

Review Article

Evaluation of executive functions and everyday life for people with severe mental illness: A systematic review

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1. Introduction

The National Institute of Mental Health (2019) defined severe mental illness (SMI) as “a mental, behavioral, or emotional disorder resulting in serious functional impairment, which substantially interferes with or limits one or more major life activities.” It is an umbrella term for chronic psychiatric disorders, such as schizophrenia and schizoaffective, delusional, major depressive, and bipolar disorders (Galletly and Rigby, 2013; Ramsey and Swarbrick, 2014). According to the *Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013)*, most individuals with schizophrenia and related diagnoses experience dysfunction in several areas of daily living, such as self-care, but these difficulties differ among individuals and according to illness severity. Changes in the mental health system (e.g., new services), as well as rehabilitation possibilities in the community (e.g., technological solutions), have expanded opportunities for the population of individuals with SMI. These changes now enable therapists to expand their evaluation plan for daily living activities and interpret more accurate findings out of it (James and Pitonyak, 2019).

The mental health literature typically uses the term *everyday life*, adding more specific terms, to address activities or tasks that individuals perform daily as part of their self-routines. Each term refers to a different set of activities and often includes domains such as leisure or social participation that elsewhere are considered independent domains (James and Pitonyak, 2019). In this review, we use the term *everyday life* to address activities that individuals perform regularly in the community.

Regarding everyday life, several performance predictors can be classified according to the International Classification of Functioning, Disability, and Health (ICF; World Health Organization, 2001) taxonomy, which aims to provide a unified and standard language and framework to describe health and health-related states. As Fig. 1 shows, the ICF taxonomy describes outcome measures, quality of life, or environmental factors with a common language among a wide range of health disciplines. In this review, the domains discussed relate to three ICF taxonomy components: The SMI domain relates to the health-condition component, everyday life to activities, and executive functions (EF) to body functions.

The EF are defined as higher-order mental functions required to perform complex and novel nonroutine tasks. These functions refer to a wide range of skills, including initiation, inhibition, working memory, and cognitive flexibility (Connor and Maeir, 2011; Togliola and Katz, 2018). Loewenstein and Acevedo (2010) stated that understanding the EFs of people with SMI through functional assessment of everyday life is an initial part of integrating information to establish treatment plans. Therefore, this review focuses on EFs and how they are measured while evaluating everyday life in the SMI population.

Previous review studies raised questions about some issues within the scope of the current review. Overdorp et al. (2016) systematically examined relationships between neuropsychological deficits and instrumental activities of daily living (IADL) for an aging population. They found both memory and EF to be associated with present IADL impairment and predictive of future decline in IADL (in 66.7% of the studies they reviewed). Cramm et al. (2013) conducted a scoping review to reveal the use of EF evaluation in occupational therapy treatment with varied populations. They referred to evaluation of EF components together with complex activities and stated that EF evaluation should be established as a dynamic analysis of performance in real-life contexts. Recently, Josman and Meyer (2019) conducted a scoping review to describe occupational therapy evaluation of EF within pediatric and youth populations. They highlighted the importance of choosing precise assessment tools to define intervention goals for each individual. In our review, we analyzed assessment tools according to Harvey et al.'s (2007) classification, which address the usefulness of performance-based measurements in clinical treatment of schizophrenia by five assessment types.

In this systematic review, we aim to capture characteristics of both everyday life and EF evaluation processes for people with SMI in international research across professions. We do this by reviewing articles that address the evaluation of both. Specifically, we examine: (a) EF components reflected in the evaluation of everyday life for clients with SMI; (b) primary everyday-life tasks that are examined as part of the evaluation process of clients with SMI; (c) assessment tools used for EF and everyday life; and (d) how EF and everyday life performance are used and examined in the evaluation process.

