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Subjective cognition in adults with common psychiatric classifications; a systematic review

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ABSTRACT

The aim is to assess whether instruments developed to measure subjective cognitive complaints (SCCs) and in neurology and aging can reliably be used in ADHD and other common psychiatric classifications. MEDLINE, PsycINFO, CINAHL and EMBASE+EMBASE CLASSIC were searched for relevant work on SCCs in psychiatric classifications (ADHD, autism, mood disorders, schizophrenia) in two phases: 1 identify instruments, 2 relevant studies. 35 studies with varying study quality were included. SCCs are most commonly studied in ADHD and mood disorders, but are found in all psychiatric classifications. SCCs show inconsistent and low associations to objective cognition across disorders, but higher and consistent relations are found with behavioral outcomes.

SCCs are not qualitatively different for ADHD compared to other psychiatric classifications, and should thus not be seen as analogous to well validated measures of objective cognition. However, SCCs do reflect suffering, behavioral difficulties and problems experienced by across those with psychiatric problems in daily life.

A protocol is registered under https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020144867

1. Introduction

Subjective cognition is defined as a person's experiences or views of their own cognitive processes such as attention, memory, and executive functioning. Subjective cognitive complaints (SCCs) occur frequently in older age. Prevelence reports show that among people over 50 years of age, between 11% to more than 55% (Geerlings et al., 1999; Reid and Maclullich, 2006; Srisurapanont et al., 2015) experience subjective decline in memory, attention, or other cognitive functions. SCCs are associated with a decreased ability to perform activities of daily life (Cordier et al., 2019; Montejo et al., 2012), and poor quality of life (Montejo et al., 2012; Rotenberg Shpigelman et al., 2019). Moreover, in older adults without clinical cognitive impairment, SCCs are associated with greater psychological distress (Hill et al., 2016). Also, SCCs (either self-observed or by a proxy) are a common cause for referral for neuropsychological testing. The SCCs play an important part in the diagnostic criteria for neurological disorders such as Mild Cognitive Impairment (MCI) and Alzheimer's dementia (AD) (Albert et al., 2011; McKhann et al., 2011), thus it of the utmost importance to measure subjective cognition properly. In neurological patients, SCCs not necessarily reflect cognitive impairment, but might reflect comorbid fatigue, depression, worries and a subsequent focus on signs of cognitive failures. Longitudinally, SCCs in the *absence* of objective cognition deviations are often seen as a precursor for later AD (Jessen et al., 2014), but are also associated with an increased risk for future major depressive disorder (MDD)(Hill et al., 2016). While most psychiatric classifications[1] are also characterized by SCCs (Bortolato et al., 2014; Pierre et al., 2019), the role of subjective cognition in clinical practice is even more elusive in psychiatry, as internalizing and/or externalizing symptoms are the most frequent reason for referral.

SCCs are part of the core symptoms of many psychiatric problems (e.g., attention problems in internalizing classifications and attention-deficit/hyperactivity disorder (ADHD), problems in social cognition in

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[1] Please note that we use the term psychiatric classifications to indicate the DSM-5 terminology in order to be consistent across all included diagnostic classifications as some of the disorders listed are no longer considered to be disorders and are more and more referred to as disabilities.

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autism spectrum disorder (ASD) (American Psychiatric Association, 2013). Moreover, many people with psychiatric classifications show deviations in objectively measured cognition (Faraone et al., 2015; Hur et al., 2019; Lai et al., 2014; Roiser and Sahakian, 2013; Van Assche et al., 2017). Although often very low associations are found between objective and subjective measures of cognition (Burmester et al., 2016; Reid and Maclullich, 2006). However, in ADHD research, SCC's (often measured with the Behavior Rating Inventory of Executive Function (BRIEF)) are sometimes judged as an indication of underlying objective cognitive performance.

Several explanations for lack of association between SCC's and objective cognitive impairnment are possible. First, the instruments used to measure SCCs could be a better reflection of cognition used in daily functioning compared to objective measures of cognition, i.e., SCCs could be more ecologically valid than objective cognition. Second, SCCs might reflect the impact, distress or worries individuals experience, as is reflected in associations with for example quality of life (Montejo et al., 2012; Rotenberg Shpigelman et al., 2019), or affective symptoms (e.g., Serra-Blasco et al., 2019). However, this is a complicated relation since this relationship can, partly, be bidirectional (Hill et al., 2016). Lastly, in dementia research it is theorized that SCCs are a precursor of cognitive problems that can be objectively measured, i.e., the beginning of the course of cognitive decline (Jessen et al., 2014). In ADHD but also in other psychiatric classifications it remains unclear how we should see, and make use of SSCs, both in research and clinical practice. Moreover, it is unclear whether SCCs associated with one psychiatric classification underlie the same construct as in a different psychiatric classification.

Since SCCs are a key referral reasons in neurological disorders and aging, many instruments are developed for those populations. However, the large variety in the instruments used to measure SCCs (Rabin et al., 2015), but also in the definition of SCCs (Abdulrab and Heun, 2008), complicate the research field. In clinical practice the SCCs instruments that were developed for neurological disorders and aging are also used in psychiatric populations, however it is unclear whether this is a reliable and valid approach. Complicating this, is the unclarity of the underlying construct that is at the base of SCCs. Jonker and colleagues (Jonker et al., 2000) found that in younger samples SCCs were related to depressive symptoms, while in older samples associations with memory performance were found. This suggests that at different ages, different constructs are at the base of SCCs, and that they cannot just be attributed to 'senior moments'. Moreover, while in aging memory complaints are possibly most prevalent, in psychiatric classifications, other cognitive domains might be more frequent, like difficulties with attention and concentration. Whether this is also the case in other psychiatric classifications is currently unknown. However, measuring SCCs is a cost-efficient and fast way to measure common complaints in people with psychiatric classifications, however, it is of the utmost importance to understand what we are measuring, what we should measure, and which construct is represented by SCCs.

The aim of this systematic review is twofold: i) we aim to assess whether instruments developed for neurologic disorders and aging can reliably be used in psychiatric research. ii) We aim to investigate which constructs are associated with SCCs in ADHD and other psychiatric classifications. A systematic review will be conducted in two steps. First, we will identify commonly used instruments to measure SCC that are developed for either neurological disorders or general use. Second, we will use these instruments in further searches to identify research into SCCs looking at common psychiatric diagnoses occurring in adulthood (ADHD, ASD, mood and anxiety classifications, and schizophrenia). Moreover, by including multiple psychiatric classifications, we will compare the different dimensions of SCCs, and see whether they represent different underlying constructs in different classifications.

2. Methods

A protocol for the current review is registered under https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020144867. Prisma guidelines were followed (prisma checklist available in the Supplements).

