ADHD Attention Deficit and Hyperactivity Disorders (2019) 11:139–147
https://doi.org/10.1007/s12402-018-0268-7

SHORT COMMUNICATION

Rapid screening for cognitive deficits in attention deficit and hyperactivity disorders with the screen for cognitive impairment in psychiatry

Smadar Valérie Tourjman[1] · Stéphane Potvin[1] · Fernando Corbalan[1] · Akram Djouini[1] · Scot E. Purdon[3] · Emmanuel Stip[1,4] · Robert-Paul Juster[2] · Edouard Kouassi[1]

Received: 24 February 2018 / Accepted: 10 September 2018 / Published online: 17 September 2018

Abstract

Cognitive impairments constitute a core feature of attention deficit and hyperactivity disorders (ADHD), but are infrequently assessed in the clinical setting. We have previously demonstrated the ability of an objective cognitive battery, the Screen for Cognitive Impairment in Psychiatry (SCIP), to differentiate adult ADHD patients from healthy controls in five cognitive domains. Here, we further characterize these subtle cognitive deficits by conducting additional univariate analyses on our ADHD dataset to assess the contributions of various demographic characteristics on SCIP performance and to determine correlations between SCIP scores and scores on other measures evaluating illness severity, perceived cognitive deficits, and overall functioning. Age and years of education were moderately associated with performance on the SCIP and/or its subscales in our ADHD cohort. The SCIP global index score was moderately correlated with clinician-rated measures of illness severity and weakly associated with clinician-rated overall functional status. Intriguingly, overall SCIP performance was only weakly associated with patient self-reported measures of cognitive functioning. Of practical importance, small-to-moderate associations were consistently observed between performances on two subscales of the SCIP and the other measures evaluating illness severity, overall functioning, and patient self-reported cognitive functioning (the working memory and visuomotor tracking subscales). Thus, these data demonstrate that the SCIP, particularly the working memory and visuomotor tracking subscales, is sensitive enough to detect cognitive deficits in adult patients with ADHD, and that these deficits are correlated with functional impairments. Furthermore, these data highlight the importance of integrating both objective and subjective evaluations of cognition in adult ADHD.

Keywords Cognition · ADHD · Brief cognitive assessment · SCIP · Subjective and objective assessment

Introduction

Attention deficit hyperactivity disorder is a complex disorder with pleiotropic presentations and may more aptly be termed attention deficit and hyperactivity disorders (ADHD). Although it is often considered a disorder of childhood and adolescence, up to 5% of adults meet the criteria for an ADHD diagnosis (Gallagher and Blader 2001). Adult patients with ADHD are more likely to present with cognitive difficulties such as impaired attention and disorganization of thought than with symptoms of hyperactivity (Biederman et al. 2000; Gallagher and Blader 2001). While reported impairments in cognitive functioning are central to adult ADHD, there is no distinctive or specific pattern of neurocognitive disturbances; several domains of cognitive dysfunction have been identified including executive motor inhibition, planning, vigilance, set

✉ Smadar Valérie Tourjman
vtourjman.iusmm@ssss.gouv.qc.ca

[1] Department of Psychiatry, Institut Universitaire en Santé Mentale de Montréal, l'Université de Montréal, 7401 Hochelaga, Montréal, QC H1N 3M5, Canada

[2] Department of Psychiatry, Columbia University Medical Center, New York, NY, USA

[3] Department of Psychiatry, University of Alberta, Edmonton, AB, Canada

[4] Centre de Recherche du Centre Hospitalier de l'Université de Montréal, Montréal, QC, Canada

shifting, sustained attention, temporal processing, verbal and spatial working memory (Castellanos et al. 2006; Mostert et al. 2015; Willcutt et al. 2005). It should be noted that while most studies on cognition in ADHD have centered around executive control processes, there is evidence to suggest that the cognitive deficits of ADHD are not limited to executive dysfunction (Vaidya and Stollstorff 2008), and that the executive dysfunction may be explained in part by other primary deficits (Castellanos et al. 2006; Kupper et al. 2012).

Remission of ADHD symptoms is associated with improvements in cognitive and neurophysiological processes, and hence, interventions aimed at improving these processes are indicated (Michelini et al. 2016). In view of the importance of cognition to clinical symptoms, prognosis, and psychosocial functioning, clinicians should assess the cognitive capabilities of a patient as part of the clinical assessment to determine the patient's specific cognitive profile and to personalize global treatment plans accordingly (Gallagher and Blader 2001; Koziol and Stevens 2012; Lange et al. 2014). However, the objective measurement of the cognitive deficits of ADHD patients in the clinical setting remains limited. An important barrier to this clinical practice is the lack of brief neuropsychological assessments that are specifically designed to assess the cognitive impairments in adult patients with ADHD or that are sensitive enough to capture the more subtle and wide-ranging cognitive deficits observed in these patients (Cholet et al. 2014; Randolph et al. 1998).