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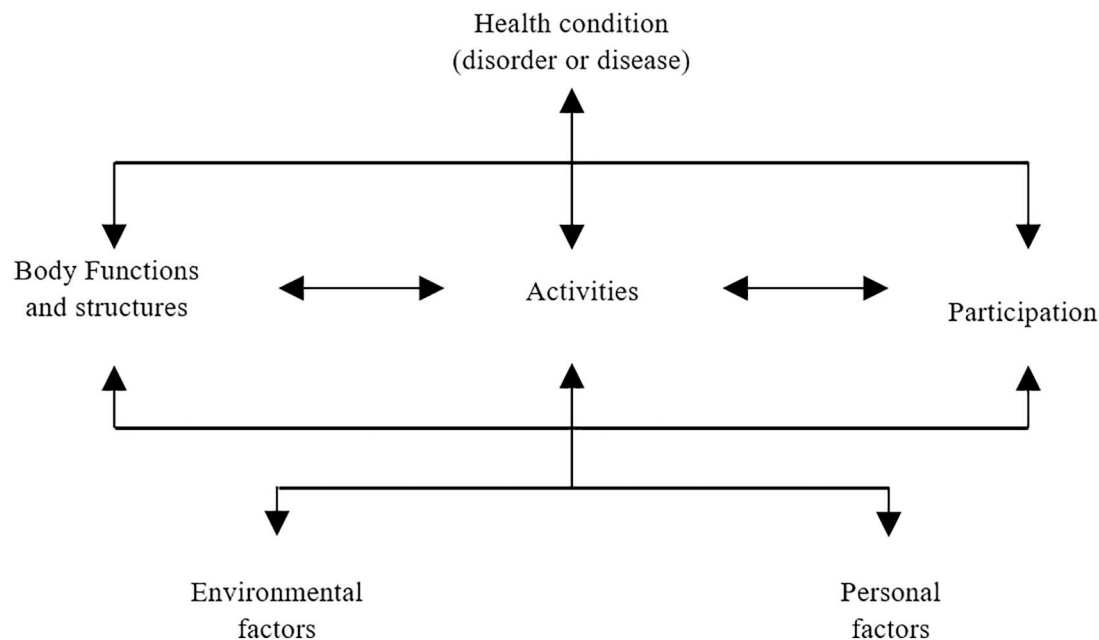


Fig. 1. International Classification of Functioning, Disability and Health (ICF).

2. Material and methods

2.1. Search strategy

The protocol and results reporting in this review are based on PRISMA recommendations for systematic reviews (Moher et al., 2009). The review protocol is registered with PROSPERO (CRD42018105538). Relevant searches were conducted in the following electronic bibliographic databases: PubMed, CINAHL, Cochrane Library, Web of Science, PsycINFO, EDS (EBSCO Discovery Service), OTDBASE, Scopus, and ProQuest for Dissertations and Theses. MeSH terms are used for PubMed, CINAHL, Cochrane Library, and PsycINFO (full search terms are available at https://www.crd.york.ac.uk/PROSPEROFILES/105538_STRATEGY_20180817.pdf). The search was last updated in February 2020 and authors contacted regarding possible duplication (e.g., thesis and article by the same author).

The search strategy terms related to population (SMI), functional domain (everyday life), and cognitive features (EF). Quantitative research articles were included. These studies examined cognitive and metacognitive evaluation that address EF as well as everyday life. Qualitative studies and non-English-language articles were excluded. Studies set in community and hospital environments were included.

We entered the results obtained from the search into the Covidence software program (Babineau, 2014). Two independent reviewers reviewed the articles by first scanning titles and abstracts and then assessing full-text copies of relevant articles. Disagreements between the reviewers about particular studies were resolved by discussion and involvement of a third review author when necessary.

2.2. Study eligibility

Eligibility criteria were specified using the population-intervention-comparison-outcomes approach. *Population* included adults with SMI, defined as schizophrenia and schizoaffective, major depressive, or bipolar disorders. People with other mental diagnoses, such as Alzheimer's disease or anxiety, and minors (under 18 years old) were excluded. Because the focus of this review is on evaluating assessment tools for both EF and everyday life, *interventions* were included only for their baseline evaluation, although treatment that did not include

specific attention to daily functioning was excluded. The *comparison* component included the population of people not diagnosed with SMI or evaluations not focused on everyday life. *Outcome* covered the evaluation process; that is, assessments that measured everyday life and EF were selected and addressed according to Harvey et al.'s (2007) five categories: global rating scales, self-report instruments, direct observation of behavior, informant reports, and performance-based measures of functional skills.

2.3. Data extraction

Two reviewers analyzed the following data to assess study quality and for evidence synthesis: authors, author disciplines, keywords, publication year, purpose (e.g., assessment, intervention), literature source (e.g., journal article, book chapter), population description, research setting and location, assessment tool, and key findings relating to EF and everyday life.

2.4. Quality assessment

Because this systematic review addressed the evaluation process, we based the quality assessment of bias risk on Hayden and Co's (2006) recommendations but modified according to our research questions. Those questions examined the domains of study participation, domain measured, and confounders for studies with two groups. The process of describing the risk of bias with these domains enabled us to label the evaluation process accurately (Fig. 2).

