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Measuring cognitive impairment in young adults with polysubstance use disorder with MoCA or BRIEF-A – The significance of psychiatric symptoms

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ABSTRACT

Introduction: Chronic polysubstance use disorder (PSUD) is associated with cognitive impairments. These impairments affect the quality of life, occupational functioning, and the ability to benefit from therapy. Psychological distress also affects neurocognitive status, and impaired neurocognition characterizes several psychiatric conditions. Neurocognitive assessment is thus of importance but faces several interpretive challenges. One is disentangling the link between psychological distress and cognitive impairment. This paper investigates the associations between psychological distress and two cognitive screening tools, the Montreal Cognitive Assessment (MoCA) and the Behavior Rating Inventory of Executive Function - Adult Version (BRIEF-A) in young adults with PSUD.

Material and methods: This study included 104 patients with PSUD recruited from the Norwegian Stayer study. Participants completed the MoCA, a self-report measure of executive functioning (EF), the BRIEF-A, and the Symptom Checklist 90 Revised, a measure of psychiatric symptoms (SCL-90-R). Cognitive impairment was diagnosed in accordance with previously published cutoff scores for the MoCA and BRIEF-A. Correlation analysis and multiple logistic regression were used to evaluate the association between cognitive impairment identified with the MoCA or BRIEF-A and psychological distress.

Results: More than a third (34.6%) of patients scored below the threshold for cognitive impairment on the MoCA. On the BRIEF-A, 63.2% of participants reported executive problems that exceeded what was expected based on previously published norms. SCL-90-R scores were, as expected, elevated when compared with normative scores. Logistic regression analysis demonstrated a significant association between cognitive impairment identified by the BRIEF-A and scores on the SCL-90-R Global Severity Index (OR = 17.3, 95% CI: 4.4–68.8, $p < 0.001$) and age (OR = 0.7, 95% CI: 0.6–0.9, $p = 0.003$). Cognitive impairment identified by the MoCA was not significantly associated with demographic variables or SCL-90-R GSI score in multiple regression analysis.

Conclusions: Our study indicated that the MoCA is a measure of cognitive impairment that is independent of psychological distress, as measured with the SCL-90-R, whereas the BRIEF-A Global Executive Composite is strongly associated with distress. This suggests the need to interpret BRIEF-A results within a broad differential diagnostic context, where the assessment of psychological distress is included. The findings support that performance-based assessment such as the MoCA could reduce the impact of psychological distress in cognitive screening.

1. Introduction

Substance use disorder (SUD) is associated with cognitive impairment (Rogers & Robbins, 2001; Vik, Cellucci, Jarchow, & Hedt, 2004; Yucel, Lubman, Solowij, & Brewer, 2007), with the prevalence varying between 20% and 80% among SUD patients (Bates, Bowden, &

Abbreviations: BRI, Behavioral Regulation Index; BRIEF-A, Behavior Rating Inventory of Executive Function - Adult Version; CI, confidence interval; EF, executive function; GSI, Global Severity Index; MCI, mild cognitive impairment; MI, Metacognition Index; MoCA, Montreal Cognitive Assessment; OR, odds ratio; PSDI, Positive Symptom Distress Scale; PST, Positive Symptom Total; SCL-90-R, Symptom Checklist 90 Revised; SUD, substance use disorder

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Barry, 2002; Copersino et al., 2009).

SUD patients show deficiencies in executive function (EF), including decision-making and emotional control (Barry & Petry, 2008; Bechara, 2005; Dolan, Bechara, & Nathan, 2008; Verdejo-Garcia & Bechara, 2010; Verdejo-Garcia, Bechara, Recknor, & Perez-Garcia, 2006). Associations have been reported between cognitive impairments and low treatment adherence (Bates, Pawlak, Tonigan, & Buckman, 2006; Verdejo-García et al., 2012), poor attendance at outpatient therapy sessions (Guthrie & Elliott, 1980), reduced disposition to change (Blume & Marlatt, 2009), low self-insight (Horner, Harvey, & Denier, 1999), and denial of substance abuse (Rinn, Desai, Rosenblatt, & Gastfriend, 2002). Cognitive impairment has an impact on the quality of life and work-related functioning, which then affect the course of recovery for patients with SUD (Brorson, Arnevik, Rand-Hendriksen, & Duckert, 2013; Fernandez-Serrano, Perez-Garcia, & Verdejo-Garcia, 2011). People who use multiple substances constitute a particularly high-risk group compared with other patients with SUD, with more distinct depressive and suicidal symptomatology at treatment admission (Riehman, Iguchi, & Anglin, 2002), and more social anxiety (Bakken, Landheim, & Vaglum, 2005).