The Screen for Cognitive Impairment in Psychiatry (SCIP) is a brief, objective evaluation of cognitive deficits and has been shown to be able to detect cognitive deficits in patients with neuropsychiatric disorders (Cuesta et al. 2011; Gomez-Benito et al. 2013; Guilera et al. 2009; Jensen et al. 2015; Ott et al. 2016; Pino et al. 2008; Purdon 2005; Rojo et al. 2010; Svendsen et al. 2012). We recently demonstrated the ability of the SCIP to differentiate adult ADHD patients from healthy controls (Potvin et al. 2016). The goal of the present study is to further characterize the subtle cognitive deficits observed in this cohort of adult patients with ADHD. To this end, we report on cognitive deficits observed as a function of various demographic variables in our subset of adult ADHD patients objectively evaluated using the SCIP. We also assess the ability of the SCIP and its subscales to predict illness severity and overall functioning, and examine associations between the SCIP and its subscales with subjective measures of cognitive functioning.

Methods

Study design and participants

A more detailed description of study design and participant selection has been previously published (Potvin et al. 2016). Briefly, 36 consecutive individuals consulting for follow up at the Institut en Santé Mentale de Montréal (IUSMM) mood disorder clinic were invited to participate in the study. These patients had been referred to the mood disorder clinic for diagnostic clarification and treatment of suspected or complex ADHD. All participants had received a diagnosis of ADHD based on the DSM-IV-TR criteria and provided written informed consent after study procedures were explained. Study inclusion and exclusion criteria were kept to a minimum so as to allow the closest possible approximation to the typical clinical population—participants were only excluded if they were unable to give informed consent, had a neurological illness or other condition that could conceivably impair cognitive functioning, or had another diagnosis as the primary focus of treatment. The study was approved by the Institutional Review Board (IRB) of the IUSMM and was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for human experiments.

Participants completed various self-report questionnaires and the SCIP. The start and finish times for the administration of the SCIP were also documented. Following completion of the SCIP and questionnaires, participants underwent clinical evaluation by an experienced psychiatrist with expertise in adult ADHD (S.V. Tourjman) who completed a full DSM-IV-TR diagnosis which included a global assessment of functioning (GAF) (DSM-IV-TR 2000 4th ed., text rev.) and evaluated illness severity using the Clinical Global Impression Severity Scale (CGI-S) (Berk et al. 2008) while they were blinded to the results of the SCIP and to other questionnaires.

Measures and questionnaires

More detailed description of the different measures and questionnaires is available in previous publications (Potvin et al. 2016; Purdon 2005). Briefly, the recently translated and validated French version of the SCIP (SCIP-F) was used to objectively assess cognitive functioning (Potvin et al. 2016; Tourjman et al. 2016). The SCIP consists of five subscales that assesses function in different cognitive domains: a verbal learning task (VLT) with immediate (VLTi) and delayed (VLTd) recall subtests for short and long term memory, a working memory task, a verbal fluency task, and a visuomotor tracking task (VMT) that assesses processing speed. After administration of the SCIP-F, participants filled out a self-report survey designed to capture their subjective experience of completing the SCIP and a brief questionnaire to collect demographic data.

The Échelle d'auto-évaluation cognitive (EDEC), a validated, 16-item questionnaire was used to assess participants' subjective measure of global cognitive functioning and its impact on day-to-day functioning. Illness severity

was assessed using the Clinical Global Impression Severity Scale (CGI-S). Level of functioning was evaluated using two scales: the GAF score of the multiaxial DSM-IV-TR diagnosis and the self-report Sheehan Disability Scale (SDS) in which participants rate the extent to which their work/school, social life, and home life/family responsibilities are impaired by their ADHD symptoms on a visual ten-point analog scale (Sheehan et al. 1996).

Statistical analysis

Statistical analyses. Univariate analyses were employed to assess contributions of various demographic characteristics to performance on the SCIP global index, a composite value representing all five subscales, as well as for each individual subscale. As preliminary descriptive analyses of skew and kurtosis revealed that study variables were normally distributed, we used one-way analysis of variance (ANOVA) for categorical variables (sex, menopause status, race/ethnicity, civil status, occupation status, educational attainment, and health behaviors) and Pearson's product-by-moment correlations for continuous variables (age, years of education). In addition, Pearson's correlation coefficient analyses were performed among the scores from the different questionnaires to assess correlations between the SCIP global index (and subscales) and subjective measures of cognitive functioning (EDEC perceived cognitive deficit, EDEC perceived functional impact), level of functioning (GAF, SDS), and illness severity (CGI-S). Analysis of the actual and perceived time to complete the SCIP was compared using t-tests. The associations between the SCIP global index (and subscales) and the perceived time to complete the test were assessed using Pearson's correlations.