2.1. Study selection

Study selection took place in two phases. The first phase was aimed at identifying relevant instruments. In the second phase the instruments identified in phase one where used combined with more general search terms to identify relevant studies. Authors AG (cognitive neuroscientist, postdoc, and lecturer) and SvdW (registered clinical neuropsychologist, clinical practitioner, and assistant professor) performed the screening of studies. The complete search query is available in the Supplements.

2.2 Search phase one

The purpose of the first phase was to determine relevant questionnaires that are often used to assess subjective cognition in both neurological disorders and psychiatric classifications. Relevant instruments were identified by searching in MEDLINE, PsycINFO, CINAHL and EMBASE+EMBASE CLASSIC for reviews on subjective cognition in either brain disorders or mental health classifications in adults. Search terms included synonyms and hierarchical family forms (e.g., MESH terms) of subjective cognition and meta-analyses or review and adult and brain diseases or mental classifications. During this identification phase reviews were included on neurological disorders (e.g., MCI, dementia) or psychiatric classifications aimed at adults that described research on subjective cognition as an outcome or predictor, or had subjective cognition as their main outcome. Subjective cognition is defined as a person's experiences or views of their cognitive processes such as attention, memory, and executive functioning. The following inclusion criteria were applied to instruments to be included in our further searches: The instrument should

i be a generic instrument, i.e., not disease specific
ii be developed for use in neurologic or brain disorders such as dementia or developed for the general population
iii measure subjective reports of cognitive functions
iv be available in English
v be aimed at adults
vi look at two or more cognitive domains. Cognitive domains being: attention, cognitive speed, motor skills, language, memory, perception, planning, working memory, inhibition, and cognitive flexibility
vii include at least a self-report form (only proxy ratings will be excluded)
viii not only be a subscale of an instrument. Larger test batteries that provide stand-alone questionnaires are?/were allowed.

2.3. Search phase two

The purpose of the second phase was to find relevant research to answer our two main aims, i.e., to assess whether instruments developed for neurologic disorders and aging can reliably be used in psychiatric research and to investigate which factors are associated with SCCs in psychiatric classifications. A similar search strategy was applied, but search terms were supplemented with the names and abbreviated names of the instruments identified in phase one (also see the Supplements for a full copy of search criteria). In this phase only papers on ADHD, ASD, anxiety, mood disorders, or schizophrenia (common psychiatric classifications) were included. Furthermore, reference lists of relevant papers were hand-searched to identify relevant research.

Papers that were included were written in English of Dutch,

described adult participants with a diagnosis of ADHD, ASD, anxiety, mood disorders, or schizophrenia based on the DSM IV (1994) or ICD-10 (1993) or later versions. Included papers should describe subjective cognition as an outcome, or should have subjective cognition as its main focus, measured using an instrument fulfilling our previously stated criteria. Papers aimed at children, subjective/narrative reviews, or papers describing one domain of cognition (i.e., attention, cognitive speed, motor skills, language, memory, perception, planning, working memory, inhibition, or cognitive flexibility) will be excluded.

2.4. Study quality

Authors APG and SvdW independently rated the quality of the selected studies using an adapted version of the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies, rating selection bias, performance bias, attrition bias, and detection bias. In contrary to our preregistration, inter-rated discrepancies were resolved by the first author. A full copy of the instrument used for quality assessment is available in the Supplements.

2.5. Data extraction

Since treatment effects on subjective cognitive complaints is beyond the scope of the current review, we extracted baseline information from RCTs. Data extraction was performed by APG. The following data (means, correlations, and significance of reported relations) was extracted from the manuscripts: classifications (i.e., diagnoses), classification method ((semi structured) interviews), clinical classification (DSM), type of study, comorbidity, measure of subjective cognition, other measures, number of participants, sex of the participants, country of origin, age of the participants, main conclusion concerning subjective cognition.

3. Results

3.1. Eleven relevant instruments were identified in phase one

Twenty reviews (for PRISMA flowchart see the Supplements) describing at least two SC instruments were identified. Eleven instruments (i.e., Behavior rating inventory of executive function (BRIEF), Cognitive difficulties scale (CDS), Cognitive complains Questionnaire, Cognitive failures questionnaire (CFQ), Cognitive problems in daily life checklist, cognitive self-report questionnaire, Multiple abilities self-report questionnaire (MASQ), Nuremberg self-assessment list (NSL), Subjective cognitive decline questionnaire, and Subjective cognitive complaints scale) met our inclusion criteria and were added to the search in the second phase. Instruments that were identified but not deemed suitable can be found in the Supplement

3.2. The majority of SCC studies focus on ADHD and mood disorders

In the second phase of the search 35 studies were identified (prisma flowchart available in Supplement). Of those 16 were aimed at ADHD, 14 at mood disorders (eight bipolar, six depression), three at autism, two at schizophrenia, and none at anxiety. A summary of the identified studies, summarized per diagnosis, can be found in Table 1.

The quality of included studies was diverse

Quality of the included studies was rated on 9 items, complete ratings are available in the supplement, the summary score can be seen in Table 1. APG and SvdW reached substantial agreement (κ=0.70). Quality scores were between 11.1% and 77.8% with an average of 45.7%. Three studies obtained a score of 11% (Demant et al., 2015; Iverson and Lam, 2013; Paans et al., 2018), and one study obtained a score of 77.8% (Biederman et al., 2012). Most studies (33/35) had a good description of their research question, while only few studies had a good sample size justification (2/35) or included blinded measures (4/35). For most studies (34/35) there was no description in the paper whether 50% of eligible persons participated in the study.

3.5. ADHD

In ADHD (Adler et al., 2014a, 2014b, 2013; Adler et al., 2014c; Arntsberg Grane et al., 2014; Biederman et al., 2012; Durell et al., 2013; Fuermaier et al., 2015; Gray et al., 2016; Lovstad et al., 2016; Low et al., 2018; Roth et al., 2013; Stem and Maeir, 2014) studies note more self-reported difficulties in cognition compared to controls.

In ADHD two studies found significant weak to moderate correlations (r between −0.2 and −0.5) with executive functioning (working memory and inhibition) and self-reports of executive functioning (BRIEF) (Arntsberg Grane et al., 2014; Gray et al., 2016). Interestingly, better scores on inhibition were related to worse BRIEF scores (Arntsberg Grane et al., 2014). This is consistent with the finding that those with objectively measured executive functioning deficits are less likely to obtain T-scores above 65 on the BRIEF (Biederman et al., 2012). However, the opposite, and expected, direction (worse scores, more complaints) is found for reaction time variability, reading, and working memory (Arntsberg Grane et al., 2014; Gray et al., 2016).

In ADHD, lower subjective cognition was related to lower quality of life (QoL)(Brod et al., 2015; Stem and Maeir, 2014) and higher ADHD symptoms (Gray et al., 2016, 2014; Low et al., 2018). Moreover, it was found that lower perseverance and passion for long term goals was associated with higher cognitive complaints (Gray et al., 2016). Concluding, in ADHD most deviations of all classifications are reported. Possibly caused by a large overlap between the core symptoms of ADHD and the individual items assessed by the BRIEF (e.g., the BRIEF item “I often lose things (keys, money, wallet, homework etc.)” is an almost exact match to the DSM criterium “Often loses things necessary for tasks and activities (e.g. school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses, mobile telephones)” for ADHD).

