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Commentary

COMMENTARY

Measuring Self-Reported Cancer-Related Cognitive Impairment: Recommendations From the Cancer Neuroscience Initiative Working Group

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Abstract

Cancer and its treatments are associated with increased risk for cancer-related cognitive impairment (CRCI). Methods and measures used to study and assess self-reported CRCI (sr-CRCI), however, remain diverse, resulting in heterogeneity across studies. The Patient-Reported Outcomes Working Group has been formed to promote homogeneity in the methods used to study sr-CRCI. In this report, using a psychometric taxonomy, we inventory and appraise instruments used in research to measure sr-CRCI, and we consider advances in patient-reported outcome methodology. Given its psychometric properties, we recommend the Patient-Reported Outcome Measurement Information System Cognitive Function Short Form 8a for measurement of sr-CRCI in cancer patients and survivors, at a minimum, to increase scientific rigor and progress in addressing CRCI.

Cancer and its treatments are associated with increased risk for cancer-related cognitive impairment (CRCI). Standardized neuropsychological testing consistently detects CRCI in 30%-50% of patients with cancers outside of the central nervous system prior to starting chemotherapy; 75% experience CRCI during adjuvant treatment; and 35%-60% experience CRCI for months to years after treatment ends (1-8). CRCI is associated with reduced quality of life and survival (9,10), and it can interfere with social and occupational functioning (1,8,9,11-23). Even subtle cognitive changes can have devastating effects on one's everyday life (1).

Standardized neuropsychological testing represents the gold standard for evaluating neurocognitive disorders and has extended to CRCI (24,25). However, survivors' performances on such tests usually fall within the range of normal to mild cognitive deficits, in contrast to survivors' reports of a much greater impact of cancer on cognitive functioning (1,26). Incidence of self-reported cognitive impairment (sr-CRCI) is typically higher than incidence of objectively measured CRCI, with estimates of sr-CRCI as high as 78%, most commonly related to memory, executive functioning, processing speed, and attention (2). Neuropsychological testing, by itself, is thus insufficient for characterizing and diagnosing CRCI (27), and efforts are therefore being made to better understand sr-CRCI (28,29). This shift aligns with an increasing appreciation of patient-reported outcomes as part of comprehensive cancer research (30). In a recent systematic review of cross-sectional and longitudinal studies, for example, sr-CRCI in breast cancer patients was found to be worse than healthy controls and typically improved after treatment ended (29). Cross-sectional studies have also demonstrated persistent sr-CRCI in subgroups of cancer survivors up to 20 years after treatment (29,31).

Small or no relationships between objective cognitive tests and sr-CRCI are commonly reported (26,29). Consistent correlations between psychological distress and sr-CRCI are also reported (32) leading many to conclude that distress conflates measurement of sr-CRCI. Distress and cognition, however, share similar neural prefrontal networks (33,34) and intrinsic whole-brain networks (35-37), and it is likely that sr-CRCI is a

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separate neural phenotype of CRCI. Neuroimaging studies have found associations between sr-CRCI and altered brain structure (13,38,39) and function (40,41). Mood and/or distress should not be conceptualized as confounds of sr-CRCI; researchers should consider both as part of the clinical problem.

The published studies of sr-CRCI to date lack homogeneity (29) and power, thereby limiting clinical application (42). Published guidelines for measuring objective CRCI (25) and CRCI-related brain structure and function (43) and for preclinical CRCI research (44) do not apply to self-reported cognitive outcomes. To address this gap in the literature, the Patient-Reported Outcomes Working Group was formed by the Cancer Neuroscience Initiative to advance the science of sr-CRCI and promote homogeneity in methods used to study it. The Cancer Neuroscience Initiative was established to promote the integration of cancer-related neuroscience within the MD Anderson Cancer Center as well as through collaborations between MD Anderson and outside neuroscience research groups including, but not limited to, the University of Texas at Austin, University of California Los Angeles, and Baylor College of Medicine. Here, we offer evidence-based recommendations for the measurement of sr-CRCI in cancer patients and survivors, based on a roundtable discussion among the members of the working group after critical appraisal of instruments used in research measuring sr-CRCI. We also consider the unique needs of vulnerable oncology populations and advancements in patient-reported outcomes methodology.