Studies have shown that therapists may not reliably assess the cognitive status of patients with SUD based on mere clinical observation (Fals-Stewart, 1997). Therefore, therapists might overrate the cognitive abilities of their patients, leading to a lack of adjustment of treatment in accordance with patients' cognitive profiles.

With cognitive impairments recognized as a negative factor affecting the course of treatment for these patients, valid, cost-effective and widely applicable screening of cognitive functioning is of vital importance (Fernandez-Serrano et al., 2011; Hagen et al., 2016). The application of extensive neuropsychological assessment is cost-prohibitive for most SUD treatment services, and specialized neuropsychological expertise is usually rare in outpatient settings (Vaskinn & Egeland, 2012). With the scarcity of clinicians specialized in neuropsychology, the assessment should be readily available for use by clinicians without specialization. The Montreal Cognitive Assessment (MoCA®) is a short, easily administered screening measure that has shown accurate discriminative ability for the detection of mild cognitive impairment (MCI) in many conditions, including SUD (Copersino et al., 2009). Further, the MoCA is shown to have superior sensitivity for mild cognitive impairment compared to the previous 'gold standard' short screening the MMS, and as there is emerging literature promoting MoCA as a sound measure for use also in the SUD population. We thus consider the MoCA as a prudent choice for our study.

Neurocognitive status can also be assessed using questionnaires that ask participants about their functioning in real-life situations. One such scale is the 75-item Behavior Rating Inventory of Executive Function-Adult Version (BRIEF-A) (Roth, Isquith, & Gioia, 2005; Roth, Lance, Isquith, Fischer, & Giancola, 2013). The BRIEF-A is a self-report questionnaire composed of nine subscales and three composite scores. Our previous findings indicate that self-report measures of executive functions can be valuable, cost-effective, and sufficiently accurate for an initial clinical evaluation, providing complementary measures to performance-based tests (Hagen et al., 2016).

However, initial screening for cognitive deficits in patients with SUD faces several interpretive challenges, including the influence of psychiatric symptoms. Psychiatric symptoms with following psychological distress may significantly confound the current neuropsychological profile, and it has been widely reported that several psychiatric conditions inflict changes in cognitive functions (Hwang, Masterman, Ortiz, Fairbanks, & Cummings, 2004; Lyketsos et al., 2002; Möller, 2009). While the correlation between psychological distress and cognitive performance may indicate that psychiatric disorders cause impairment in actual cognitive functioning, it is also possible that people with psychiatric symptoms are more apprehensive about their performance during testing or that psychiatric symptoms may render test-takers more susceptible to environmental influences during testing (Moritz et al., 2017). Thus, testing using performance-based measures of cognitive functioning could lead to inflated estimates of the degree or prevalence of impairment in people with SUD. An ecologically valid measure, such as the BRIEF-A, may be less susceptible to such confounding. On the other hand, the BRIEF-A depends on self-report, and negative self-perception may also influence responses to items.

Although the BRIEF-A is promising as an initial screening tool, the association of the MoCA and BRIEF-A with general psychological distress in young adults with SUD is still not well understood and requires further study. The present study focuses on young adults under 30 years of age and addresses the following question: What are the associations between psychological distress and two cognitive screening tools in an unselected clinical population of young adults with polysubstance use disorder (PSUD), with the expected heterogeneity in terms of drugs of abuse, and medical and psychiatric co-morbidity. Specifically, we aimed to disentangle the links between performance-based and self-reported cognitive functioning on the one hand, and self-reported psychiatric symptoms on the other.