Effect sizes. To gauge the strength of association between variables, we used the corresponding proportion of shared variance index (i.e., eta^2 for ANOVAs and r^2 for correlational analyses) using conventional benchmarks. For ANOVAs, we defined effects sizes as "small" if 1–6% of the variance of the dependent variable was accounted for by the independent variable ($0.010 < eta^2 < 0.060$), as "medium" if the independent variable shared 7–20% of the variance in the dependent variable ($0.070 < eta^2 < 0.20$), and "large" if over 20% of the variation in dependent variable was defined by the independent variable ($eta^2 \leq 0.20$). For correlations, < 5% common variance ($r^2 < 0.005$, or $r < 0.224$) was considered to be of no practical importance, 5–20% common variance ($0.05 < r^2 < 0.20$, or $0.224 < r < 0.447$) was considered to reflect a small effect, 20–30% common variance ($0.20 < r^2 < 0.30$, or $0.447 < r < 0.548$) was considered to reflect a medium effect, and 50% or more common variance ($r^2 < 0.50$, or $r < 0.707$) was considered to reflect a strong effect. For all analyses, statistical significance level was set at $p < 0.05$ (two-tailed). Statistical analyses were performed using the Statistical Package for the Social Sciences© Version 22 and Prism 5© for Macintosh. Post hoc power analyses were performed using G*Power version 3.0.10.

Results

Patient demographics associated with SCIP global index and subscale scores

The sample descriptives and clinical features of the cohort of ADHD patients are presented in Tables 1 and 2, respectively. The number and percentage of patients identified to have cognitive impairments in the SCIP global index and subscales are presented in Table 2. The identification of cognitive impairments is based on previously published cutoff scores for the SCIP and its subscales (for a full analysis of the sensitivity and specificity of the proposed cutoffs, please refer to (Rojo et al. 2010)). Importantly, gender composition and mean age of the control group in Rojo et al. (2010) are comparable to our ADHD cohort; it should be noted, however, that relative to their control group, a greater proportion of our ADHD patients had attended post-secondary institutions.

Categorical variables. Performance on the SCIP (global index or any of the subscales) was independent of all categorical variables except menopausal status: menopausal status was associated with performance on the visuomotor tracking test (non-menopausal women performed better than postmenopausal women: $F_{[1,14]} = 4.79$, $p = 0.046$, $eta^2 = 0.255$). However, as visuomotor tracking performance is inversely associated with age (see below), we cannot presently discern whether the decreased performance seen in postmenopausal woman is directly related to menopause or indirectly to age.

Continuous variables. Using Pearson's correlations, we found that age was negatively associated with SCIP visuomotor tracking ($r = -0.44$, $p = 0.007$, $r^2 = 0.19$). Years of education were positively associated with SCIP working memory task ($r = 0.43$, $p = 0.008$, $r^2 = 0.19$), SCIP verbal fluency task ($r = 0.56$, $p < 0.001$, $r^2 = 0.32$), SCIP verbal learning-delayed task ($r = 0.34$, $p = 0.043$, $r^2 = 0.11$), and the SCIP global index ($r = 0.55$, $p = 0.001$, $r^2 = 0.30$).

Association of SCIP global index and subscale scores with subjective measures of cognitive functioning, illness severity, and overall functioning

The correlation matrix is presented in Table 3. The SCIP global index score was moderately correlated with clinician-rated measures of disease severity (CGI-S: $r = -0.52$, $p = 0.001$, $r^2 = 0.27$) and weakly with functional status (GAF: $r = 0.42$, $p = 0.01$, $r^2 = 0.18$). There were weak associations

Table 1 ADHD sample characteristics

Information	
N	36
Demographics	
Sex, % women	38.9
Age, M (SD)	39.59 (11.98)
Menopause status	
Postmenopausal, %	50.0
Pre-menopausal, %	50.0
Race/ethnicity, % Caucasian	86.1
Civil status	
Single, %	41.7
Married or common law, %	33.3
Divorced or separated, %	25
Occupation status	
Employed or full-time student, %	66.6
Unemployed or retired, %	5.6
Sick leave, %	27.8
Educational background	
Years of schooling, M (SD)	14.19 (4.89)
Secondary level, %	47.2
Some post-secondary, %	52.6
College, %	35.9
Health behaviors	
Smoking	
Non-smokers, %	30.6
Ex-smokers, %	27.8
Smokers, %	41.7
Illicit drugs	
Users, %	8.3
Non-users, %	55.6
Ex-users, %	36.1
Alcohol	
Consumers, %	50.0
Ex-consumers, %	13.9
Non-consumers, %	36.1
Characteristics	
Handedness	
Right handed, %	77.8

