruments to assess the current status, (i.e., signs and symptoms) and also potentially assessing change. However, the design does not allow evaluation of capability to assess enduring characteristics (i.e., maladaptive traits) (Chaplin et al., 1988; DeYoung et al., 2022; Fridhandler, 1986).

Although all raters received regular training in general psychopathology and the use of the rating scales included in this analysis, we did not systematically infer the inter-rater reliability index. We think this is compensated in clinical practice by the use of anchored scales and supervision (Armstrong et al., 1997; Lachar et al., 2001). We did not include all proposed HiTOP dimensions, first of all because the count of patients for the "somatoform" and "detachment" dimensions was too little, secondly because those are less well defined and validated (Kotov et al., 2017). The externalizing dimension with its "disinhibited" and "antagonistic" spectra was put together, although each belong to a specific diagnostic group (Kotov et al., 2017). In our sample, we only included patients requiring hospitalization for treatment, therefore the application of our results may be reduced to this population group.

The BPRS and mini-ICF-APP showed significant internal consistency, indicative of their applicability across the diagnostic spectrum. The correlation coefficients between both scales were moderate and lower than in previous reports (Balestrieri et al., 2013). This might be due to the different distribution of both scales as BPRS featured a right skewness due to the less distinctive psychopathological symptoms of those with an externalizing disorder. Nonetheless, no participant achieved the lowest possible score on the scale, therefore, a real floor effect can be ruled out for our sample (Koedel and Betts, 2010; McHorney and Tarlov, 1995). The differences between BPRS and mini-ICF-APP results support previous findings that show that symptom severity is not unconditionally sufficient to explain functional impairment (Garcia-Velazquez et al., 2017) and that several specific psychiatric disorders might manifest less marked symptoms but a similar burden of disease (Egger et al., 2019; Linden and Baron, 2005); expressed in employment status and including sick leave or permanent disability (Wciorka et al., 2020). Despite the moderate correlation indices, the BPRS and mini-ICF-APP show a great degree of overlap and agreeableness, indicating that both scales could accurately assess the severity of a psychiatric disorder, although from a different perspective (Gerke, 2020; Haghayegh et al., 2020), and thus

complement each other.

In our study, the BPRS and the mini-ICF-APP showed a great degree of correlation and agreement. Furthermore, they performed satisfactorily in a group of patients with heterogeneous psychiatric diagnoses. The joint psychometric properties of the BPRS and mini-ICF-APP corroborate the notion that the interplay between pivotal psychopathological symptoms and functional impairment determines the severity of the psychiatric disorder. From our results, the BPRS scale is suitable to assess the psychopathological status in patients hospitalized for treatment of psychiatric disorders. Since the BPRS is a widely known and readily available psychometric scale, our results support its use as a transdiagnostic measurement instrument of psychopathology.

CRediT authorship contribution statement

Andreas B. Hofmann: Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Hanna M. Schmid:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Mounira Jabat:** Writing – original draft. **Nathalie Brackmann:** Writing – original draft. **Vanessa Noboa:** Methodology, Writing – original draft, Writing – review & editing. **Julio Bobes:** Investigation, Supervision, Validation. **Maria Paz Garcia-Portilla:** Supervision, Validation. **Erich Seifritz:** Supervision, Funding acquisition, Resources, Project administration. **Stefan Vetter:** Supervision, Funding acquisition, Resources, Project administration. **Stephan T. Egger:** Conceptualization, Methodology, Software, Formal analysis, Resources, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration.

Declaration of Competing Interest

The authors have no conflicts of interest to disclose.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2022.114659.

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