2. Material and methods

2.1. Design

The study was part of the Norwegian Stayer study, a prospective, longitudinal cohort study of men and women treated for SUD. The study included patients who started a new treatment sequence at the inpatient and outpatient treatment facilities of the Stavanger University Hospital. Participants were tested after two weeks of abstinence (Miller, 1985) to minimize contamination from drug withdrawal and acute neurotoxic effects from psychoactive substances. The Regional Ethical Committee (REK 2011/1877) approved the project.

2.2. Inclusion procedure

To be included in the study, patients needed to: a) sign a written informed consent to participate; b) embark on a new treatment sequence within the substance use treatment service; c) be considered to have SUD by the admittance committee for specialized SUD treatment at the University Hospital of Stavanger; and d) be at least 16 years of age. Patients also had to have been enrolled in the program to which they were admitted for at least two weeks. Abstinence was verified through self-report for both inpatients and outpatients. In one of the first treatment sessions (1–3), patients were given an information sheet with a short project description.

2.3. Participants and procedures

We recruited 202 participants from 10 specialized outpatient and residential treatment facilities within the region. To have the right to access treatment within the specialized treatment services in Norway, patients must have a substance use disorder that fulfills the criteria for the diagnosis F1x.1 - harmful use, or F1x.2 - dependency syndrome, as defined by the ICD-10 (World Health Organization, 1994). We recruited patients between March 2012 and December 2015 and enrolled all consenting patients consecutively within the recruitment period. The SUD group included patients reporting the use of more than one drug or a history of intravenous polysubstance use.

Of the 202 patients recruited, 122 were between 16 and 30 years of age, and thus considered young adults. Many studies have investigated dropout as a function of age, and young age has been found to be a predictor for dropout as reported in several studies (Brorson et al., 2013). Furthermore, we chose young adults as the health-care system in Norway guarantees shorter processing time from referral to submission for younger adults. We did not exclude patients with comorbid psychiatric conditions as most SUD patients in the Norwegian public health care system has one or more co-occurring psychiatric secondary

diagnoses. We excluded 16 patients for not having a substance-related disorder or having a mono-substance use. Two additional participants were excluded because of missing data on the MoCA, leaving a final group consisting of n = 104 SUD patients.

2.4. Measures

Experienced and trained psychometric staff administered all tests in the Stayer cohort. An interview based on items from the preliminary version of the National Quality Register for Substance Abuse Treatment was used to collect demographics, type of substance used, debut age, treatment and work history, and educational data.

2.4.1. Performance-based assessment with the MoCA

We screened all participants for cognitive impairment with the MoCA (Nasreddine et al., 2005). The MoCA is a short screening instrument for cognitive function scored in integers up to 30 points on seven dimensions: Visuospatial/Executive (up to 5 points), Naming (up to 3 points), Memory (up to 5 points), Attention (up to 6 points), Language (up to 3 points), Abstraction (up to 2 points), and Orientation (up to 6 points). The MoCA has shown good psychometric properties within the SUD group (Copersino et al., 2009). With a sum-score cutoff value of < 26, the MoCA identifies cognitive function in the range of mild cognitive impairment with excellent sensitivity and acceptable specificity (Copersino et al., 2009; Nasreddine et al., 2005). In accordance with this literature, we used the < 26 cut-off for mild cognitive impairment in the present study.

2.4.2. Self-reported executive functions with the BRIEF-A

We assessed executive functions with the BRIEF-A (Gioia, Isquith, Guy, Kenworthy, & Baron, 2000; Roth et al., 2005). The BRIEF-A has been shown to have high ecological validity (Gioia et al., 2000; Roth et al., 2005), and to be associated with substance use status as well as several social adjustment indicators in patients with a history of PSUD (Hagen et al., 2016). The BRIEF-A includes three composite scores including sets of subscales. We calculated the Behavioral Regulation Index (BRI-index) from the Inhibit, Shift, Self-Monitor, and Emotional Control subscales. We calculated the BRIEF-A Metacognition Index (MI) from the Initiate, Plan/Organize, Working Memory, Organization of Materials, and Task Monitor subscales. Validity scales of the BRIEF-A were examined, using the cutoff scores proposed by the original authors (Gioia et al., 2000). We categorized a total of nine BRIEF-A protocols as invalid. To identify participants with cognitive impairment, ≥65 for the BRIEF-A Global Executive Composite (GEC), the t-score was utilized as the cutoff score.