3.6. ASD

In ASD three studies reported elevated scores on SCCs (Davids et al., 2016; Lever and Geurts, 2016; van Heijst and Geurts, 2015), and one other did not (Joshi et al., 2016).

Two in ASD reported on the relation between subjective and objective cognition (Davids et al., 2016; Lever and Geurts, 2016), In ASD a relation was found between all subscales of the BRIEF and the Tower of London (planning, problem solving), and between BRIEF behavior regulation index and inhibition scale and the ZOO Maps (planning and priority setting) (Davids et al., 2016). Interestingly, these scores were specific to the ASD group, and were not found in the control group in the analyses (r between −0.37 and −0.44). In ASD SCCs had a negative association with QoL, but this relation seemed dependent on outliers in the data (van Heijst and Geurts, 2015).

3.7. Mood disorders

Two studies in depression (Iverson and Lam, 2013; Lam et al., 2016) reported elevated SCCs. In bipolar disorder, all but one study found that those with a diagnosis had elevated scores compared to controls (of those reporting this (Peters et al., 2014; Stange et al., 2011; Van Der Werf-Eldering et al., 2011)). Interestingly, in the one study that did not find elevated scores people in bipolar disorder, excluded current mood disorders. Moreover, it was the only study performed in older adults (Schouws et al., 2012).

In bipolar disorder, two studies reported significant weak correlations between objective and subjective cognition. One found that SCCs as measured with the CDS (cognitive difficulties scale) were related to short term memory (Burdick et al., 2005), the other found that a higher

Table 1
Study characteristics.

Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
Adler et al. 2014	ADHD	ACDS 1.2	Double-blind placebo-controlled trial of ATX	Total $n = 328$ (ATX $=161$, con $n = 167$)	77.5%	18–30	NR	BRIEF-A SR	None related to BRIEF-A	USA	55.6	93.6% scores abnormal ($T = 60$) on GEC, 73.97% on BRI, and 93.15% on MI
Adler et al., 2013	ADHD	Clinical DSM-IV & ADHD-RS-IV baseline score > 28	Double-blind placebo-controlled trial of lisdexamfetamine dimesylate	Total $n = 159$ (Lisdexamfetamine $n = 79$, placebo $n = 80$)	52.2%	18–55	Excluded: Conditions controlled with prohibited medication or uncontrolled including severe axis I or II dxs.	Brief-A SR or informant report	None related to BRIEF-A	USA	66.7	All but 2 participants had GEC T>65 NB. GEC T>65 was inclusion criterium.
Adler et al. 2014 (executive)	ADHD	DSM-IV-TR	open-label treatment with atomoxetine	1898	58.7	18–50, 33.2	Excluded: BP psychotic, anxiety dx or. current major depression	BRIEF-A SR and informant	–	USA	66.7	1638/1898 individuals GEC $T > 65$ according to SR. 1245/1784 informant reports $T > 65$ on GEC.
Adler et al. 2014	ADHD	ACDS 1.2	Crossover clinical trial	24	66.7%	19–55 mean = 34.9 ± 8.2 years)	Exclusion: history of MDD, dysthymia, or anxiety current Axis I psychiatric and BP or psychotic dxs.	BRIEF		USA	44.4	All BRIEF-A subscale scores except emotional control and self-monitor were elevated (T> 60)
Arntsberg Grane et al. 2014	ADHD	DSM-IV criteria with semi-structured interview	Case-con	ADHD $n = 36$, Con $n = 35$	47.9%	19–53-ADHD 31.8 ± 10, Con 32.2 ± 9.5	Excluded: Memory problems and substance use dxs	BRIEF-A (SR and informant)	TOVA (go reaction time, reaction time variability, go signal omission error, no go commission.	Norway	66.7	ADHD > cons on all SR BRIEF subscales. Informant reported all but organization of materials T>65. SR T>65 for Initiate, Working Memory, Plan/Organize, Task Monitor, inhibit, and MI and BRI, informant scores did not reach T>65. Significant correlations between CE (r_{self} =−0.45, r_{other}=−0.54), OE (r_{self} =−0.54, r_{other}=−0.40),

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Table 1 (*continued*)

Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												RTvar (r_{self}=−0.35, r_{other}=−0.35), and organization of materials, OE (r_{self} =−0.34), and plan/ organize, OE (r_{self} =−0.40) and initiate, and CE and Task monitor (r_{other}=−0.40).
Biederman et al., 2012	ADHD	DSM-IV (SCID & KSADS)	RCT	87	60.91	19–60 33.87	Excluded: clinically unstable psychiatric dx (i.e. bipolar dx, psychosis, suicidality),	BRIEF-A	ANT, stop signal test, digit symbol, working memory, color word inhibition ToL, Trails number letters	USA	77.8	93% of ADHD EFD on >2 BRIEF scales, compared to 40% on >2 objective measures. Only the BRIEF inhibition, emotional con and self-monitor were associated with EFDs (i.e. ADHD without objective EFDs reported **more** impairment)
Brod et al. 2014	ADHD	Conners' Diagnostic Interview (DSM-IV)	randomized withdrawal trial of ATX	1819	59.2	18–50 (m = 33.2(9.1)	Excluded: BP dx, current MDD, a current anxiety dx or any history of a psychotic dx were excluded	BRIEF-A	AAQOL	USA & European countries	33.3	All subscales of the AAQOL (life productivity, psychological health, life outlook and relationships) correlated with BRIEF A metacognition (r=−0.80, r=−0.54, r=−0.48, r=−0.54 resp.), behavioral regulation (r=−0.60, r=−0.66, r=−0.44, r=−0.62 resp.), and GEC (r=−0.77, r=−0.64, r=−0.49, r=−0.62 resp.)