Instruments to Measure sr-CRCI

In 2018, Bray et al. (29) reviewed 101 studies of self-reported cognitive function in cancer survivors from 1936 to December 2017. We used this systematic review to inventory instruments used to measure sr-CRCI across studies, because this was not an aim of the original systematic review (29). To account for studies from December 2017 to December 2019, we have updated Bray et al.'s systematic review, using the same search criteria (see the Supplementary Methods, available online), which yielded a combined inventory of instruments from 151 studies (Supplementary Table 1, available online). Before 2018, the 3 most common measures of general or global sr-CRCI were the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC-QLQ-C30, n = 30), the Functional Assessment of Cancer Therapy-Cognitive Function (FACT-Cog, n = 22), and the Cognitive Failures Questionnaire (CFQ, n = 13). In some of the studies prior to 2018, domain-specific measures of attention or executive function were used to operationalize sr-CRCI, with attention to the most common domain examined using the Questionnaire for Experiences of Attention Deficits (German FEDA, n = 6) and the Attentional Function Index (AFI, n = 3). The Behavioral Rating Inventory of Executive Function (BRIEF) was also used in 3 studies.

A large number of studies did not specify how they measured sr-CRCI, instead stating that "study-specific" or "interview" questions were used (n = 19). Since 2018, use of the FACT-Cog (n = 25) to measure sr-CRCI rather than the EORTC-QLQ-C30 (n = 3) has increased. There has also been a trend toward less use of domain-specific measures—only 7 studies since 2018, as opposed to 18 previously. Furthermore, studies published after 2018 have not used unspecified measures or other patient-reported outcome measures as proxies for sr-CRCI.

The trends in choices of instruments to measure sr-CRCI can be attributed to the instruments' psychometric properties. We evaluated the 5 most common instruments used to measure general sr-CRCI and the 3 most common instruments used to measure domain-specific sr-CRCI. The Consensus-based Standards for the Selection of Health Measurement Instruments (COSMIN) informed our criteria for evaluating the instruments (http://www.cosmin.nl) (45). COSMIN provides a measurement taxonomy that incorporates interpretability as well as reliability and validity and also accounts for a temporal perspective in longitudinal studies (46). In addition, we considered the accessibility of the instruments, including cost, availability in different languages, and mode of administration (Table 1). We considered the demonstration of adequate reliability and validity of each instrument in the literature, within the context of number of instrument items and/or subscales and accessibility, when considering instruments for use in sr-CRCI studies.

The general measures of sr-CRCI, except the EORTC-QOL, comprised 25-38 items. The EORTC-QOL contains only 2 items assessing cognitive function, which likely do not capture the complexities and nuances inherent in CRCI, given variable patterns of patients' reports. Study design should reflect a balance in measurement quality and participant burden. It is also important to consider the time frame to which items/questions in an instrument refer (67), especially in cancer populations with varied treatments and recovery trajectories. For example, the FACT-Cog asks about the frequency of symptoms in the past week, whereas the Patient Assessment of Functioning Inventory (PAOFI) varies in asking about when symptoms occurred, using "recent days" for some questions and "the past 6 months" for others.

All 5 of the measures for general sr-CRCI have been validated in cancer survivors with CRCI and have demonstrated reliability, although supporting evidence for instrument development, validity, and reliability (beyond internal consistency) was difficult to find for instruments other than the FACT-Cog and PAOFI. In terms of accessibility, the EORTC and FACT-Cog are widely available in multiple forms and can be used for free. The Cognitive Failures Questionnaire, PAOFI, and Multiple Ability Self-Report Questionnaire can be found in print in various publications and are less accessible.

The FACT-Cog (https://www.facit.org) is a well-documented, validated instrument (54), with its 20-item subscale for perceived cognitive impairments (PCI) used most often. Our review showed that the FACT-Cog is the measure most commonly used to evaluate change in sr-CRCI in terms of responsiveness to interventions. This is likely because minimal clinically important change values have been published for the FACT-Cog, which are valuable for interpreting findings in intervention trials (68). However, the published values were derived from the total score, and the FACT-Cog developers have specified that researchers should use subscale scores, not total scores. This practical issue makes administration and interpretation of the FACT-Cog potentially confusing.