2.4.3. Psychological distress with SCL-90-R

To measure psychological distress, we used the Symptom Checklist-90-R (SCL-90-R) (Derogatis & Unger, 2010). This is a 90-item self-report symptom inventory that yields measures of nine symptom domains of psychological distress: (1) Somatization; (2) Obsessive compulsion; (3) Interpersonal sensitivity; (4) Depression; (5) Anxiety; (6) Hostility; (7) Phobic anxiety; (8) Paranoid ideation; and (9) Psychoticism. This study includes the nine subscales, and the three global indexes: Global Severity Index (GSI), Positive Symptom Distress Scale (PSDI), and the Positive Symptom Total (PST) (Derogatis & Unger, 2010).

2.5. Statistical analyses

All statistical analyses were performed using IBM SPSS software (v. 25 for Windows). We assessed neuropsychological and psychopathological data for normality using histograms and the Shapiro–Wilk test. While the BRIEF-A GEC was normally distributed, SCL-90-R GSI scores and MoCA sum scores were both skewed. We gathered descriptive statistics for demographic, clinical, and cognitive variables. Gender differences were assessed using Student's *t*-test for continuous variables and chi-square for categorical variables.

To assess the relationship between the full-scale scores of these tests, correlations between SCL-90-R GSI, MoCA sum score, and BRIEF-A GEC were calculated. As the SCL-90-R GSI and MoCA sum score were non-normally distributed, Spearman rank order correlations were used to determine the correlation between the variables. Supplemental analyses of all subscales of SCL-90-R was also performed; first, with the MoCA sum score, and then with all the subscales of the BRIEF-A.

We used multiple logistic regression (enter method) to assess how the identification of cognitive impairment by the MoCA and BRIEF-A was associated with psychological distress. In these analyses, a binary variable for cognitive status ("cognitive impairment" or "no cognitive impairment") from either the MoCA or the BRIEF was used as the dependent variable, while SCL-90-R GSI score and demographic control variables (age and gender) were entered as independent variables. Multicollinearity and heteroscedasticity of the models were assessed using P-P-plots and plots of standardized predicted values and standardized residuals.

3. Results

3.1. Demographics, substance abuse, and treatment history

Table 1 summarizes the demographic variables. Participants were predominantly male, with a mean age of 23.4 (SD 3.4) years. With regard to clinical variables, participants were all polysubstance users, with a mean duration of drug use of 10.3 (SD 3.6) years. Although the number of previous treatment attempts varied (Range 0–20), most patients reported one previous treatment attempt.

3.2. Cognitive measures

Scores on subdomains of the MoCA are summarized in Table 2. A total of 34.6% (n = 36) patients scored below the cutoff for cognitive impairment (< 26) on the MoCA.

Table 2 summarizes the scores on the valid BRIEF-A subscales and indexes. Please note that nine invalid BRIEF-A protocols were removed from this analysis, leaving a N = 95. A total of 63.2% (n = 60) patients scored over the cutoff for self-reported executive dysfunctions on the GEC index.

3.3. SCL-90-R

Table 3 reports the scores on all subdomains of the SCL-90-R stratified by gender. In general, participants reported elevated scores on all subscales of the SCL-90-R, compared with previously published US norms (Derogatis & Unger, 2010).

Table 1
Demographics, drug use history, and characteristics of young adults from the Stayer cohort, stratified by gender.