3. Results

3.1. Selected studies

A total of 15,808 articles were identified from the literature search once duplicates were removed. Two reviewers independently screened titles and abstracts and excluded articles that met the exclusion criteria as defined above, mainly because they used pharmacological interventions. Further exclusions were made for articles that addressed adolescent and child populations or focused on neurologic disorders such as dementia and Alzheimer's disease. The remaining 175 full-text

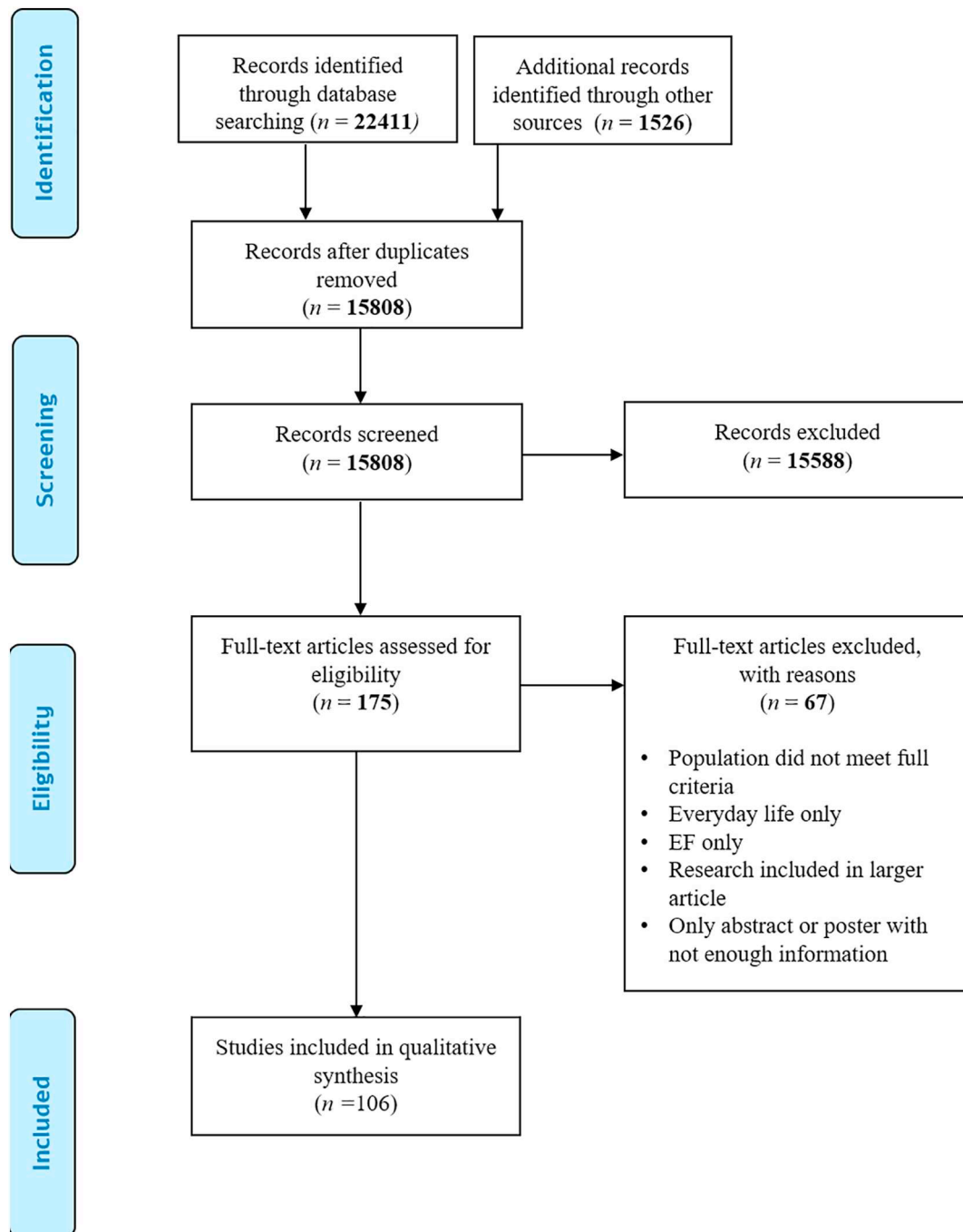


Fig. 2. PRISMA flow diagram for studies included in the systematic review.

articles were then reviewed for eligibility. Of them, 106 studies were confirmed as eligible for inclusion in this study (see [Appendix A](#) for full bibliography of included studies).

3.2. Study characteristics

Among the eligible articles, study designs included 14 randomized control trials, two nonrandomized trials, one case report; and 20 case-control, 23 cross-sectional, and 46 descriptive studies. Fifty-one studies were conducted in the United States, 21 in Europe, 10 in Canada, nine in Israel, nine in East Asia, four in Australia, and two in South America. Subjects were inpatients in 17 studies and both in- and outpatients in 12

studies. The majority (78) of studies were conducted on outpatient subjects. Most (55) addressed schizophrenia diagnoses; 31 added a schizoaffective diagnosis to schizophrenia. Thirteen articles examined affective diagnoses, and seven defined the population in general or as SMI. Studies ranged from sample sizes of nine to 921 (an Italian cross-sectional study conducted as part of the Italian Network for Research on Psychoses). Notably, other studies cited or reported on the same projects. For example, nine studies reported the U.S. National Institutes of Health-supported Validation of Everyday Real-Life Outcomes Project. All but one study (Bowie et al., 2012) included male and female participants. Fig. 3 depicts the different research fields among the studies and their sample sizes on a chronological timeline.