Among the 3 domain-specific sr-CRCI measures, we could not evaluate the FEDA, an unpublished German instrument from 1991 (69). The other 2 instruments were the AFI and BRIEF. The *AFI*, a 13-item questionnaire, measures attention only, with reports of validity and reliability (63). The BRIEF, a psychometrically sophisticated comprehensive measure of executive functioning, allows standardized scoring and interpretation and is available in Spanish. However, its 75 items may be burdensome

for participants, and it is available only through purchase from PAR, Inc.

Considerations for Different Populations

Pediatric, Adolescents, and Young Adult Patients

Few self-report measures of cognitive ability exist for children and adolescents, and most are focused on executive function or attention or do not focus exclusively on cognition. Examples include the BRIEF (11-18 years) (70), the Brown Executive Function/Attention Scales (8-18 years) (71), the third edition of the Conners assessment (Conners 3; 8-18 years) (72), and the Child Behavioral Checklist (6-18 years). Most ratings for children are obtained with the use of informants (ie, parents, teachers), so it is difficult to obtain a child's perception of cognitive function. The BRIEF appears to be the most commonly used measure across studies (73). In the adolescent and young adult cancer survivor population (those 15-39 years of age), research on sr-CRCI is rare, and measures are heterogenous.

Older Cancer Survivors

Older adults (65 years or older) comprise the majority of patients with cancer (74). Aging is a risk factor for cognitive decline (75), making older cancer patients highly vulnerable to CRCI (76). Geriatric assessment in cancer patients would be more effective with the inclusion of measures for cognitive self-report (77). In older adults, sr-CRCI is a possible early sign of progressive dementia and is considered a serious concern (78). However, self-reported cognitive dysfunction has not been similarly prioritized as a clinical red flag in older cancer patients and survivors. The Cancer and Aging Research Group has proposed clinical guidelines for older cancer patients: the Mini-Cog and the Blessed Orientation-Memory-Concentration Test (79). However, these measures, originally designed and validated for dementia screening, may be insufficient to detect the more subtle forms of cognitive vulnerability associated with cancer and cancer treatment.

Metastatic Cancer Survivors

Patients with metastatic noncentral nervous system tumor types are especially vulnerable to cognitive sequelae that can accompany systemic cancer treatment. In fact, cognitive symptoms are one of the most common reports of persons with advanced cancer (80), and they can be further worsened by metastatic brain involvement and/or drugs for pain management (81). Considering that treatments for advanced cancer must also prioritize symptom management and quality of life, more research is needed on CRCI within this population to guide clinicians and patients in managing cognitive symptoms and selecting appropriate therapies for either active anticancer therapy or palliative care delivered concurrently with anticancer therapy. If cognitive patient-reported outcomes are studied and validated in this population, use of these measures could be especially beneficial, because they could facilitate more frequent, complete assessments of patients' cognitive function to inform treatment decisions during palliative therapy (82).

Central Nervous System Cancer Patients

Patients with cancers involving the central nervous system (primary and metastatic brain tumors) are distinctly prone to cognitive dysfunction, because such cancers and their treatments directly impact brain structure and function. Cognitive performance and risk of cognitive deterioration are routine components of therapeutic decision making in the care of these patients (83). Patient-reported outcome measures are often included (84-86); however, these tools contain limited questions on cognition and may lack the sensitivity of tools designed to identify the breadth of possible cognitive symptoms. Given the central importance of cognitive function in studies of brain tumors, a holistic understanding of cognition, including sr-CRCI, is warranted.

Advancements in Patient-Reported Outcome Measurement and Evaluation

Within CRCI measurement, the majority of patient-reported outcome measures are paper-and-pencil instruments developed using classical test theory (87) (see Table 1). Inherent limitations to such assessments (88,89) have led to a marked increase in the availability and application of more advanced psychometric tools and techniques for patient-reported outcome development and administration. Item response theory and computerized adaptive testing (CAT) are modern tools used to assess patients' outcomes in some areas of health care, but they have not been widely adopted in the assessment of CRCI (90). Item response theory is central to the methodology of the National Institutes of Health's Patient-Reported Outcomes Measurement Information System (PROMIS) initiative (91) as well as increasingly available free open-source psychometric software for conducting analyses (88,92). In the measurement of CRCI, item response theory can help determine which items within a questionnaire are suitable for assessing levels of dysfunction (93).