	Male (n = 64)	Female (n = 40)	Total (n = 104)
Age	23.6 (3.4)	23.0 (3.5)	23.4 (3.4)
Education, years	11.6 (1.4)	11.7 (1.8)	11.7 (1.6)
Years of work experience	3.8 (3.1)	2.4 (2.6)*	3.3 (3.0)
Age of initial drug use	12.8 (2.2)	13.5 (1.6)	13.1 (2.0)
Years of drug use	10.8 (3.7)	9.5 (3.4)	10.3 (3.6)
Previous treatments, median (range)	1 (0 – 20)	0 (0–6)	1 (0–20)
Intravenous drug use[a], n (%)	37 (57.8)	25 (62.5)	63 (56.3)

All data are mean (SD) unless otherwise specified.
[a] Patients who responded affirmative to a "yes" or "no" question.
* Indicates a significant difference ($p < 0.05$) between male and female participants.

Table 2
Scores on Montreal Cognitive Assessment domains and BRIEF-A scales and indexes (n = 104).

Measure	M	SD	Range	n (%) impaired[a]
MoCA scales				
Visuospatial	4.4	0.7	2–5	–
Picture naming	2.9	0.2	2–3	–
Attention	4.7	1.3	1–6	–
Language	2.6	0.6	0–3	–
Abstraction	1.4	0.6	0–2	–
Delayed recall	4.0	1.3	0–5	–
Orientation	5.9	0.4	4–6	–
MoCA sum score	26.2	2.5	19–31	36 (34.6)
BRIEF-A t-scores[b]				
Inhibit scale	65.8	11.3	7–91	53 (55.8)
Shift scale	64.8	10.3	39–87	40 (42.1)
Emotional control scale	59.8	9.5	38–83	27 (28.4)
Self-monitor scale	61.4	11.7	37–89	37 (38.9)
Initiate scale	65.5	10.4	43–85	50 (52.6)
Working memory scale	65.6	10.7	43–89	46 (48.4)
Plan/organize scale	63.5	10.1	38–86	49 (51.6)
Task monitor scale	62.3	11.3	36–90	36 (37.9)
Organization of materials	56.1	10.2	36–78	18 (18.9)
Behavioral Regulation Index	65.2	10.0	39–88	55 (57.9)
Metacognition Index	64.4	9.8	41–85	48 (50.5)
Global Executive Composite	66.3	10.0	40–89	60 (63.2)

Abbreviations: BRIEF-A GEC t-score, Behavior Rating Inventory of Executive Function - Adult Version Global Executive Composite t-score; MoCA, Montreal Cognitive Assessment.

[a] Cognitive impairment is categorized based on previously published recommendations; MoCA patients with a sum score of < 26 are categorized as impaired, while t-scores ≥65 are used as the cutoff on BRIEF-A scales and indexes.

[b] BRIEF-A scores are based on valid BRIEF protocols only (n = 95).

Table 3
Scores for SCL-90-R domains among young adults in the Stayer cohort (n = 104).

	Young adults in Stayer cohort (n = 104)				US norms (n = 974)[a]			
	Male (n = 64)		Female (n = 40)		Male		Female	
SCL-90-R domain	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Somatization	0.9	0.7	1.1	0.8	0.3	0.3	0.4	0.4
Compulsive behavior	1.4	0.7	1.7	0.7	0.3	0.4	0.4	0.5
Interpersonal sensitivity	1.2	0.8	1.4	0.9	0.3	0.3	0.4	0.4
Depression	1.2	0.8	1.5	0.8	0.3	0.3	0.5	0.4
Anxiety	1.2	0.8	1.5	0.8	0.2	0.3	0.4	0.4
Hostility	0.9	0.8	0.8	0.9	0.3	0.4	0.4	0.4
Phobic anxiety	0.8	0.7	1.2	1.0	0.1	0.2	0.4	0.3
Paranoia	1.2	0.8	1.3	1.0	0.3	0.4	0.5	0.4
Psychoticism	0.7	0.7	0.7	0.6	0.1	0.2	0.2	0.3
Additional	1.3	0.7	1.6	0.8	–	–	–	–
Global Severity Index	1.1	0.6	1.3	0.7	0.3	0.2	0.4	0.4
Positive symptom total	52.4	21.2	55.9	17.7	17.0	13.9	22.0	16.2
Positive symptom distress	1.8	0.5	2.0	0.5	1.3	0.4	1.4	0.4

Abbreviations: SCL-90-R, Symptoms Checklist 90 Revised.