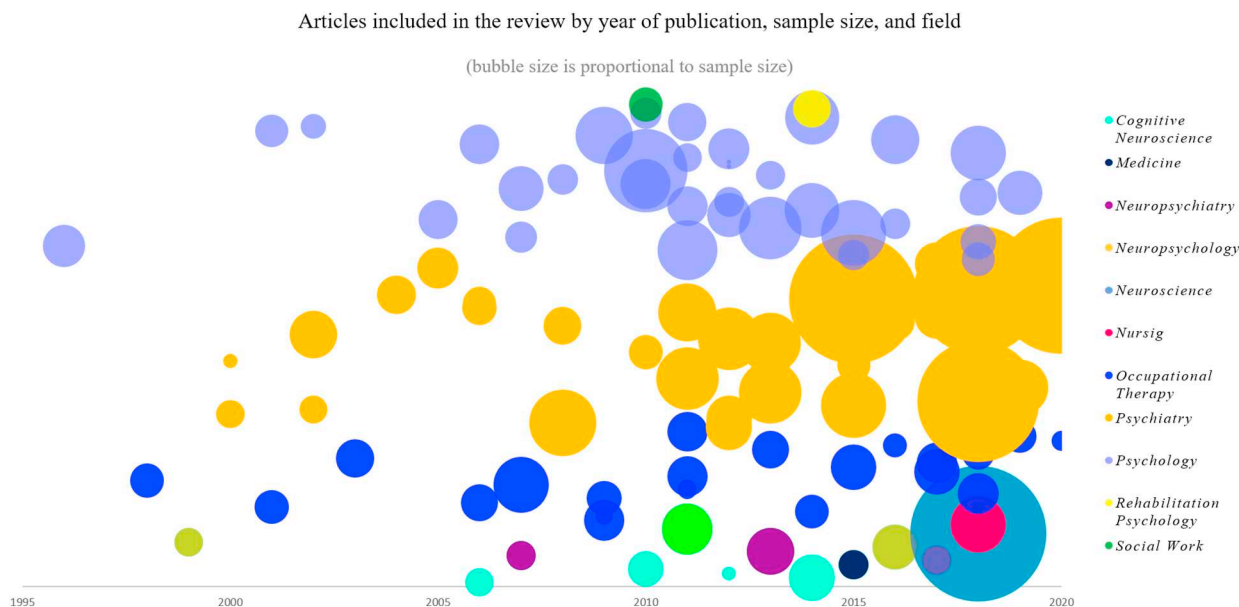


Fig. 3. Articles reviewed by year, sample size, and field.

3.3. Study quality

We evaluated risk of bias according to Hayden and Co's (2006) recommendations concerning participants, measurements, and confounders. For *study participation*, most studies declared their population and sample clearly. For *factor measurement*, we defined the strength of assessments according to their scope. Specifically, we rated an instrument's representation of a domain as 1 if it fully addressed the domain and 0.5 if the domain was only part of the outcome measure (see next section). For *EF*, we addressed assessment as a range measuring EF as a global score as opposed to EF-specific components, such as working memory, categorization, problem-solving, impulsivity, or planning. Thirty-seven studies measured EF with a global score (e.g., the MATRICS Consensus Cognitive Battery), and 69 reported specific EF-component scores (e.g., working memory). We considered instruments to be *everyday life* assessments if they were defined as measuring a specific activity, such as meal preparation, shopping, or driving. We found that 78 studies addressed everyday life as a separate component, whereas the rest measured it as part of a larger topic (e.g., everyday behavior, which included work status; Bowie et al., 2012). In sum, 55 studies examined both EF and everyday life in full scope. For *confounders*, 33 studies had a control group, and all reported and controlled the appropriate confounders.

3.4. Everyday life assessments

Table 1 lists the 64 assessment tools used to measure everyday life in the reviewed studies, sorted according to Harvey et al.'s (2007) five categories: 26 performance-based measures of everyday life (10 of which incorporated an EF index in the test), 18 self-report instruments, 11 informant reports, five direct observations of behavior, and four global rating scales. There were no dominant or typical instruments used in the studies. The most-frequently used instrument (41 studies) was the University of California San Diego Performance-Based Skills Assessment (UPSA) and its brief version, followed by the Global Assessment of Functioning in 12 studies. The remaining instruments were scattered within studies, with each tool used one to eight times. Some studies used multiple assessment tools to measure the same activity in different ways. For example, Rempfer and Fowler (2018) examined performance skills under both simulated and naturalistic conditions with the UPSA, Knowledge of Grocery Shopping Skills Test, and Test of

Grocery Shopping Skills. Other studies used everyday life assessments to understand the subject's global functioning in the community, usually by the subject or an informant completing a questionnaire (e.g., the Independent Living Skill Survey). Ten performance-based instruments scored EF performance as part of a test's index.