CAT enables dynamic, individualized assessments by iteratively selecting the most relevant items to administer, based on estimates of a person's level of ability given the underlying construct of the measure (94). Compared with standard fixed-length assessments, CAT can improve the accuracy of assessments and reduce the number of questions that must be asked. CAT is available through the PROMIS system (95). However, a disadvantage of CAT is that participants will likely receive different numbers of assessment items and, therefore, potentially vastly different assessments, which would have to be considered in statistical analyses.

PROMIS Cognitive Scales

PROMIS is intended to provide precise, efficient, psychometrically sound instruments for clinicians and researchers. PROMIS scales are available in CAT (item bank) and paper-and-pencil (instrument) formats. PROMIS scale development begins with a literature review to define a given target concept with input from experts, followed by the composition and refinement of individual items through cognitive interviews, with item banks constructed for CAT. Measurement properties are determined for the individual items in each bank, and different instrument formats are then developed (computer, paper-and-pencil, telephone). Construct, content, and criterion validity are determined along with responsiveness for use in longitudinal

Table 1. Evaluation of instruments

Instrument	Citation	No. of items, subscales	Time frame captured	Validity[a]	Reliability[b]	Responsiveness in longitudinal research[c]	Accessibility[d]	No. of studies that have used it
Global								
European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC-QLQ-C30)	Aaronson et al. 1993 (47)	2 items for cognitive functioning (concentration and memory oriented) out of 30 total items	In the past week	Content[e] Clinical criterion[e] Construct[e]	Internal consistency[e] (47)	Responsive by time, not by group or group X time[e] (47, 48)	Published and available in paper form[e] (47)	33 (n = 30 pre-2018, n = 3 post-2018)
Cognitive Failures Questionnaire (CFQ)	Broadbent et al. 1982 (49)	25 items, perception, memory, and motor function	In the past 6 months	Face[e] Criterion[e] (49) Construct[e] (50)	Internal consistency[e] Test-retest reliability[e] (51, 52)	Response to intervention[e] (53) Variance stability[e] (52)	Published and available in paper form[e]	14 (n = 13 pre-2018, n = 1 post-2018)
Functional Assessment of Cancer Treatment Cognition (FACT-Cog)	Wagner et al. 2009 (54)	37 items; perceived cognitive impairment, perceived cognitive abilities, quality of life, comments from others	Applies to the past 7 days	Discriminant[e] Convergent[e] Concurrent[e] (55)	Internal consistency[e] Test-retest reliability[e] (54)	Response to interventions[e] (56–58)	Free download paper form[e] Computer form[e]	47 (n = 22 pre-2018, n = 25 post-2018)
Patients Assessment of Own Functioning Inventory (PAOFI)	Van Dyk et al. 2016 (59)	33-item subscales: higher level cognitive and intellectual functions executive functioning memory motor/sensory/perceptual	Some items within the past "day or two," others within "the past year or so"	Construct[e] (59, 60)	Internal consistency[e] (59, 60)	No responsiveness to intervention (61)	Published and available in paper form[e] (59)	7 (n = 5 pre-2018, n = 2 post-2018)
Multiple Ability Self Report Questionnaire (MASQ)	Seidenberg et al. 1994 (62)	38 items, subscales: language, visuo-perceptual, verbal memory, visual memory, and attention	Unspecified	Content[e] (62)	Internal consistency[e] (62) Interrater reliability[e] (62)	No responsiveness in intervention studies	Published and available in paper form[e] (62)	7 (pre-2018)
Domain-specific instruments								
Self-Perceived Deficits in Attention/ Questionnaire of Experienced Deficits of Attention (FEDA/ QEDA)	—	Unknown number of items, distractibility and retardation in mental tasks	No details available in the literature	No details available in the literature	No details available in the literature	No details available in the literature	No details available in the literature	7