[a] Based on previously published norms (Derogatis & Unger, 2010).

3.4. Correlation between cognitive tests and SCL-90-R GSI

Table 4 summarizes the correlations between SCL-90-R GSI score, BRIEF-A GEC score, and MoCA sum scores. There was a significant correlation between the SCL-90-R GSI score and the BRIEF-A GEC t-score (rs = 0.62, p < 0.001). There was no significant correlation between the SCL-90-R GSI score and the MoCA sum score or between the BRIEF-A GEC score and the MoCA sum score.

Table 4
Spearman correlations coefficient between SCL-90-R GSI score, MoCA, and BRIEF-A GSI among young adults in the Stayer cohort (n = 104).

	SCL-90-R GSI	MoCA sum score	BRIEF-A GEC[a]
SCL90-R GSI	1	–0.19[b]	0.61**
MoCA sum score	–	1	−0.20
BRIEF-A GEC[a]	–	–	1

Abbreviations: BRIEF-A GEC, Behavior Rating Inventory of Executive Function - Adult Version Global Executive Composite; MoCA, Montreal Cognitive Assessment; SCL-90-R GSI, Symptoms Checklist 90 Revised Global Severity Index.

** p < 0.01 (2-tailed).

[a] BRIEF-A GEC correlation is based only on participants with valid BRIEF-A protocols (n = 95).

[b] Correlation between SCL-90-R and MoCA sum score is based on the full study cohort (n = 104).

We performed subanalyses of the nine subscales of the SCL-90-R and BRIEF-A subscales to ensure that no singular subset of the BRIEF-A resulted in significant correlations between the SCL-90-R GSI and BRIEF-A GEC. In these analyses, eight subscales of the BRIEF-A showed statistically significant associations with all nine subscales of the SCL-90-R (see Supplementary table E-1 for details). We found a significant correlation between the BRIEF-A scale Organization of Materials and five of the nine SCL-90-R subscales. A similar subanalysis of the correlations between the MoCA sum score and the nine SCL-90-R subscales showed no significant correlations (see Supplementary table E-2 for details).

3.5. Association between identified cases of cognitive impairment and SCL-90-R score

Table 5 summarizes the results of the logistic regression analysis. In these analyses, cognitive impairment identified by either MoCA or BRIEF GEC t-score was used as the dependent variable, and SCL-90-R GSI score, gender, and age at testing were entered as independent variables.

The logistic regression model for cognitive impairment identified with MoCA was not significant ($\chi^2 = 4.9$, p = 0.177), explaining 6.4% (Nagelkerke $r^2 = 0.064$) of the variance in cognitive status. None of the independent variables were significant in this analysis.

The logistic regression model for cognitive impairment identified with the BRIEF-A GEC t-score resulted in a significant model ($\chi^2 = 49.7$; p < 0.001), explaining 55.7% (Nagelkerke $r^2 = 0.557$) of the variance in BRIEF-A GEC score. Of the independent variables, the SCL-90-R GSI score (OR = 17.3; 95% CI: 4.4–68.8; p < 0.001), and age at testing (OR = 0.7; 95% CI: 0.6–0.9; p = 0.003), were significantly associated with cognitive status. Follow-up sub-analyses resulted in similar results for both the BRI-index and the MI-index (data not shown).

4. Discussion

Our study indicated that MoCA was not associated with psychological distress in young adults with PSUD, while the BRIEF-A GEC was significantly associated with psychological distress as measured with the SCL-90-R. Young adults often report high levels of psychological distress (Mojtabai, Olfson, & Han, 2016), and our data suggest caution when using self-report measures, such as the BRIEF-A, to screen for cognitive dysfunction due to a possible methods bias. Particularly in the initial phases of treatment as the level of psychological distress could

Table 5
Logistic regression with cognitive dysfunctions defined by either MoCA or BRIEF-A GEC as the dependent variable (n = 104).