Table 2 ADHD sample clinical features

N	36
ADHD presentation	
Predominately inattentive	6 (16.7%)
Predominately hyperactive/impulsive	0 (0%)
Mixed presentation	29 (80.6%)
Not specified	1 (2.7%)
Comorbidities	
No comorbidities	7 (19.4%)
1 comorbidity	20 (55.6%)
2 comorbidities	6 (16.7%)
3 + comorbidities	3 (8.3%)
Anxiety disorder	9 (25%)
General anxiety disorder	6
Panic disorder	1
Social anxiety disorder	1
Anxiety disorder, nos	1
Bipolar and related disorders	3 (8.3%)
Bipolar disorder, Type I	1
Bipolar disorder, Type II	1
Cyclothymia	1
Depressive disorders	15 (41.7%)
Major depressive disorder (present)	5
Major depressive disorder (in remission)	8
Recurrent depression/dysthymia	1
Substance/medication induced	1
Motor disorders—Tourette's disorder	2 (5.6%)
Post-traumatic stress disorder	1 (2.7%)
Sleep–wake and breathing-related sleep issues	2 (5.6%)
Insomnia chronic	1
Sleep apnea	1
Substance-related and addictive disorders	4 (11.1%)
Cognitive impairments	
SCIP verbal learning task (immediate)	11 (30.6%)
SCIP verbal learning task (delayed)	16 (44.4%)
SCIP working memory task	23 (63.9%)
SCIP verbal fluency task	27 (75.0%)
SCIP visuomotor tracking task	26 (72.2%)
SCIP global index	14 (38.9%)

that did not reach statistical significance between the SCIP global index score and subjective patient self-assessment of their level of functioning (SDS: $r = -0.26$, $p = 0.13$, $r^2 = 0.07$), the functional impacts of their cognitive deficits (EDEC perceived functional impact: $r = -0.25$, $p = 0.14$, $r^2 = 0.08$), and their perceived cognitive deficits (EDEC perceived cognitive deficit: $r = -0.28$, $p = 0.09$, $r^2 = 0.06$).

Among the SCIP subscales, the visuomotor tracking task demonstrated small-to-moderate correlations with subjective cognitive tests: patient subjective measure of cognitive deficits (EDEC perceived cognitive deficits: $r = -0.39$, $p = 0.019$, $r^2 = 0.15$); patient self-report of functional impact of their cognitive deficits (EDEC perceived functional impact: $r = -0.43$, $p = 0.010$, $r^2 = 0.18$); as well as clinician-rated measure of illness severity (CGI-S: $r = -0.56$, $p < 0.0001$, $r^2 = 0.32$), functional status (GAF: $r = 0.48$, $p = 0.003$, $r^2 = 0.18$), and patient self-report of level of global functioning (SDS: $r = -0.47$, $p = 0.004$, $r^2 = 0.07$). The visuomotor tracking task also demonstrated significant correlations with all three subdomains assessed in the SDS (disruptions to work/school, social life, and family life/home responsibilities; data not shown). The working memory

Table 3 Descriptive statistics, correlation matrix of study variables, and effect sizes

Correlations (percentage of shared variance: $r^2 \times 100\%$)										
Variable	*M* (SD)	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. CGI	3.9 (1.5)	–									
2. GAF	61.0 (15.4)	−0.0819 (67.1%)[c]	–								
3. Global SDS	15.8 (7.8)	0.505 (25.5%)[b]	−0.413 (17.1%)[a]	–							
4. EDEC: perceived cognitive deficits	74.4 (34.4)	0.454 (20.6%)[b]	−0.271 (7.3%)[a]	0.702 (49.3%)[b]	–						
5. EDEC: perceived functional impacts	63.8 (63.8)	0.455 (20.7%)[b]	−0.251 (6.3%)[a]	0.735 (54.0%)[c]	0.943 (88.9%)[c]	–					
6. SCIP VLTi	21.9 (4.9)	−0.235 (5.5%)[a]	0.146 (2.1%)	−0.188 (3.5%)	−0.268 (7.2%)[a]	−0.158 (2.5%)	–				
7. SCIP WMT	16.9 (4.2)	−0.510 (26.0%)[b]	0.429 (18.4%)[a]	−0.220 (4.8%)	−0.341 (11.6%)[a]	−0.334 (11.1%)[a]	0.543 (29.5%)[b]	–			
8. SCIP VFT	14.9 (6.0)	−0.451 (20.3%)[b]	0.394 (15.5%)[a]	−0.052 (0.3%)	0.038 (0.1%)	0.012 (0.1%)	0.210 (4.4%)	0.545 (29.7%)[b]	–		
9. SCIP VLTd	6.5 (2.7)	−0.215 (4.6%)	0.122 (1.5%)	−0.212 (4.5%)	−0.285 (8.1%)[a]	−0.218 (4.7%)	0.778 (60.5%)[c]	0.514 (26.4%)[b]	0.219 (4.8%)	–	
10. SCIP VMT	9.8 (2.8)	−0.564 (31.8%)[b]	0.485 (23.5%)[b]	−0.470 (22.1%)[b]	−0.388 (15.1%)[a]	−0.425 (18.1%)[a]	0.421 (17.7%)[a]	0.694 (48.2%)[b]	0.472 (22.3%)[b]	0.408 (16.6%)[a]	–
11. SCIP global index	70.0 (15.6)	−0.521 (27.1%)[b]	0.420 (17.6%)[a]	−0.259 (6.7%)[a]	−0.281 (7.9%)[a]	−0.250 (6.3%)[a]	0.750 (56.3%)[c]	0.862 (74.3%)[c]	0.717 (51.4%)[c]	0.713 (50.8%)[c]	0.750 (56.3%)[c]