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Table 1 (*continued*)

Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												and total AAQoL and GEC r= −0.79
Durell et al., 2013	ADHD	DSM-IV clinical interview	RCT	161 ATX, 167 placebo	61.44	24.7	excluded current MDD, panic, posttraumatic stress, eating dx, or SUDs, and current or lifetime obsessive-compulsive, bipolar dx, or psychosis.	BRIEF-A SR	No correlations with other measures were reported	USA & Puerto Rico	66.8	Mean raw scores of 156 (=*T*-scores of 76) on the GEC.
Fuermaier et al., 2015	ADHD	DSM–IV clinical interview	Case-con	ADHD (n-55), con $n = 66$	con=46.3 ADHD = 47.3	Con = 31.9 ± 10,2 m ADHD =34.6 ± 10.7	mood dxs ($n = 14$), anxiety dxs ($n = 2$), personality dxs ($n = 3$), eating dxs ($n = 1$), adjustment dx ($n = 1$), and SUDs (no SUDs in the previous 6 months; $n = 2$).	Memory self-efficacy questionnaire, Comprehensive assessment of prospective memory, Dysexecutive questionnaire*	Visual Scanning, vigilance, (TAP), word recognition, logical memory (WMS), delayed task execution, stroop, TMT-B, word fluency.	Germany	33.3	ADHD reported more cognitive problems on self-report scales. ADHD scored lower on all objective tests except fluency. Self-reports did not predicted impairments in any of objective measures.
Gray et al., 2014	ADHD	confirmed dx of ADHD	cohort	135	42	18–35 (23.7 ± 3.6)	all registered with learning disability. major neurological dysfunction and psychosis, and (3) current use of sedating or mood altering medication	CFQ	ASRS- 6	Canada	(same sample as Gray 2014)	Higher total ADHD score on the ASRS correlated moderately with more cognitive complaints (total CFQ scores; $r = 0.55$).
Gray et al., 2016 (same sample as Gray 2014)	ADHD	confirmed dx of ADHD	cohort	135	42	18–35 (23.7 ± 3.6)	NR	CFQ and BDEFS	ASRS, GRIT (+ambition), KS-10. Digit span forward, backward, sequencing (WAIS), Spatial span task and spatial working memory task (CANTAB), Math fluency (woodcock johnson), Test of word reading efficiency), GPAs	Canada	22.2	Impairments in EF compared to clinical threshold BDEFS. High scores on CFQ, females > males. Higher psychological stress, higher symptoms, and lower grit, associated with more everyday cognitive

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Table 1 (*continued*)

Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												complaints (r between 0.38 and 0.60). Lower scores on digit span were related to BDKEFS and test of word reading efficiency scores to the CFQ.
Low et al., 2018	ADHD	DIVA DSM-IV	Prospective nonrandomized nonblinded 6 week follow up study	ADHD $n = 42$Con $n = 42$	ADHD= 66%, Con = 57.1%	ADHD 26.9 ± 7.38, Con 26.7 ± 5.6	Exclusion of primary neurological or psychiatric diagnosis other than ADHD	BRIEF-A SR (planning, working memory inhibition) and Quick delay questionnaire	ASRS	Denmark	55.6	ADHD> con BRIEF Working memory ($d = 2.78$), planning ($d = 3.67$) & inhibition ($d = 3.37$). QDQ correlated to ADHD subscales (rest between 0.34 and 0.46). Only BRIEF inhibition correlated to ADHD hyperactivity ($r = 0.45$).
Roth et al., 2013	ADHD	DSM-IV	Case con	19 ADHD, 19 Con	ADHD= 63.2 Con= 52.6	18–35 (25.21±5.65)	Eight patients had a history of mood dx, three generalized anxiety dx, and one alcohol use dx	BRIEF-A SR	Beck depression inventory	USA	33.3	ADHD >con MI ($d = 1.42$), BRI ($d = 0.71$), but not emotional regulation ($d = 0.39$, ns). Greater depressed mood was associated worse MI ($r = 0.76$, p=.004) and Emotional Regulation ($r = 0.68$, p=.02), but unrelated BRI ($r = 0.30$, p=.34)
Stern et al. 2014	ADHD	DSM-IV Structured interview	case con	ADHD $n = 81$, Con $n = 58$	ADHD 49.4 Con 37.9	ADHD 35.2 ± 10.18, Con 29.29 ± 8.03	Exclusion of acute psychiatric ds according to SCID	BRIEF-A	Canadian occupational performance measure, ASRS, AAQOL	Israel	33.3	ADHD> con on MI than BRI, working memory scale was highest and self-monitor lowest. 90.1%/ 88.7% of ADHD scores above T>65 compared to 0% of con on MI and GEC.

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Table 1 (*continued*)

Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												ADHD and con differed on all BRIEF scores. BRIEF GEC was correlated to COPM (r=−0.331) and AAQOL (r=−0.489)
Zhao et al. 2017	ADHD	SCID DSM-IV	Case con	ADHD n = 28, Con n = 30	ADHD 53.5 Con 56.67	ADHD, 27.07±5.48 Con 25.92±3.77	no current diagnosis of schizophrenia, severe major depression, clinically significant panic dx, bipolar dx, pervasive developmental ds, or mental retardation	BRIEF-A	Resting state functional connectivity	China	44.4	Correlations between BRIEF WM and RSFC between the left AI and right precuneus (r = 0.557), right inferior temporal gyrus (r =−0.449) and left superior occipital gyrus (r =−0.512), and RSFC of the right AI and left cuneus (r = −0.455) in health con, but not in ADHD.
Davids et al., 2016	Autism	ADOS and/or a semi-structured DSM-5 ASD interview	Case con	ASD=36, con=36		50–84	NR	Brief-A SR and proxy	SRS-A, Processing Speed Index of the WAIS-IV-NL, ToL, Zoo map of BADS, semantic and phonetic verbal fluency	NL	55.6	SR ASD >con on GEC, BRI and MI. correlations SR and proxy were large (GEC r = 0.64, BRI r = 0.68, MI r = 0.67). No differences between groups on the cognitive tasks except that ASD used more time on Tower. In ASD group significant correlations between the Tower percentile scores and MI scale and subscale scores of the self BRIEF. negative correlation between age and

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Table 1 (*continued*)

Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
Joshi et al., 2016	ASD	DSM-IV-TR criteria for autistic, Asperger, or pervasive developmental dx	Prospective open label trial	18	78%	28±9.5	Unstable psychiatric conditions, diagnosis of psychotic dx, and/or a recent history (in last 3 months) of substance dependence	BRIEF-A SR	na	USA	44.4	BRIEF-shifting was found No elevated BRIEF index or subscale scores in ASD. ±33% report EFD on BRIEF-A scales (T-score ≥65): shift (41%), initiate (35%), plan/organize (35%), self monitor (30%), and working memory (30%).
Van Heijst and Geurts 2015	ASD	Clinical consensus and/or SRS ≥60	Case con	ASD=24, Con = 24	77.1%	63.6 (51–84)	NR	CFQ	RAND-36, DART, SRS-A, SCL-90	NL	44.4	ASD reported more cognitive complaints than con. Cognitive complaints were related to QoL, but this relation seemed dependent on extreme datapoints.
Lever& Geurts 2016	ASD	MINI DSM IV TR	Case con	ASD 118, Con 118	70.3	20–79 mean 44.7 (±14.9)	Excluded schizophrenia, or >1 psychosis, current SUDs	CFQ	WMS-III (vidual memory) RAVLT (verbal memory), Phological and semantic fluenc, Faux pas	NL	55.6	ASD >con CFQ total score (partial eta^2 0.29). CFQ score was not associated with any of the objective cognitive measures
Burdick et al., 2005	BP	SCID-P	Case con	37	49.9	46.2 (14.1)	Excluded SUDs (DSM-IV)	CFQ, CDS, PAOF	Digit span total, digit symbol, trials (A, B), Stroop (interference), CVLT (list A, short delay and long delay), HAM-D, YMRS	USA	55.6	Only the CDS and CVLT-Short delay correlated $r = 0.33$*. Mood ratings and scores of mania did not correlated with CDS, CFQ or PAOF. Trend results suggest more SCCs(CFQ) with higher depressions scores and with lower mania scores.
	BP	ICD-10 with SCAN		Total 77, CFQ 44	33.8			CFQ		Denmark	11.1	