	Dependent variable: MoCA					Dependent variable: BRIEF-A GEC[a]				
	B	Std. error	OR	95% CI of OR	p-Value	B	Std. error	OR	95% CI of OR	p-Value
(Constant)	5.2	2.4	176.4	–	0.034	5.1	2.4	159.4	–	0.034
SCL-90-R GSI	0.4	0.4	1.0	0.5–2.1	0.912	2.9	0.7	17.3	4.4–68.8	**< 0.001**
Gender	−0.4	0.5	0.6	0.3–1.6	0.326	−1.1	0.6	0.3	0.1–1.2	0.084
Age	−0.1	0.1	0.9	0.8–1.0	0.152	−0.3	0.1	0.7	0.6–0.9	**0.003**

Abbreviations: SCL-90-R GSI, Symptoms Checklist 90 Revised Global Severity Index; BRIEF-A GEC, Behavior Rating Inventory of Executive Function - Adult Version Global Executive Composite; MoCA, Montreal Cognitive Assessment; SCL-90-R, Symptoms Checklist 90 Revised; OR, odds ratio.
Bold indicates significant p-values.
[a] This analysis is based on valid BRIEF protocols only (n = 95).

significantly influence the profile. This finding is relevant for clinicians within the field and supports the use of more objective screening tools when assessing cognitive dysfunctions in young adults early in the treatment of PSUD.

Our findings are consistent with previous research showing that MoCA provides a time- and resource-efficient assessment for identifying MCI in patients with SUD (Copersino et al., 2009, 2012; Régis, Bertrand, Stéphanie, & Pascal, 2015). In this cohort, 34.6% of participants scored below the threshold for cognitive impairment in SUD. This prevalence is comparable to findings from other SUD cohorts using both comprehensive neuropsychological test batteries and findings from other cohorts using MoCA (Bruijnen et al., 2018; Marceau, Lunn, Berry, Kelly, & Solowij, 2016).

Several studies have supported the validity of the BRIEF scales in assessing everyday EF (Isquith, Roth, & Gioia, 2013). The findings indicate that current polydrug users report significantly more dysfunction than nonusers on the BRIEF-A (Hadjiefthyvoulou, Fisk, Montgomery, & Bridges, 2012). Moreover, there are established associations between BRIEF scores and corresponding neural substrates (Anderson, 2002), and ecological validity with regard to predicting both everyday functioning (Isquith et al., 2013) and academic performance (Waber, Gerber, Turcios, Wagner, & Forbes, 2006). The BRIEF-A questionnaire assesses the participant's subjective evaluation of their functioning in real-life situations. We have previously suggested that the BRIEF-A can be a valuable and cost-effective clinical evaluation, providing complementary measures to performance-based tests. (Hagen et al., 2016). The BRIEF-A captures the responder's view of his or her ability to maintain appropriate control of their behavior and emotional responses, and results, therefore, encompass self-reported cognitive and emotional characteristics (Hagen et al., 2016; Roth et al., 2005). Previous findings have shown an association between the BRIEF-A and emotional distress among healthy peers as well as neurologically impaired groups, while no, or weak, associations have been reported with broader measures of IQ and performance-based tests of EF (Løvstad et al., 2016). In sum, our findings confirm previous results in which patients' self-reports of cognitive functioning do not give a precise picture of neurocognitive status, and are closely associated with emotional distress rather than reflecting the level of actual cognitive functioning (Shelton & Parsons, 1987).

Our data also suggest the need to interpret BRIEF-A results within a broad differential diagnostic context, where assessment of psychological distress is included in addition to performance-based tests, such as the MoCA, to delineate common variance from true cognitive deficiency. Several studies have supported this low concordance between objective and self-report measures (Toplak, West, & Stanovich, 2013), and we suggest that the impact of the emotional component in BRIEF-A scores accounts for some of these differences.

Both psychiatric symptoms and the BRIEF-A were measured using self-reported data, meaning that the two shared methods variances, while the MoCA is a performance-based measure. The shared method variance might influence the correlation, indicating the importance of using diverse methods when assessing SUD patients.