[a]Small effect size

[b]Moderate-to-moderately large effect size

[c]Large effect size

CGI Clinical Global Impression, *EDEC* Échelle d'autoévaluation cognitive (self-evaluation of cognition scale), *GAF* Global Assessment of Functioning Scale, *SCIP* Screen for Cognitive Impairment in Psychiatry (*VLTi* verbal learning task immediate, *WMT* working memory task, *VFT* verbal fluency task, *VLTd* verbal learning task delayed, *VMT* visuomotor tracking task), *SDS* Sheehan Disability Scale

task score similarly demonstrated significant correlations of small-to-medium-sized effects with all measures except the SDS: illness severity (CGI-S: $r=-0.51$, $p=0.002$, $r^2=0.26$), clinician-rated assessment of functioning (GAF: $r=0.43$, $p=0.009$, $r^2=0.18$), and the two EDEC subscales of patient-reported cognitive deficits ($r=-0.34$, $p=0.042$, $r^2=0.11$) and functional impact ($r=-0.33$, $p=0.046$, $r^2=0.11$). The verbal fluency task demonstrated small-to-moderate strength associations with clinician ratings of illness severity (CGI-S: $r=-0.45$, $p=0.007$, $r^2=0.20$) and overall functioning (GAF: $r=-0.39$, $p=0.017$, $r^2=0.16$). Neither the short-term nor the long-term memory subscales of the SCIP were consistently related to subjective measures of cognitive functioning, illness severity, or overall functioning (Table 3).

Actual and perceived time to complete the SCIP

Participants significantly overestimated the time it took to complete the SCIP. The average actual time required to complete the SCIP was less than 15 min ($M=12.50$, SD$=2.93$ min), but the average perceived time to complete the assessment was significantly longer ($M=17.92$, SD$=6.02$; $t(35)=5.24$, $p<0.001$). Interestingly, while the actual time to complete the SCIP was not correlated with the SCIP global index score ($r=-0.035$, $p=0.84$), the perceived time required to complete the SCIP was negatively associated with this score ($r=-0.44$, $p=0.007$). Subscale analyses demonstrated inverse, small associations between perceived time and SCIP working memory ($r=-0.38$, $p=0.021$), SCIP verbal fluency ($r=-0.34$ $p=0.045$), and SCIP visuomotor tracking ($r=-0.38$, $p=0.024$), but not with either of the SCIP memory subscales.

Discussion

Clinicians should assess cognitive impairments in adult ADHD patients; however, performing a comprehensive neuropsychological assessment is often not feasible in clinical settings. Here we demonstrate that the SCIP can be completed by adult ADHD patients in less than 13 min. We also demonstrate that performance on the SCIP is correlated with functional impairments and illness severity. Although the SCIP global index is only weakly correlated with subjective patient self-reports of cognitive functioning, two of its five subscales consistently demonstrated small-to-moderate associations—namely processing speed and working memory. Further, processing speed was also moderately correlated with functioning whether it was assessed by the clinician (GAF) or by the patient (SDS global index). Thus, the SCIP, and these two subscales in particular, can be easily employed in a clinical setting to assess cognitive deficits in adult ADHD patients.

In the present analysis, we report moderately strong correlations between the SCIP global index and clinician-rated measures of illness/symptom severity and overall functioning, but intriguingly, no (or only weak) associations to patient self-reported deficits or functioning. Discordance between subjective perception of cognitive deficits and objective measures of cognitive functioning has been reported previously (Barkley and Fischer 2011; Biederman et al. 2008; Fuermaier et al. 2015; Toplak et al. 2013). This observed incongruity has led to the supposition that the results from objective performance-based tests and subjective ratings on self-report scales of cognition are not interchangeable, but that they assess different cognitive constructs. Specifically, objective psychometric tests are purported to evaluate optimal performance or peak cognitive efficiency, whereas self-rating scales measure actual day-to-day performance (Toplak et al. 2013). It is also reasonable to assume that a patient may not be the best judge of his or her own cognitive skills and that the objective scores are less sensitive to personal bias. As such, proper assessment of cognitive functioning in patients with ADHD should include both objective (i.e., how well *can* the patient perform cognitive tasks) and subjective (i.e., how well *does* the patient perform cognitive tasks) measures (Fuermaier et al. 2015; Toplak et al. 2013).