(continued)

Table 1. (continued)

Instrument	Citation	No. of items, subscales	Time frame captured	Validity[a]	Reliability[b]	Responsiveness in longitudinal research[c]	Accessibility[d]	No. of studies that have used it
Attentional Function Index (AFI)	Cimprich et al. 2011 (63)	13 items	At the present time	Content, Construct, Criterion, Face[e] (63)	Internal consistency[e] (63)	Responsiveness to intervention (109)	Paper version available through publication[e] (63)	5
Behavioral Rating Inventory of Executive Function (BRIEF)	Roth et al. 2005 (64)	75 items, 9 subscales: inhibit, shift, emotional control, self-monitor, initiate, working memory, task monitor, organization of materials (64)	Ranges	Convergent[e] Discriminant[e] (65) Able to norm and standardize scores[e]	Internal consistency[e] (64) Test-retest reliability[e] (64)	No responsiveness to intervention (66)	Paper/Online administration and scoring available in Spanish proprietary[e]	5

[a]Informed by COSMIN taxonomy (https://www.cosmin.nl/tools/cosmin-taxonomy-measurement-properties/) considered content, face, criterion, and construct for the domain of validity. CRCI = cancer-related cognitive impairment.
[b]Informed by COSMIN taxonomy (https://www.cosmin.nl/tools/cosmin-taxonomy-measurement-properties/) and considered internal consistency, test retest, interrater, intrarater, and measurement area for reliability domain.
[c]Informed by COSMIN taxonomy (https://www.cosmin.nl/tools/cosmin-taxonomy-measurement-properties/) and considered change score reliability and responsiveness for intervention and/or longitudinal studies.
[d]Considered cost for using the instrument and the forms available (print, computer, computerized adaptive testing).
[e]Demonstrated as adequate in prior referenced studies.

studies. Finally, the reliability of the instrument is determined and the interpretability of the scores described (96).

PROMIS Cognitive Scales and FACT-Cog

The FACT-Cog was used by PROMIS developers to build a bank of items to assess perceived cognitive function (97). Two PROMIS measures are specific to cognitive functioning: measuring cognitive abilities and cognitive impairment. Conceptually, cognitive impairment and abilities differ, and psychometric analyses of both qualitative and quantitative data informed PROMIS developers' decision to keep both scales rather than merge or use only one of them for patient-reported cognitive-related symptoms (97).

These instruments are available in 4-, 6-, and 8-item short forms as well as proprietary CAT formats, which consist of a full item bank of 32 items for adult cognitive function and 31 for adult cognitive function abilities. There are also PROMIS cognitive function instruments for pediatric populations (Pediatric v1.0, Cognitive Function 7a) and parent proxies (Parent Proxy v1.1, Cognitive Function 7a), also in short-form and CAT formats. The PROMIS Cognitive Function Scale, measuring cognitive impairments occurring over the previous 7 days, has demonstrated construct and criterion validity in patients with chronic lymphocytic leukemia (98), brain tumors (99), head and neck cancer (100), and breast cancer (56, 101) and in survivors of chimeric antigen-receptor modified T-cell immunotherapy (102). This instrument was also validated in a large cohort study with more than 5000 individuals with cancer (prostate, breast, lung, cervical, uterine, colorectal, non-Hodgkin lymphoma) ages 21-84 years (103). The instrument has demonstrated high reliability (104) and has also demonstrated invariance across different race and ethnic, educational, age, and sex groups in more than 5000 cancer patients (105).

We mapped the PROMIS Cognitive Function Short Form 8a and PROMIS Cognitive Abilities Short Form 8a onto the FACT-Cog version 3 for side-by-side comparison. The FACT-Cog PCI subscale (20 items) and the PROMIS Cognitive Function Short Form 8a (8 items) share 7 items. The FACT-Cog PCI has an additional 14 items, and the PROMIS Cognitive Function Short Form 8a has 1 additional item. The FACT-Cog Perceived Cognitive Abilities (PCA) Subscale and the PROMIS Cognitive Abilities Short Form 8a have 8 items, and they share 5. The PROMIS Cognitive Abilities asks a more general question about memory function, and the FACT-Cog asks 3 specific memory impairment questions. The FACT-Cog PCA has 1 item about shifting attention, and the PROMIS Cognitive Abilities Scale has 2 additional items about thinking fast and thinking clearly. See Table 2 for item mapping.