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Table 1 (*continued*)

Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
Demant et al., 2015			77 patients with BD pooled from our two clinical trials: the EPO and the REMEDI trials			18–65 (m = 37.4 ± 10.5)	Excluded dx schizophrenia schizoaffective dx, significant suicide risk, current SUDs		RAVLT, Rapid Visual Information Processing (CANTAB), Repeatable Battery of the Assessment of Neuropsychological Status, coding and digit span TMT-B WAIS-III Letter-Number-Sequencing and verbal and semantic fluency			There were no significant correlations between SCC on the CFQ and objective cognitive dysfunction(p-values>0.176).
Paans et al., 2018	Bipolar dx	DSM-IV SCID or MINI	Cohort	90	44.4	67.3	Exclusion of primary substance use dx and dementia	CFQ	Coping	NL	11.1	Subjective cognitive complaints (according to CFQ) were not associated with active or passive coping.
Peters et al., 2014	Bipolar dx I	DSM-IV confirmed with MINI	Cohort	68	54	35.21±13.43	Lifetime comorbidities of 69% anxiety, 2% eating dx, 60% SUDs, 12% ADHD.	BRIEF and FrSBe	Manic symptoms (YMRS) and depressive symptoms (HAM-D)	USA	55.6	Impairment on all subscales of BRIEF and FrSBE compared to norms. Manic symptoms were associated with BRIEF impulsiveness/ distractibility, emotional con, attention, Task monitoring and organization, and FrSBe behavioral control and executive dysfunction. Depressive symptoms were associated with Cognitive flexibility, emotional con, initiate, attention, and plan FrSBE behavioral control and executive dysfunction. More lifetime

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Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												psychiatric comorbidities were associated with BRIEF Impulsiveness, and organization, and FrSBe executive disfunction.
Schouws et al., 2012	Bipolar II and II, currently euthymic	SCID-I	Case con	BP-many complaints(n = 43), BP few complaints (n = 58), (Comparison n = 76)	BP: 49,5 Comparison 27.0	BP: 69.46 Comparison: 71.76	NR	CFQ	Digit span, TMT-A/B, Amsterdam short term memory test, 10 words test, RAVLT, figure copying, and clock drawing, Stroop color word, Mazes (WISC), rule shift cards BADS	NL	55.6	No difference in CFQ total score between con and BP. BP with few complaints had a longer duration of illness than PB with manu complaints. BP with few cognitive complaints had worse cognitive functioning (attention and executive function) than those with many complaints. CFQ total score was associated with executive function after controling for age.
Stange et al., 2011	Bipolar dx	DSM-IV (mini)	Treatment trial nonrandomized prepost design	8	25	41.9 ± 7.5	Exclusded schizophrenia, schizoaffective, delusional psychotic dxs, MDD or mood congruent or incongruent psychotic features, b) SUDs	BRIEF and FrSBe	nr	USA	55.6	Above norm on BRIEF inhibit (1.2SD above mean), Emotional con (0.8 SD above mean), Self-monitor (0.6 SD above mean), Initiate (1.5 SD above mean), working memory (1.8 SD above mean), Plan Organize (1.8 SD above mean), task monitor (1.8 SD above mean), and organization

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Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												of materials (1 SD above mean)
VdWerf et al. 2011	Bipolar dx	DSM-IV mini	Case con	BP $n = 108$ C $n = 75$	BP= 38 C $n = 36$	BP= 45.8 C = 40.8	NR	CFQ	Processing speed, (CANTAB), speed of information processing (stroop color and word and RT CANTAB), attention switching (CPT), Verbal memory (California VLT) Visual memory (pattern recognition), executive function/ WM (spatial WM CANTAB), IDS	NL	33.3	BP >con CFQ (memory, distractibility, blunders, names). No associations between CFQ total or scales and cognitive scores, except for memory for names (CFQ) and information processing speed ($r = 0.257$). Correlations between IDS and CFQ total ($r = 0.532$), CFQ memory ($r = 0.478$), CFQ distractibility ($r = 0.558$), and CFQ blunders ($r = 0.485$). Depressive symptoms did not moderate between subjective and objective cognition.
Iverson et al. 2013	Depression	SCID-I	Case con	Depression $n = 62,\ 31.2$ Con= 112		M: 47.4 ± 12	All who were interviewed were found to be free of a current Axis I dx	BC—CCI	none	Canada	11.1	Depression<con on (forgetfulness, poor concentration, expressing thoughts word finding, slow thinking, and problems solving) and total score. No correlation with age or sex. Lower correlation in con between BDI and subjective cognition($r = 0.43$) than in

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Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												depression (r = 0.66).
Keilp et al., 2018	Unipolar depression		Case con	Depression n = 232, Con n = 140	Depressed 38.5%, con 50.7	(18–80) Depressed (mean 38.1 sd 12), Con (mean 33.8 sd 12.4)	20.6% borderline, 17.9% PTSD, 27.9% past SUDs.	CFQ	Choice RT, Digit symbol CPTd' Stroop interference, Buschke SRT total recal, WCST errors, Letter&category fluency, Gonogo commision errors, logical reasoning. BDI	USA	22.2	CFQ total score was correlated with CPT d' (r=−0.14, ns), the blunders subscale was correlated with CPT d' (r=−0.18). BDI correlated with CFQ total (r = 0.31), memory complaint (r = 0.27), distractibility (r = 0.34), and blunders (r = 0.23). BDI subjective depression (r.32) and selfblame (r = 0.30) associated with CFQ total score and most strongly with CFQ distractibility (r = 0.34,and r = 0.32). Objective measures of cognition were not correlated to BDI except choice RT (r=−0.14)
Lam et al., 2016	MDD	MINI DSM-IV-TR	Non randomized treatment with desvenlafaxine	40	45	39±10.8	Excluded lifetime dx of bipolar dx or other significant primary psychiatric dx, active SUDs in past year	BC—CCI	na	Canada	66.7	All participants had some degree of perceived cognitive impairment, as measured by the BC—CCI.
Pae et al., 2008	MDD (pre and post menopausal women with MDD)	DSM-IV with SCID	prospective, 6-week, open-label naturalistic study	39	0	nr	Excluded: AXIS 1 dxs	CFQ	Hormone levels, MADRS depression	Korea	66.7	CFQ not associated with age, age at onset, depressive severity and antidepressant drug, menopausal