The visuomotor tracking (VMT) task demonstrated correlations of small-to-medium-sized effects with all subjective cognitive tests, including the Sheehan Disability Scale, and the working memory task with all but the Sheehan Disability Scale. The VMT task of the SCIP is primarily a measure of processing and psychomotor speed, but it also involves sustained attention, executive skills, spatial skills, and memory. Research using neuropsychological testing in ADHD patients has repeatedly identified deficits in sustained and focused attention and working memory, as well as impaired processing and motor speed (Barkley 1997; Hervey et al. 2004). The fact that VMT and working memory tasks both tap into multiple cognitive processes that are often impaired in ADHD may account for the robustness of their associations to the various subjective assessments observed in our study. It is also possible that patients are more aware of their limitations in speed and attention relative to verbal fluency and memory.

Errors in temporal processing have been well documented in ADHD and may be related to cerebellar cognitive dysfunction (Pironti et al. 2016; Pollak et al. 2009; Suarez et al. 2013; Wilson et al. 2013). In addition, dopamine has been linked both to the perception of time and to ADHD pathophysiology (Del Campo et al. 2011; Marinho et al. 2018; Soares et al. 2016). We noted a significant difference in the perceived and actual time to complete the test—ADHD

patients believed the SCIP took approximately 5 min (38%) longer than the actual administration time. While there was no significant correlation between the SCIP global index and actual time to complete the test, there was with perceived time. This finding indicates that those with the greatest cognitive deficits made significant errors in time estimation, which suggests a direct association between cognitive limitations and ADHD symptomatology and time perception anomalies. Importantly, we have not noticed such time estimation errors in other non-ADHD clinical populations to whom we administered the SCIP (Potvin et al. 2016; Tourjman et al. 2016).

Limitations

The inclusion and exclusion criteria for this study were kept to a minimum to ensure closest possible approximation to the clinical population. While this approach provides important insight into the feasibility of routinely using the SCIP to screen for cognitive deficits in the clinical setting, it introduces numerous confounding factors such as ADHD subtypes, medication status, drug use history, presence of comorbidities, age, and education level. It should be noted that we did not control for treatment status or presence of comorbidities; therefore, the detected cognitive deficits observed in this cohort cannot be attributed solely to ADHD psychopathology. Indeed, nearly 80% of our sample exhibited at least one other comorbid psychiatric disorder, in agreement with rates previously reported (Katzman et al. 2017). Although this limits confident attribution of etiology, the naturalistic aspect reinforces the sensitivity and importance of cognitive screening in the less controlled environment of a typical clinic. Nonetheless, the highly heterogeneous nature of our cohort undoubtedly resulted in increased variability and consequently reduced effect size. These confounding factors should be addressed in future replications.

The present study was underpowered to detect possible weaker correlations. For example, while the power to detect effect size estimates of 0.70 was 0.99, the power to detect effect sizes of 0.20 was only 0.25 ($\alpha = 0.05$, two-tailed). The observed power of our univariate analyses ranged from 0.05 to 1.00. While our study was sufficiently powered to detect correlations between the SCIP global index and clinician-rated measures of disease severity ($1 - \beta = 0.94$) and functional status ($1 - \beta = 0.77$), the power to detect the weaker associations between the SCIP global index score and subjective patient self-reported deficits in cognition and functioning of measurements ranged between 0.33 and 0.40. Further studies with larger sample sizes are needed to verify that this observed discordance between subjective perception of cognitive deficits and SCIP scores is not related to the 60% probability of making a Type II error. Such studies would also permit greater sensitivity to detect more subtle influences of ADHD on cognition.

Conclusions

This study provides important insight into the type and prevalence of cognitive deficits in a clinically relevant sample of adults with ADHD. It also further illustrates the feasibility of using a brief neuropsychiatric assessment, the SCIP, to screen for cognitive dysfunction in a clinical setting. Most importantly, this study shows clear associations between cognitive deficits and functional impairments in ADHD patients, and reinforces the importance of integrating both objective and subjective measures of cognitive assessments in this patient population.

Acknowledgements We thank the patients who agreed to participate in this study. We would also like to thank research coordinators Souad Lahlaffi and Patricia Gravel for their excellent support.

Funding This work was supported by an unrestricted Grant from +Prends soin de toi+

Compliance with ethical standards

Conflict of interest Scot E. Purdon receives royalties from sales of the Spanish version of the SCIP. Smadar Valérie Tourjman: speaker: Janssen, Lundbeck, Otsuka, Purdue, Shire, Sunovion; research funding: Janssen, Lundbeck, Pfizer, DiaMentis; board member: CANMAT, CADDRA. Stéphane Potvin receives grant from Otsuka pharmaceuticals. All other remaining authors declare that they have no conflict of interest.