Only a few studies of sr-CRCI have included both the FACT-Cog and PROMIS scales. Myers and colleagues (101) administered all 3 instruments in breast cancer survivors (n = 23) and healthy controls (n = 23). Statistically significant differences were found between survivors and healthy controls on the FACT-Cog-PCI, FACT-Cog-PCA, and PROMIS Cognitive Function but not the PROMIS Cognitive Abilities. In another intervention study (56), the same group also used all 3 instruments, with similar findings—differences on FACT-Cog-PCI, FACT-Cog-PCA, and PROMIS Cognitive Function, but not PROMIS Cognitive Abilities. Administering both the negative (PROMIS Cognitive Function) and positive (PROMIS Cognitive Abilities) scales may be advantageous in some studies, because they may capture different constructs (101).

Table 2. PROMIS Cognitive Function Short Form 8a and Cognitive Abilities Short Form 8a items mapped on the items from the FACT-Cog version 3 Perceived Cognitive Impairment (PCI) and Perceived Cognitive Abilities (PCA) subscales[a]

FACT-Cog PCI items (in the past 7 days)	PROMIS 8a cognitive function items (in the past 7 days)
I have had trouble forming thoughts.	I have had trouble forming thoughts.
My thinking has been slow.	My thinking has been slow.
I have had trouble concentrating.	I have had trouble concentrating.
I have had trouble finding my way to a familiar place.	—
I have had trouble remembering where I put things, like my keys or my wallet.	—
I have had trouble remembering new information, like phone numbers or simple instructions.	—
I have had trouble recalling the name of an object while talking to someone.	—
I have had trouble finding the right word(s) to express myself.	—
I have used the wrong word when I referred to an object.	—
I have had trouble saying what I mean in conversations with others.	—
I have walked into a room and forgotten what I meant to get or do there.	—
I have had to work really hard to pay attention or I would make a mistake.	I have had to work really hard to pay attention or I would make a mistake.
I have forgotten names of people soon after being introduced.	—
My reactions in everyday situations have been slow.	—
I have had to work harder than usual to keep track of what I was doing.	I have had to work harder than usual to keep track of what I was doing.
My thinking has been slower than usual.	It has seemed like my brain was not working as well as usual.[b]
I have had to work harder than usual to express myself clearly.	—
I have had to use written lists more often than usual so I would not forget things.	—
I have trouble keeping track of what I am doing if I am interrupted.	—
I have trouble shifting back and forth between different activities that require thinking.	I have had trouble shifting back and forth between different activities that require thinking.
	I have had trouble adding or subtracting numbers in my head.
FACT-Cog PCA items (in the past 7 days)	**PROMIS 8a cognitive abilities items (in the past 7 days)**
I have been able to concentrate.	I have been able to concentrate.
I have been able to bring to mind words that I wanted to use while talking to someone.	I have been able to remember things as easily as usual without extra effort.
I have been able to remember things, like where I left my keys or wallet.	
I have been able to remember to do things, like take medicine or buy something I needed.	
I am able to pay attention and keep track of what I am doing without extra effort.	I have been able to pay attention and keep track of what I am doing without extra effort.
My mind is as sharp as it has always been.	My mind has been as sharp as usual.
My memory is as good as it has always been.	My memory has been as good as usual.
I am able to shift back and forth between two activities that require thinking.	—
I am able to keep track of what I am doing, even if I am interrupted.	I have been able to keep track of what I am doing, even if I am interrupted.
	My thinking has been as fast as usual.
	I have been able to think clearly without extra effort.

[a]FACT-Cog = Functional Assessment of Cancer Therapy-Cognitive Function; PROMIS = Patient-Reported Outcome Measurement Information System.
[b]Not exact match, warrants psychometric validation.