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Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												status (corrected for age, age at onset, and depressive symptoms). In postmenopausal MDD CFQ was related to estradiol levels, but not in premenopausal MDD. (first depression in postmenopausal women at 54 years instead of 34 year)
Sawada et al., 2019	Depression	ICD-10	Cohort	102	45	50.5 ± 14.7	nr	PDQ	QIDS, MADRS	Japan	55.6	MADRS (r = 0.64) and QIDS (r = 0.79) total score were correlated with PDQ total score (higher symptoms higher PDQ score). Female <males sex on PDQ
Serra-Blasco et al., 2019	MDD	DSM-IV clinical diagnosis	cohort	Acute depression n = 81, remitter n = 57	REmitted38.6, Acute: 46.01	18–65 Remitted n = 51.09 ± 11.68, Acute 53.99±6.64	Exclusion of bipolar dx schizophrenia past or present substance abuse or axis II diagnosis.	PDQ-20	HDRS-17, Composite scores of attention (TMT-A, Digit span forward, spatial span forward, WMS-III), memory (RAVLT).	Canada	55.6	HDRS scores correlated with subjective cognition (attention r=−0.64, memory r=−0.57) Objective and subjective attention correlated (r = 0.34 in acute group not remitted r = 0.26, ns.), Memory in the acute r = 0.35 group not remitted r = 0.05 ns.). The remitted group overestimated their ability while the active

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Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												MDD group underestimated their ability.
Bulzacka et al., 2013	Schizophrenia	Diagnostic Interview for Genetic Studies (DSM-IV)	Case con	31	81	39.7		BRIEF-A	Verbal Fluency, Wisconsin Card Sorting Test, TMT, Stroop Test and Digit Span forward and backward.	France	22.2	Schizophrenia> con with large ESs. A significant negative small correlation was found over groups between the inhibition scale and digitspan backwards
Kumbhani et al., 2010	Schizophrenia	DSM-IV SCID	Case con	Schizophrenia n = Con n =	Schizophrenia 51.7, con 50.0	Schizophrenia 40.69±10.79, Con 32,16 ± 12.22	Excluded of significant systemic medical illness and SUDs	BRIEF SR and informant on subset	Obsessive compulsive inventory	Lebanon	55.6	SR and informant reported lower scores on the BRIEF on working memory, and shift. Informant reported lower scores on all subscales. Obsessing correlated with most BRIEF subscales according to informant and SR (r = 0.31–0.47). Informant reports correlated more often with subscales than SR.
Power et al., 2012	Schizophrenia	ICD-10	cohort	112	72.3	44.5 ± 13.03	No exclusion criteria	BRIEF-A (IR)	GAF, SBS	Australia	33.3	T-score of several scales and indeces were abnormally elevated. BRIEF–A GEC associated to GAF (r =−0.25), and SBS (r = 0.59); similar trends were observed for both BRI and MI T-scores.
		DSM-IV	Case con				NR		Cognitive measures	Norway	33.3	

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Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
Lovstad et al., 2016	ADHD, BP-I/BP-II, BPD			ADHD: 34 BP-II:21 BPD:18 Neurological groups (TBI:125, PFC:29, CC:24, PD:42) Con= 115	ADHD: 47.1 BP-II:14.3 BPD:27.8 Neurological groups (TBI:77.4, PFC:48.3, CC:54.2, PD:73.8) Con= 42.6	ADHD: 31.7 BP-II:26.2 BPD:33.2 Neurological groups (TBI:37.9, PFC:43.3, CC:22.5, PD:59.8) Con= 31.3		BRIEF-A (self and informant)				Con= PFC & con=CC (any index, PD(GEC, BRI),on all other test patients differed from con. con scored around 40, neurological disorders between 45 and 50 and neuropsychiatric groups around $T = 65$. neuropsychiatric ≠con But neurological group = con. neuropsychiatric group, ss did not differ on any BRIEF index. No correlations between IQ and EF index and BIREF scores. One association was significant, i.e., CWIT and BRI in the PD group ($r = 0.39$). In ADHD SCL-90 GSI correlated with BRIEF GEC ($r = 0.51$) and BRI ($r = 0.56$), in BP and BPD SCL 90 and the BRI were correlated ($r = 0.59$). Correlations were lower in neuropsychiatry (r range 0.35–.55; $p<.01$–.001; R2 = 0.12–.30), and the MI did not correlate In the Con PFC, CC and PD groups no difference between self and

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Study	Dx	Classification method	Type of study	N	Sex (%male)	age	comorbidity	Measure of SC	Other measures	Country of origin	Quality score	Main conclusion
												informant. Informants in ADHD reported lower scores, while in TBI group informant reported higher scores but only on GEC and MI. NB age and education used as covariates in all analyses. No informant ratings were available in BP and BPD.

Note. AAQOL=Adult adhd quality of life; ACDS=Adult ADHD Clinical Diagnostic Scale; ASRS= adhd self report scale; ATX= Atomoxetine; BDEFS= Barkley Deficits in Executive Functioning Scale–Short Form; BP= bipolar, BPD borderline personality disorder BRI= behavioral regulation index; CC=Cerebellar lesions; con=controls; CE= commission errors; CFQ= Cognitive failures questionnaire; CDS= Cognitive difficulties scale; Dx= psychiatric classification; GAF= global assessment of functioning GEC = Global Executive Composite; FrSBe =Frontal systems behavior rating scale; HAM-*D*= Hamilton Depression Rating Scale; IDS= Inventory depressive symptoms; KS-10= Kessler psychological distress scale; MADRS= Montgomery–Asberg Depression Rating Scale; MI = Metacognitive Index; OE=Ommision Errors; PAOF= patient assessment of own; PD= Parkinson disease; PFC= prefrontal lesions; QIDS= Quick Inventory of Depressive Symptomatology,; RAVLT= Rey Auditory Verbal LearningTest; RTvar=reaction time variability; SBS= social behavior schedule; SC= Subjective Cognition; SCAN = Schedule for Clinical Assessment in Neuropsychiatry;SCID_*I*= Structured Clinical Interview for DSM-IV; SR= self-report; SRS-*A*= Social Responsiveness Scale-Adults (SRS-A); SUDs= substance use disorders; TBI: traumatic brain injury; TOVA=Test of variables of attention; YMRS= Young Mania Rating Scale functioning * these are available in English, two german questionnaires are not mentioned here.

score on the CFQ subscale names was associated with lower speed of information processing (Van Der Werf-Eldering et al., 2011). Concurring with findings in ADHD, one study showed that respondents with few SCCs had worse cognitive functioning on attention and EF compared to those with many SCCs (Schouws et al., 2012).

Both studies in depression showed weak, but significant correlations between objective and subjective cognition. One study showed a very weak relation ($r=-0.14$) between total CFQ score and continuous performance task d', which appear to be driven by the subscale CFQ blunders (Keilp et al., 2018). The other study found scores on a composite measure of memory, and attention to correlate with subjective memory and attention (Serra-Blasco et al., 2019).