Ethical Standards All participants provided written informed consent after study procedures were explained. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

References

Barkley RA (1997) Behavioral inhibition, sustained attention, and executive functions: constructing a unifying theory of ADHD. Psychol Bull 121(1):65–94

Barkley RA, Fischer M (2011) Predicting impairment in major life activities and occupational functioning in hyperactive children as adults: self-reported executive function (EF) deficits versus EF tests. Dev Neuropsychol 36(2):137–161. https://doi.org/10.1080/87565641.2010.549877

Berk M, Ng F, Dodd S et al (2008) The validity of the CGI severity and improvement scales as measures of clinical effectiveness suitable for routine clinical use. J Eval Clin Pract 14(6):979–983. https://doi.org/10.1111/j.1365-2753.2007.00921.x

Biederman J, Mick E, Faraone SV (2000) Age-dependent decline of symptoms of attention deficit hyperactivity disorder: impact

of remission definition and symptom type. Am J Psychiatry 157(5):816–818. https://doi.org/10.1176/appi.ajp.157.5.816
Biederman J, Petty CR, Fried R et al (2008) Discordance between psychometric testing and questionnaire-based definitions of executive function deficits in individuals with ADHD. J Atten Disord 12(1):92–102. https://doi.org/10.1177/1087054707305111
Castellanos FX, Sonuga-Barke EJ, Milham MP, Tannock R (2006) Characterizing cognition in ADHD: beyond executive dysfunction. Trends Cognit Sci 10(3):117–123. https://doi.org/10.1016/j.tics.2006.01.011
Cholet J, Sauvaget A, Vanelle JM et al (2014) Using the brief assessment of cognition in schizophrenia (BACS) to assess cognitive impairment in older patients with schizophrenia and bipolar disorder. Bipolar Disord 16(3):326–336. https://doi.org/10.1111/bdi.12171
Cuesta MJ, Pino O, Guilera G et al (2011) Brief cognitive assessment instruments in schizophrenia and bipolar patients, and healthy control subjects: a comparison study between the brief cognitive assessment tool for schizophrenia (B-CATS) and the screen for cognitive impairment in psychiatry (SCIP). Schizophr Res 130(1–3):137–142. https://doi.org/10.1016/j.schres.2011.05.020
Del Campo N, Chamberlain SR, Sahakian BJ, Robbins TW (2011) The roles of dopamine and noradrenaline in the pathophysiology and treatment of attention-deficit/hyperactivity disorder. Biol Psychiatry 69(12):e145–e157. https://doi.org/10.1016/j.biopsych.2011.02.036
Fuermaier AB, Tucha L, Koerts J et al (2015) Cognitive impairment in adult ADHD—perspective matters! Neuropsychology 29(1):45–58. https://doi.org/10.1037/neu0000108
Gallagher R, Blader J (2001) The diagnosis and neuropsychological assessment of adult attention deficit/hyperactivity disorder. Scientific study and practical guidelines. Ann N Y Acad Sci 931:148–171
Gomez-Benito J, Guilera G, Pino O et al (2013) The screen for cognitive impairment in psychiatry: diagnostic-specific standardization in psychiatric ill patients. BMC Psychiatry 13:127. https://doi.org/10.1186/1471-244x-13-127
Guilera G, Pino O, Gomez-Benito J et al (2009) Clinical usefulness of the screen for cognitive impairment in psychiatry (SCIP-S) scale in patients with type I bipolar disorder. Health Qual Life Outcomes 7:28. https://doi.org/10.1186/1477-7525-7-28
Hervey AS, Epstein JN, Curry JF (2004) Neuropsychology of adults with attention-deficit/hyperactivity disorder: a meta-analytic review. Neuropsychology 18(3):485–503. https://doi.org/10.1037/0894-4105.18.3.485
Jensen JH, Stottrup MM, Nayberg E et al (2015) Optimising screening for cognitive dysfunction in bipolar disorder: validation and evaluation of objective and subjective tools. J Affect Disord 187:10–19. https://doi.org/10.1016/j.jad.2015.07.039
Katzman MA, Bilkey TS, Chokka PR, Fallu A, Klassen LJ (2017) Adult ADHD and comorbid disorders: clinical implications of a dimensional approach. BMC Psychiatry 17(1):302. https://doi.org/10.1186/s12888-017-1463-3
Koziol LF, Stevens MC (2012) Neuropsychological assessment and the paradox of ADHD. Appl Neuropsychol Child 1(2):79–89. https://doi.org/10.1080/21622965.2012.694764
Kupper T, Haavik J, Drexler H et al (2012) The negative impact of attention-deficit/hyperactivity disorder on occupational health in adults and adolescents. Int Arch Occup Environ Health 85(8):837–847. https://doi.org/10.1007/s00420-012-0794-0
Lange KW, Hauser J, Lange KM et al (2014) Utility of cognitive neuropsychological assessment in attention-deficit/hyperactivity disorder. Atten Deficit Hyperact Disord 6(4):241–248. https://doi.org/10.1007/s12402-014-0132-3