3.5. EF and component assessments

Table 2 identifies the 30 assessment tools that measured EF in the review studies. The table lists EF assessment tools and what each measured according to how it was presented in the study. In cases where the article did not provide explanation, we obtained the specific EF from the assessment tool's manual. Together, the tools assessed 19 features that covered a vast range of EF, including the key components of initiation, inhibition, working memory, and cognitive flexibility. Within the types of assessment tools, 23 were tabletop (i.e., a task carried out in a controlled environment), four were performance-based (i.e., involved performing the task in a naturalistic environment), and three were self-report questionnaires. Some tools, such as the Wisconsin Card Sorting Test, were applied as stand-alone tools to examine global EF components, whereas others, such as the Neurobehavioral Cognitive Status Examination, measured separate EF components within its subtests. Still other tests, such as the Behavioral Assessment of the Dysexecutive Syndrome, were included as a single type in one study and subsequently as subtests (e.g., the key search subtest) in another study.

3.6. Everyday life and EF assessments

Descriptions of the indices evaluated were not always consistent between the studies and the manuals for everyday life and EF assessment tools. In compiling both Tables 1 and 2, we included the assessment purpose as the manual described in cases where the purpose was either unclear in or conflicted with the article's stated purpose. The aim of most studies was broader than merely the relationships between EF and everyday life. Instead, they sought to understand quality-of-life measures, social participation, cognition, illness status, and so forth. Hence, the studies' outcomes were low or moderate in terms of our research question or they reached conclusions based on other hypotheses. For example, Knight and Baune (2018) found that EF and spatial cognition mediated issues in leisure time and reached a

Table 1
Everyday life assessment tools.

#	Assessment tool (# articles using tool)	Example article using the tool	Everyday life activity measured by assessment
Direct observation of behavior			
1	ADL script and task (1)	Godbout et al., 2007	Going to restaurant\doctor\hairdresser\wedding\cinema; shopping for groceries
2	Apparel purchase decision task (1)	Kim et al., 2019	Clothing shopping
3	Food preparation task (1)	Knight, 2000	Two food preparation activities: one simple (tuna sandwich); one complex (macaroni and cheese)
4	Kitchen behavioral video task with researcher-built script (1)	Semkovska et al., 2002	Cooking a meal
5	Three ADL tasks (1)	Semkovska et al., 2004	Choosing a menu, shopping for ingredients, cooking a meal
Global rating scales			
6	Global Assessment of Functioning (12)	Holt et al., 2011	Global functioning
7	Health of the Nation Scale (1)	Roberts, 2004	Global functioning
8	Reintegration to Normal Living Index (1)	Katz and Keren, 2011	Global functioning
9	Social and Occupational Functioning Scale (1)	Velligan et al., 2016	Global functioning
Informant			
10	Basic Everyday Living Skills (1)	Power et al., 2013	Basic living skills
11	Direct Assessment of Functional Status, revised (1)	Vizzotto et al., 2016	Skills for time orientation, communication, dealing with finances, shopping, grooming, eating
12	Disability Assessment Schedule (1)	Ojeda et al., 2012	Self-care management, social competence, vocational outcome, family contact
13	Independent Living Skill Survey, informant version (3)	Harvey et al., 2013	Completing everyday tasks within the last 30 days
14	Multnomah Community Abilities Scale (3)	Tan and King, 2013	Health, adaptation, social skills, behavior
15	Personal and Social Performance Scale (2)	Inchausti et al., 2018	Self-care, activities, relationships, behavior
16	Rehabilitation Evaluation Hall and Baker (1)	Takahashi et al., 2005	General behavior
17	Social Autonomy Scale (1)	Bulzacka et al., 2016	Personal hygiene, everyday life management, resource management, outside functioning, affective life/social interaction
18	Specific Levels of Functioning (14)	Bowie et al., 2008	Community activities, interpersonal skills, work skills
19	Strauss-Carpenter Levels of Functioning Scale (1)	Dickinson and Coursey, 2002	Hospitalization frequency, social contacts, employment and productive activities, symptomatology
20	Routine Assessment of Patient Progress (1)	Thornton et al., 2010	Daily functioning: socialization skills, leisure activities, budgeting skills, and social problem-solving
Performance-based			
21	Executive Functions Performance Test ^a (3)	Katz and Keren, 2011	Simple cooking, telephone use, medication management, bill payment
22	Assessment of Motor and Process Skills ^a (1)	Träger et al., 2017	Personal ADL (PADL) and IADL
23	Cognitive Screening for Medication Self-Management ^a (1)	Johnson, 1998	Medication self-management
24	Computerized Shopping Task (2)	Laloyaux et al., 2013	Shopping task
25	Driving simulator (1)	Miyata et al., 2018	Driving
26	Everyday Functioning Battery (1)	Harvey et al., 2011	Financial management
27	Familiarity with Meal Preparation Task questionnaire (2)	Aubin et al., 2014	Meal preparation
28	Independent Living Scales (3)	Tan and King, 2013	Memory/orientation, managing money, managing home and transportation, health and safety, social adjustment
29	Jentig50 Driving Simulator (1)	Fuermaier et al., 2019	Driving
30	Kitchen Task Assessment ^a (3)	Lipskaya-Velikovsky et al., 2015	Cooking task
31	Knowledge of Grocery Shopping Skills Test (1)	Rempfer and Fowler, 2018	Grocery shopping
32	Medication Management Ability Assessment (2)	Kurtz et al., 2007	Medication management
33	Multiple Errands Test ^a (1)	Bulzacka et al., 2016	Unpredictable situations and interpersonal interactions
34	Naturalistic Action Test (4)	Iampietro et al., 2012	(a) Preparing a slice of toast and a cup of coffee (b) wrapping a gift while (c) packing a lunchbox, and packing a schoolbag
35	Observed Tasks of Daily Living, revised (3)	Lipskaya-Velikovsky et al., 2017	Taking medications, using the telephone, managing finances
36	Perceive, Recall, Plan, and Perform system of task analysis ^a (3)	Aubin et al., 2014	Meal preparation
37	Performance Assessment of Self-Care Skills (1)	Gildengers et al., 2013	Money management: shopping, bill paying by check, checkbook balancing; medication management; current events: obtaining critical information from auditory and visual media; home maintenance: small repairs; environmental awareness: home safety; meal preparation: stovetop and sharp utensil use
38	Plan-a-Day ^a (1)	Holt et al., 2011	Day planning scenarios in a work setting
39	Test of Everyday Attention ^a (1)	O'Shea et al., 2010	Map search, elevator counting, visual elevator, telephone search, lottery
40	Test of Grocery Shopping Skills (6)	Zayat et al., 2011	Grocery shopping
41	UCSD Performance-Based Skills Assessment (20)	Holshausen et al., 2014	Planning, finance, communication, transportation, household skills
42	UCSD Performance-Based Skills Assessment, brief version (21)	Durand et al., 2015	Communication and finances
43	Virtual Action Planning-Supermarket ^a (2)	Josman et al., 2009	Shopping task
44	Virtual Reality Apartment Medication Management Assessment (1)	Kurtz et al., 2007	Medication management