In bipolar disorder, results concerning subjective cognition in relation to mania symptoms is unclear. One study found lower subjective cognition related to higher mania scores (Peters et al., 2014), but another did not find this (Burdick et al., 2005). Possibly, these inconsistent results are due to the various phases of illness. Additionally, comorbid classifications, both somatic and psychiatric, were found to be related to higher cognitive complaints (Peters et al., 2014).

Interestingly, two studies in bipolar disorder and depression did not find a relation between depressive symptoms and SCCs (Burdick et al., 2005; Keilp et al., 2018). These studies included only subjects above a cut-off on a questionnaire (Keilp et al., 2018), or participants in various phases of illness (Burdick et al., 2005), which could possibly indicate that these patients were more severely affected than those in other studies. Possibly, this could indicate an effect of medication, as also found by Peters and colleagues (Peters et al., 2014), but it could also indicate that in highly depressed individuals, depression gets the overhand over SCCs and both stop going hand in hand. However, one study indicated that the relation between depressive symptoms and subjective cognition was highest in active MDD compared to partially and fully remitted group MDD (Serra-Blasco et al., 2019).

3.8. Schizophrenia

In schizophrenia (Bulzacka et al., 2013; Kumbhani et al., 2010; Power et al., 2012) studies note more self-reported difficulties in cognition compared to controls. In schizophrenia only one significant correlation was found between objective and subjective cognition, namely working memory and self-reported inhibition on the BRIEF.

In schizophrenia, lower subjective cognition was related to higher scores on several dimensions of obsessive compulsive disorder (Kumbhani et al., 2010), lower global functioning, and more behavioral difficulties (Power et al., 2012).

3.9. Positive relation between psychiatric, psychological or behavioral symptoms and SCCs across classifications

In 16 studies the relation between reported psychiatric, psychological, or difficulties and subjective cognition was reported (six in ADHD (Brod et al., 2015; Gray et al., 2016, 2014; Low et al., 2018; Roth et al., 2013; Stem and Maeir, 2014), one in ASD (van Heijst and Geurts, 2015), four in bipolar disorder (Burdick et al., 2005; Paans et al., 2018; Peters et al., 2014; Van Der Werf-Eldering et al., 2011), four in depression (Keilp et al., 2018; Pae et al., 2008; Sawada et al., 2019; Serra-Blasco et al., 2019) and two in schizophrenia (Bulzacka et al., 2013; Power et al., 2012)). The most common outcome investigated outcome (in seven out of 16 studies) in relation to subjective cognition was depression (Burdick et al., 2005; Keilp et al., 2018; Peters et al., 2014; Roth et al., 2013; Sawada et al., 2019; Serra-Blasco et al., 2019; Van Der Werf-Eldering et al., 2011). Most studies report that higher depressive symptoms are related to more SCCs. Moreover, increasing psychiatric, psychological and behavioral difficulties, are associated with more SCCs.

3.10. Limited and small correlation between subjective and objective cognition across classifications

A total of 13 studies reported on the relation between objective measures of cognition and subjective measures of cognition (four in ADHD (Arntsberg Grane et al., 2014; Biederman et al., 2012; Fuermaier et al., 2015; Gray et al., 2016), two in ASD (Davids et al., 2016; Lever and Geurts, 2016), four in bipolar disorder (Burdick et al., 2005; Demant et al., 2015; Schouws et al., 2012; Van Der Werf-Eldering et al., 2011), two in depression (Keilp et al., 2018; Serra-Blasco et al., 2019), and one in schizophrenia (Bulzacka et al., 2013)).

The majority of studies report (mostly) nonsignificant correlations between objective measures of cognition and SCCs (Arntsberg Grane et al., 2014; Biederman et al., 2012; Bulzacka et al., 2013; Burdick et al., 2005; Demant et al., 2015; Fuermaier et al., 2015; Gray et al., 2016; Keilp et al., 2018; Lever and Geurts, 2016; Van Der Werf-Eldering et al., 2011), the correlations found are weak to moderate at best, and correction for multiple comparisons is rare in these types of studies.

There were not enough studies across diagnoses to make a comparison about specific patterns of cognitive functions between classifications. One relation seems notable: the small but significant relation between working memory as measured with the digit span backwards and subjective cognition, as this was reported by two studies in different classifications (Bulzacka et al., 2013; Gray et al., 2016).

3.11. The impact of demographic characteristics

Although many studies used standardized scores removing the effect of age and gender, thus decreasing the possibility to draw conclusions about the effect of sex and age, some did not. Studies showed that females had more SCCs than males (Gray et al., 2016; Sawada et al., 2019), but reports of this effect was inconsistent (Iverson and Lam, 2013), possibly due to differential and higher depression scores in females (Sawada et al., 2019). Another possible explanation lies in the sex hormone estradiol, which was strongly related to SCCs in post-menopausal, but not pre-menopausal women, even after controlling for depression scores (Pae et al., 2008).

Generally, very few studies (Davids et al., 2016; Lever and Geurts, 2016; Paans et al., 2018; Pae et al., 2008; Schouws et al., 2012) focus on older (i.e., with an age above 65) individuals with psychiatric classifications. Studies on psychiatric classifications have shown inconsistent results on the relation between age and cognitive complaints, two studies report an increase in cognitive complaints in older individuals (Davids et al., 2016; Demant et al., 2015), but two others did not find this effect (Iverson and Lam, 2013; Sawada et al., 2019).

3.12. The Brief is most commonly used

Of the eligible papers, the most frequently used instrument was the Behavior Rating Inventory of Executive Function (BRIEF $n = 20$ times), followed by the cognitive failures' questionnaire (CFQ $n = 9$). Other instruments were used less frequently (Perceived difficulties questionnaire (PDQ $n = 3$), British Columbia Cognitive Complaints Inventory (BC—CCI $n = 2$), Frontal Systems Behavior Scale (FrSBe $n = 2$), cognitive difficulties scale (CDS $n = 1$). Overall, the BRIEF was also used most frequently across classifications, in 4 out of 5 disorder studies used the BRIEF.

The BRIEF was the only questionnaire used in multiple diagnoses, where studies also reported subscales (NB not all studies reported all subscales). In ADHD two subscales (self-monitor and emotional control; (Adler et al., 2014a; Arntsberg Grane et al. 2014; Biederman et al., 2012; Stem and Maeir 2014) were consequently below 65, and four subscales (task monitor, plan/organize, working memory and initiate; (Adler et al., 2014a; Arntsberg Grane et al. 2014; Biederman et al., 2012; Low et al., 2018; Stem and Maeir 2014) and two index scores (general executive composite [GEC] and metacognitive index [MI];(Adler et al.,

2014a; Adler et al., 2013; Durell et al., 2013; Lovstad et al., 2016; Stem and Maeir 2014)) consequently above 65. In ASD only the subscale shift was elevated according to one study (Davids et al., 2016), but no elevated scores were reported in another (Joshi et al., 2016), although shift had the highest T-score (63) in this study. In bipolar disorder in two out of two studies the index scores GEC and MI (Stange et al., 2011; Lovstad et al., 2016) and the subscales working memory and initiate were above 65 (Peters et al., 2014; Stange et al., 2011). In schizophrenia one paper reported subscale scores and showed elevated scores on the subscale initiate, but none of the other sub- or index scales were elevated (Bulzacka et al., 2013).