Recommendation for PROMIS Cognitive Function Scale

Based on our appraisal of the psychometric properties (ie, validity, reliability, interpretability), accessibility (eg, free access, no proprietary restrictions), number of items and/or subscales, and scoring interpretations of the instruments in this review, we recommend, at a minimum, the use of the PROMIS Cognitive Function Scale in studies of sr-CRCI. The PROMIS scales have undergone extensive development and validation using item response theory to ensure brief instruments with high measurement quality. Studies of CRCI should include at a minimum the PROMIS Cognitive Function Short Form 8a for adults. This 8-item measure stems directly from the FACT-Cog, also with comprehensive development and validation (97), and has been used across cancer populations for many years (103). Such a brief instrument limits participants' burden and facilitates incorporation into established cognitive batteries or study questionnaires. Decreasing participants' burden is especially relevant for vulnerable populations such as metastatic cancer

patients, older adults, and patients with central nervous system cancers.

PROMIS Cognitive Function can be scored with large data collection platforms such as RedCap, Assessment Center, and Epic (https://www.healthmeasures.net/explore-measurement-systems/promis/obtain-administer-measures). The interpretability of PROMIS Cognitive Function is strong—item scoring is straightforward and intuitive (no reverse scoring), and higher scores indicate worse symptoms (ie, impairment). PROMIS scales also enable T-score transformations for comparison of participants' scores with population norms. This feature facilitates comparisons across studies. The 8-item short form is free and easy to access via the PROMIS website and is available in other languages. CAT versions, representing the most recent advancements in patient-reported outcome measurement, are also available through a proprietary tablet-based application.

The major disadvantage of PROMIS Cognitive Function is that it measures global cognitive symptoms and does not comprehensively evaluate subdomains of cognition, unlike instruments such as the AFI or the BRIEF. We therefore strongly recommend including other measures of sr-CRCI, global or domain specific, depending on a study's purpose, aim(s), and/or design (ie, cross-sectional, longitudinal, interventional).

Discussion

Over the past 2 decades, research on CRCI has increased greatly, driven by clinical need. Recommendations have been published for neuropsychological testing (25), neuroimaging techniques (43), and preclinical research (106). However, there is no consensus, and there are no recommendations for how to best measure self-reports or patient-reported outcomes of cognition in cancer patients and/or survivors. In this study, as part of the Cancer Neuroscience Initiative, our working group has inventoried and evaluated instruments used across studies of sr-CRCI through December 2019, considered different cancer populations, and discussed advancements in patient-reported outcome measures. Based on psychometric quality and instrument availability, we recommend that studies of CRCI include, at a minimum, the PROMIS Cognitive Function Short Form 8a. Consistent use of the PROMIS Cognitive Function Short Form 8a would also facilitate meta-analysis and/or cross-study comparisons. Researchers should use additional self-report measures appropriate for their specific study designs and research questions.

It is possible, even likely, that the optimal patient-reported outcome measure(s) to assess cognitive function of cancer patients and survivors has yet to be developed. The continuum of cognitive function and of the negative impact of its loss is considerable. The ideal patient-reported outcome measure would allow accurate measurement across this continuum as well as high accuracy for detecting clinically relevant symptoms within individuals. Developing an instrument that is broad yet specific, not too long, and not burdensome presents a difficult challenge.

To date, the emphasis on objective measures is hindering the improvement of evidence-based practice for CRCI. Neuropsychological testing alone is not adequately capturing CRCI, and the conclusion that sr-CRCI represents mostly distress is likely erroneous and could delegitimize patient complaints. The task of researchers is to clarify and address the shortcomings of measurement approaches to support and validate patients' experience. The monitoring of patient-reported outcomes aligns with patient-centered care, and it can improve cancer patients' quality of life (107).

The underappreciation of cognitive patient-reported outcomes as evidence of CRCI is limiting clinical and investigative efforts. Cognitive problems among cancer survivors, first widely recognized because of patient reports in the early 1990s (108), continue to receive clinical attention because of patients' reports. Other cancer-related symptoms such as fatigue are assessed as patient-reported outcomes with valid, reliable measures. The same should apply to self-reports of CRCI. Harmonizing cognitive patient-reported outcomes is a step toward developing useful definitions to characterize CRCI and build an evidence base for meaningful clinical guidelines and interventions.

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Not Applicable.

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