(continued on next page)

Table 1 (continued)

#	Assessment tool (# articles using tool)	Example article using the tool	Everyday life activity measured by assessment
45	Virtual Reality Functional Capacity Assessment Test (2)	Harvey et al., 2019	Meal preparation, travel and transit, shopping, financial skills
46	Weekly Calendar Planning Assessment ^a (1)	Kaizerman-Dinerman et al., 2018	Scheduling meetings
Self-report instruments			
47	Activity Card Sort (2)	Katz and Keren, 2011	Percentage of activities an individual retained
48	Canadian occupational performance measure (1)	Kaizerman-Dinerman et al., 2018	Self-care, productivity, leisure
49	Daily Activity Report (1)	Velligan et al., 2016	Daily report of activities
50	Executive Personal Finance Scale (1)	Cheema et al., 2015	Financial management
51	Functioning Assessment Short Test (2)	Jiménez-López et al., 2018	Autonomy, occupational functioning, cognitive functioning, financial issues, interpersonal relationships, leisure time.
52	Independent Living Skill Survey, self-report (8)	Bryce et al., 2018	Completion of everyday tasks within the last 30 days
53	Independent Living Skills Inventory (2)	Keefe et al., 2006	Personal management, hygiene and grooming, clothing, basic skills (e.g., personal phone number), interpersonal skills, home maintenance, money management, cooking, resource utilization, general occupational skills, medication management
54	IADL questionnaire (1)	Hadas-Lidor et al., 2001	IADL
55	Life Skills Profile (2)	Keller and Hayes, 1998	Communication, nonturbulence, responsibility, self-care, social contact (six items; e.g., abuse of alcohol and drugs, taking offense readily, violence toward others)
56	Routine Task Inventory (2)	Katz and Keren, 2011	Basic ADL, IADL, communication, work readiness
57	Schizophrenia Objective Functioning Instrument (1)	Velligan et al., 2016	Living situation, instrumental skills, productivity, social functioning
58	Social Adjustment Scale-II (1)	Eack et al., 2010	Work affinity, primary/family relations in household, social functioning outside the home, interpersonal anguish, sexual relations, social leisure, self-care
59	Major Role Adjustment Inventory (1)	Eack et al., 2010	Vocational, social, household role functioning
60	Quality of Life Scale (1)	Gould et al., 2013	Vocational, social, everyday living skills
61	Social Functioning Scale (2)	Dickerson et al., 1996	Activation-engagement, interpersonal communication, ADL frequency; recreational and social activities, ADL competence, employment-occupational activity
62	Time Use Survey (1)	Reeder et al., 2017	Hours per week over the past month spent in employment, education, voluntary work, voluntary and structured leisure activities, housework and chores, childcare, sports and hobbies
63	Instrumental Activities of Daily Living (1)	Kim et al., 2020	Shopping, transportation, ability to handle finances, housekeeping, preparing food, ability to use a telephone, responsibility for own medication, recent memory, hobbies, watching television, and fixing things around the house
64	Satisfaction With Daily Occupations measure (1)	Holmfur et al., 2019	Domestic tasks and self-care occupations