4. .Discussion

Based on clinical observations that instruments to measure subjective cognition developed for use in neurological disorders, were being used in ADHD and other psychiatric classifciations, we set out to assess the validity of instruments in this population. However, we found that in research many of these instruments are used correctly, as the instruments are often developed for use in the studies' populations. Individuals with psychiatric diagnoses report SCCs, independent of instrument or diagnosis. In ADHD commonly SCCs (often measured with the BRIEF) are used as outcome measure in studies, and it is often assumed that this reflects objective performance. However, SCCs show inconsistent and low associations to objective measures of cognition across psychiatric classifications, including ADHD, higher and more consistent relations are found with behavioral outcomes (such as symptoms of depression (Burdick et al., 2005; Keilp et al., 2018; Peters et al., 2014; Roth et al., 2013; Sawada et al., 2019; Serra-Blasco et al., 2019; Van Der Werf-Eldering et al., 2011), OCD (Kumbhani et al., 2010), and ADHD symptoms itself (Gray et al., 2016, 2014; Low et al., 2018)) and QoL (Brod et al., 2015; Stem and Maeir, 2014; van Heijst and Geurts, 2015). While SCCs do not correlate well with objective measures of cognition in any psychiatric classification, and should thus not be seen as analogous to well validated measures of objective cognition, they are of *clinical* value. SCCs reflect suffering, behavioral difficulties and problems experienced by those with psychiatric problems in daily life, as they are related to quality of life, depression, and other measures of behavior. Where objective measures are already known to be of value because they are related to various functional outcomes in psychiatric patients (e.g., Green, 2016; Knight and Baune, 2018), we argue that despite the lack of a strong relation between SCC and such objective measures both are of importance for clinical practice.

Interestingly, associations between objective and subjective cognition vary considerably with respect to the cognitive functions involved (Davids et al., 2016; Serra-Blasco et al., 2019). For example, a relation between organization of materials of the BRIEF and reaction time, and inhibition (Arntsberg Grane et al., 2014) and CFQ names and speed of information processing, and working memory (Van Der Werf-Eldering et al., 2011). Moreover, several studies reported a negative relationship between objective cognitive performance and SCCs, in that those with worst cognitive performance, had less SCCs (Arntsberg Grane et al., 2014; Biederman et al., 2012; Schouws et al., 2012). Possibly poor meta cognitive ability, or the ability to self-monitor cognition, can lead to over or underestimating your cognitive ability. This concurs with the finding that a stronger relation was found between SCCs as reported by a clinician compared to self-reports (Burdick et al., 2005); however, we here focused on self-reports, given that these are the easiest to obtain. It has also been argued that subjective and objective measures of cognition reflect different aspects of cognition (Toplak et al., 2013). In most studies of psychiatric diagnoses SCCs are reported, independent of instrument and disorder.

The relation between depressive mood and SCCs was most commonly observed across classifications. Depressive mood can color ones' view on all aspects of life. Possibly, this relation confounds other identified relationships, as most measures used are self-reported, and thus have this depressive view incorporated in them. For example, self-reported QoL can be influenced strongly by a depressed mood, but also SCCs are influenced in this way. Confirming this, is that higher relation between depression severity and SCCs are found in those with active depression compared to those in partial or full remission (Serra-Blasco et al., 2019), and that those individuals with a higher medication load (often endogenous to more severe suffering due to ones' disorder) had more SCCs (Peters et al., 2014). Therefore, we conclude that SCCs partly reflect overall suffering.

It has previously been suggested that in younger samples worrying about neurological difficulties, SCCs were related to depressive symptoms, while in older samples SCCs are more related to objective cognition (Jonker et al., 2000). This seems the same for the psychiatric population. While most studies in younger adults report a relation between SCCs and depressive symptoms (Burdick et al., 2005; Keilp et al., 2018; Peters et al., 2014; Roth et al., 2013; Sawada et al., 2019; Serra-Blasco et al., 2019; Van Der Werf-Eldering et al., 2011) or OCD (Kumbhani et al., 2010), there is no clear indication that SSCs are related to objective cognition in older adults. One study in elderly autistic individuals did find somewhat higher correlations (Davids et al., 2016) than most studies in younger individuals; however, this is not exclusive for older age, as correlations in the same range were found in ADHD (mean age 32 years; (Arntsberg Grane et al., 2014)), and no direct correlation with age was reported. Moreover, in a study into old individuals with bipolar disorder, without current mood problems (Schouws et al., 2012), it was found that individuals who did not report SCCs, did perform worse on objective measures of cognition. Additionally, results concerning the effect of age on SCCs in psychiatric classifications remains inconclusive (Davids et al., 2016; Demant et al., 2015; Iverson and Lam, 2013; Sawada et al., 2019). While one would anticipate increasing cognitive complaints with increasing age, when filling out such questionnaires people do compare themselves to other peoples performance, or what they expected from old age. This might cause them to take this into account, and consequently do not experience this as a burden or handicap, as it considered "normal" for their age. Taken together, similar to neurological disorders, we do not find any evidence for a relation between objective cognitive performance and subjective cognition at any age in psychiatric classifications. However, studies into older adults are warranted.

The strength of the current review lies in the inclusion of different psychiatric classifications, which allowed us to draw conclusions across classifications. Additionally, we used a rigorous method to determine relevant instruments that measure SCCs. However, our results should also be interpreted in the light of several limitations. First, in different classifications different instruments were preferred. Studies using these disease specific instruments were excluded from the current examination as including these would have made true generalizability difficult. Importantly, especially in ADHD the BRIEF was used often, however, there is a very large overlap between the items on the BRIEF and the symptoms of ADHD, which might have led to an overestimation of the SCCs in ADHD. Additionally, although we worked from the clinical observation that many instruments developed for use in neurological disorders were used, we did not find this in the research papers despite our rigorous setup to identify relevant questionnaires for this purpose. Therefore, we were not able to answer the hypothesis whether instruments developed for neurological disorders can reliably be used in psychiatric classifications. Regardless of the population, we see that SCCs reflect a different construct than objectively measured cognitive performance. However, the instruments used do seem to have some face validity to be used in psychiatric groups.

Despite these caveats, we can conclude that SCCs are common among psychiatric classifications and not unique for ADHD SCCs among ADHD were minimally associated with objective measures of cognition, but significantly related to daily distress and disability measures, as such mirroring findings among other psychiatric conditions.

Declaration of interest

None

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2021.114374.

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