PSUD is the most common diagnosis among patients seeking treatment for substance use (Andrade, Carroll, & Petry, 2013). The influence of psychiatric distress on BRIEF-A scores presented in this paper is consistent with research showing that polydrug users report higher levels of general psychological distress (Andreas, Lauritzen, & Nordfjærn, 2015; Quek et al., 2013; White et al., 2013). PSUD patients report more symptoms of anxiety and depression (Booth et al., 2010; Smith, Farrell, Bunting, Houston, & Shevlin, 2011), which is clinically relevant because psychiatric comorbidity increases suicide risk, reduces life quality, and impairs social integration (Thylstrup, Bloomfield, & Hesse, 2018).

4.1. Strengths and limitations

The SUD participants were recruited from 10 different treatment facilities within the Stavanger University Hospital region, providing a wide range of patients, representative of a broader population of people with substance use disorders seeking treatment.

This research field faces some interpretive challenges regarding the etiology of cognitive deficits associated with substance abuse. Psychiatric comorbidity, medical risk factors (e.g., head trauma, HIV, malnutrition, and overdose), genetic predispositions, and premorbid vulnerability (e.g., genetic, psychosocial, and environmental) may all play significant causal roles leading to the current neuropsychological profile. Several psychiatric diagnoses are characterized by changes in EF, and psychiatric functioning is assessed with self-report, not supplemented with observer-rated scales. To ensure validity and reliability in the assessment of psychopathological symptoms, it is recommended that both patient and observer ratings be employed (Möller, 2009).

Furthermore, although there is considerable evidence of an association between different aspects of SUD and cognitive impairment, the direct versus indirect roles of the various substances are not clear. Some cognitive deficiencies could be viewed as antecedents to SUD, especially those involving EF related to decision-making and impulsivity (Nigg et al., 2006; Nigg, Blaskey, Huang-Pollock, & Rappley, 2002).

We did not collect detailed information about the nature of polydrug use, such as whether different substances were used concurrently or sequentially, in our sample. This information would be beneficial to understand better the issues of polydrug use.

Also, our measure of psychiatric symptoms was based exclusively on self-report, rather than clinical evaluation or a structured interview. However, self-reported symptoms have substantial predictive validity in people with substance use disorders (Thylstrup et al., 2018).

5. Conclusions

Timely and valid assessment of cognitive functioning should be a priority in SUD treatment. Our study indicates that the results of the MoCA are independent of concurrent psychological distress, while the BRIEF-A GEC is significantly associated with psychological distress, as

measured by the SCL-90-R. Whether this is a result of methods variance or a true link between the cognitive function construct assessed by the BRIEF-A should be the subject of further research. Consequently, our findings suggest the need to interpret BRIEF-A results within a broad differential diagnostic context, where the assessment of psychological distress is included and suggests that scores on the BRIEF-A cannot be interpreted as indicators of executive dysfunction without reservation. We, therefore, suggest that performance-based assessment, such as the MoCA, could reduce the influence of psychological distress on cognitive screening. However, the validity of neuropsychological assessment depends not only on its associations with psychiatric symptoms but its ability to predict clinically meaningful outcomes. In that respect, BRIEF-A provides a broader but valid functional description of patient status, while not describing cognitive functions in isolation. BRIEF-A may, therefore, be considered a complementary tool in a systematic initial mapping of cognitive functioning in SUD patients. Particularly in cases where emotional distress is apparent. Further research into appropriate differential diagnoses for young adults with a SUD diagnosis is needed as this could contribute to the construction of new streams of care for young people with SUD in transition to adulthood.

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EH initiated the project, wrote the manuscript, and contributed to project design, analysis, and interpretation; AHE contributed to study design, statistical analyses, interpretation, writing of the manuscript, and critical revision of the manuscript. MS, MH, and EAA contributed to writing and revising the manuscript, and interpretation of the analyses. All authors read and approved the final manuscript.

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Competing interests

The authors declare that they have no competing interests. We certify that there is no conflict of interest with any financial organization or nonfinancial competing interests regarding the material discussed in the manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jsat.2018.11.010.

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