Groupings: *Global rating scale* = rating tools scored by clinicians about the global function of the subject; *self-report instruments* = questionnaires, interviews, daily records, etc.; *informant* = caregiver, family member, personal therapist who rates the subject's routine and behavior in daily life; *performance-based measures of functional skills* = subject's capacity is measured while performing a standardized task; *direct observation of behavior* = subject performs a daily task and observer analyzes it.

See full reference list in [Appendix A](#).

^a Performance-based tools that examine both everyday life and EF; ADL = activities of daily living; IADL = instrumental ADL.

conclusion from this effect about psychosocial function.

4. Discussion

In this systematic review, we searched for information about both EF and everyday assessment tools that can help therapists choose the best tool in each person's varied life situations, in the scope of everyday life tasks. The focus on everyday life, especially for the SMI population, is crucial because there is a hidden gap between individuals' intelligence and knowledge and their actual performance. Understanding that EF are interrupted and no longer manage the unexpected or novel situations—and being able to identify the exact missing or less efficient function—may be the beginning of the work to establish meaningful and efficient strategies that will compensate toward full function. In the evaluation process, the clinician must conduct a clinical reasoning and decide which assessment tools would best capture the nature of the client's needs to reach the therapeutic goals. This process should be combined with evidence-based knowledge and professional experience.

For the SMI population, in which the range of difficulties is wide and reasons for dysfunction in routine are varied, it is essential to use the most compatible assessment tool to gather the information. For example, a self-report questionnaire about daily participation might lack information because of the patient's low self-esteem. The same tool and questions, answered together with a family member or therapist,

could brighten the picture and lead the therapist to detect meaningful and reasonable goals.

As presented in [Tables 1 and 2](#), many assessment tools currently are available for both EF and everyday life outcomes. They have progressed from measuring specific components, such as memory, to more comprehensive assessments that often use a test battery to comprehend functional cognition from several elements. Moreover, performance-based tools, which enable measuring everyday life in specific tasks, more likely include an EF index as part of the scoring. For example, the Virtual Action Planning-Supermarket ([Josman et al., 2009](#)) was developed to evaluate shopping skills, as well as the use of EF ([Josman and Regev, 2018](#)). Such tools hold many advantages. First, their ecological validity is high due to their naturalistic or close-to-real-world environments. Second, EF are more evident when they are impaired ([Connor and Maeir, 2011](#)) and, therefore, task performance is an effective method to observe the dysfunction. Assessment tools similar to the Test of Grocery Shopping Skills have the potential to measure EF ([Zayat et al., 2011](#)) but do not have standardized and specific scoring. It would be efficient to upgrade these assessment tools for use as both everyday life and as EF measurements.

Screening the assessments with understanding of SMI properties, it became noticeable that most researchers either chose short versions of the tools or shortened the tools to address the subjects' attentional capacities, as well as a combination of the tools. Using more than one

Table 2
Executive function (EF) assessment tools classification.