Marinho V, Oliveira T, Rocha K et al (2018) The dopaminergic system dynamic in the time perception: a review of the evidence. Int J Neurosci 128(3):262–282. https://doi.org/10.1080/00207454.2017.1385614
Michelini G, Kitsune GL, Cheung CH et al (2016) Attention-deficit/hyperactivity disorder remission is linked to better neurophysiological error detection and attention-vigilance processes. Biol Psychiatry 80(12):923–932. https://doi.org/10.1016/j.biopsych.2016.06.021
Mostert JC, Onnink AMH, Klein M et al (2015) Cognitive heterogeneity in adult attention deficit/hyperactivity disorder: a systematic analysis of neuropsychological measurements. Eur Neuropsychopharmacol J Eur Coll Neuropsychopharmacol 25(11):2062–2074. https://doi.org/10.1016/j.euroneuro.2015.08.010
Ott CV, Bjertrup AJ, Jensen JH et al (2016) Screening for cognitive dysfunction in unipolar depression: validation and evaluation of objective and subjective tools. J Affect Disord 190:607–615. https://doi.org/10.1016/j.jad.2015.10.059
Pino O, Guilera G, Rojo JE et al (2008) Spanish version of the screen for cognitive impairment in psychiatry (SCIP-S): psychometric properties of a brief scale for cognitive evaluation in schizophrenia. Schizophr Res 99(1–3):139–148. https://doi.org/10.1016/j.schres.2007.09.012
Pironti VA, Lai MC, Morein-Zamir S, Muller U, Bullmore ET, Sahakian BJ (2016) Temporal reproduction and its neuroanatomical correlates in adults with attention deficit hyperactivity disorder and their unaffected first-degree relatives. Psychol Med 46(12):2561–2569. https://doi.org/10.1017/s003329171600101x
Pollak Y, Kroyzer N, Yakir A, Friedler M (2009) Testing possible mechanisms of deficient supra-second time estimation in adults with attention-deficit/hyperactivity disorder. Neuropsychology 23(5):679–686. https://doi.org/10.1037/a0016281
Potvin S, Charbonneau G, Juster RP, Purdon S, Tourjman SV (2016) Self-evaluation and objective assessment of cognition in major depression and attention deficit disorder: implications for clinical practice. Compr Psychiatry 70:53–64. https://doi.org/10.1016/j.comppsych.2016.06.004
Purdon SE (2005) The screen for cognitive impairment in psychiatry (SCIP): instructions and three alternate forms. PNL Inc, Edmonton
Randolph C, Tierney MC, Mohr E, Chase TN (1998) The repeatable battery for the assessment of neuropsychological status (RBANS): preliminary clinical validity. J Clin Exp Neuropsychol 20(3):310–319. https://doi.org/10.1076/jcen.20.3.310.823
Rojo E, Pino O, Guilera G et al (2010) Neurocognitive diagnosis and cut-off scores of the screen for cognitive impairment in psychiatry (SCIP-S). Schizophr Res 116(2–3):243–251. https://doi.org/10.1016/j.schres.2009.08.005
Sheehan DV, Harnett-Sheehan K, Raj BA (1996) The measurement of disability. Int Clin Psychopharmacol 11(Suppl 3):89–95
Soares S, Atallah BV, Paton JJ (2016) Midbrain dopamine neurons control judgment of time. Science 354(6317):1273–1277. https://doi.org/10.1126/science.aah5234
Suarez I, Lopera F, Pineda D, Casini L (2013) The cognitive structure of time estimation impairments in adults with attention deficit hyperactivity disorder. Cognit Neuropsychol 30(4):195–207. https://doi.org/10.1080/02643294.2013.842548
Svendsen AM, Kessing LV, Munkholm K, Vinberg M, Miskowiak KW (2012) Is there an association between subjective and objective measures of cognitive function in patients with affective disorders? Nord J Psychiatry 66(4):248–253. https://doi.org/10.3109/08039488.2011.626870
Toplak ME, West RF, Stanovich KE (2013) Practitioner review: Do performance-based measures and ratings of executive function assess the same construct? J Child Psychol Psychiatry 54(2):131–143. https://doi.org/10.1111/jcpp.12001
Tourjman SV, Beauchamp MH, Djouini A et al (2016) French validation of the screen for cognitive impairment in psychiatry

(SCIP-F). Open J Psychiatry 6:107–118. https://doi.org/10.4236/ojpsych.2016.61013

Vaidya CJ, Stollstorff M (2008) Cognitive neuroscience of attention deficit hyperactivity disorder: current status and working hypotheses. Dev Disabil Res Rev 14(4):261–267. https://doi.org/10.1002/ddrr.40

Willcutt EG, Doyle AE, Nigg JT, Faraone SV, Pennington BF (2005) Validity of the executive function theory of attention-deficit/hyperactivity disorder: a meta-analytic review. Biol Psychiat 57(11):1336–1346. https://doi.org/10.1016/j.biopsych.2005.02.006

Wilson TW, Heinrichs-Graham E, White ML, Knott NL, Wetzel MW (2013) Estimating the passage of minutes: deviant oscillatory frontal activity in medicated and unmedicated ADHD. Neuropsychology 27(6):654–665. https://doi.org/10.1037/a0034032