#	EF assessment tool (# articles using tool)	EF measured according to article or manual
Performance-based		
1	Behavioral Assessment of the Dysexecutive Syndrome, key search task, zoo map ^a (12)	Organization, planning
2	Kitchen Task Assessment (3)	Initiation, organization, sequencing, judgment
3	Months Ordering Test of Working Memory (1)	Organization
4	Perceive, Recall, Plan, and Perform task analysis system (3)	Working memory, plan
Tabletop		
5	Stocking of Cambridge (1)	Plan, strategy
6	Allen Cognitive Level Test (2)	Cognitive level
7	Assessment of Time Management Skills (1)	Time management skills, organization and planning, and regulation of emotion
8	Brief Assessment of Cognition in SCZ ^a (6)	Reasoning, problem-solving, working memory
9	Brief Cognitive Assessment ^a (1)	Executive functioning
10	Cambridge Neuropsychological Test Automated Battery ^a (4)	Working memory, plan
11	Delis-Kaplan Executive Function System (4)	Executive functioning
12	Hayling Sentence Completion Test (2)	Inhibition
13	Letter Number Sequencing test (1)	Working memory
14	MATRICES Consensus Cognitive Battery (includes EF subtests: BACS, Category Fluency, Trail Making Test Part A, CPT-IP Working Memory, WMS-III, Mazes) ^a (23)	Problem-solving, working memory
15	Neurobehavioral Cognitive Status Examination (3)	Orientation, naming, judgment, comprehension
16	Penn Conditional Exclusion Test (1)	Problem-solving
17	Phonological fluency tests (6)	Initiation, inhibition
18	Porteus Mazes Test (2)	Plan
19	Rey Osterreith Complex Figure Test (6)	Organization, plan, working memory
20	Screen for Cognitive Impairment in Psychiatry ^a (1)	Working memory
21	Short Category Test (1)	Problem-solving
22	Stroop Interference Task (7)	Cognitive flexibility
23	Tower of London (5)	Executive functioning, plan, working memory, problem-solving
24	Trail Making Test (30)	Executive functioning
25	Wechsler Adult Intelligence Scale, various versions and parts (37)	Working memory
26	Wisconsin Card Sorting Test (28)	Reasoning, problem-solving, executive functioning
27	Working Memory N-Back Test (2)	Working memory
Self-report questionnaire		
28	Behavior Rating Inventory of Executive Function, adult version ^b (2)	Inhibition, shift, emotional control, self-monitor, initiation, working memory, plan/organize, task monitor, organize materials
29	Barratt Impulsiveness Scale (1)	Inhibition
30	Metacognitive Assessment Scale (2)	Metacognition

^a Battery.

^b Self-report and informant classifications.

evaluation method to provide related information (Rogers and Holm, 2016), such as a self-report and an informant questionnaire, enabled them to draw a more precise picture of the function—the combination considers both the objective presentation and the individual's subjective perception and self-efficacy.

In addition to evaluation methods, outcome measures have changed. In the past, independence was a main index; sometimes, safe behavior was measured. Now, indexes also can include difficulty, competency, importance, and patient satisfaction (Rogers and Holm, 2016). Performance-based assessments usually serve as everyday life assessments, although tool developers or later researchers often add an EF index as part of scoring some tests. The ability of these assessments to capture the naturalistic nature of functional EF use is strong. They can reveal the most about performance in real life and provide insight into the impact of EF on everyday-life task performance.

This study's categorization, evaluation, and presentation of current assessment tools has implications for both clinicians and researchers. Specifically, it assists them to choose the assessment tools that are most appropriate for their clients and study participants using evidence-based decisions about the lists provide in this study. They may search and compare instruments according to the categories and components each assessment tool explores. For example, for a meal preparation task in a performance-based method, the most studied assessment was the Perceive, Recall, Plan, and Perform system of task analysis.

4.1. Limitations and future research

The ambiguous concepts and varied research types noted within this

review limited our ability to group and reach conclusions from the extant relevant literature. However, we organized the data in a way that would be efficient for use in the evaluation process. Future studies might evaluate the accuracy of our findings by focusing the search strategy on a specific EF or everyday life task such as meal preparation. Nevertheless, the indefinite, as well as broader, search terms reached sources from multiple disciplines, enabling understanding of the phenomenon and enrichment of multi-disciplinary discussions on these issues.

4.2. Conclusion

In summary, this review contributes to the existing evidence-based knowledge regarding the evaluation process of EF and everyday life. For both domains, it identifies and organizes the assessment tools presently used in SMI research. Tracking assessment tool development over the last decades and classifying them by method will enable clinicians and researchers to make well-established decisions regarding which method and assessment tool best suits their interventions or answers their research questions. Future studies might use this information to expand interventions about these topics.

Contributors

SR wrote the manuscript as part of her doctoral research. She did the literature review and read the journal articles and selected the relevant articles for the review manuscript. Then, reviewed the articles together with HC, a research assistant. Co-author NJ supervised and

edited during the whole process. All authors contributed to and have approved the final manuscript.

Role of funding source

No official funding was provided to conduct this meta-analysis.

Declaration of competing interest

The authors have no conflicts of interest to report.

Acknowledgement

This article is part of the first author's fulfilments toward the PhD degree.

Appendix A. Bibliography of the 106 articles in the analysis

Allen, D.N., Bello, D.T., Thaler, N.S., 2015. Neurocognitive predictors of performance-based functional capacity in bipolar disorder. *J. Neuropsychol.* 9, 159–171. doi:10.1111/jnp.12042.

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