

Meaningfully Characterizing Cannabis Use for Research and Clinical Settings: A Comprehensive Review of Existing Measures and Proposed Future Directions

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ABSTRACT

Cannabis use is increasingly common. There is a need for validated tools to meaningfully assess recreational, medical, and disordered cannabis use in both research and clinical contexts. Cannabis assessments were considered against pre-determined inclusion criteria within a comprehensive review. Measures were categorized as either (i) evaluating use frequency or quantity, (ii) measuring symptoms of disordered use and withdrawal, or (iii) assessing use motives, effects, and perceptions. The applications and validations for each assessment are summarized. Finally, recommendations for refining of existing measures or development of new measures are presented. The literature review resulted in 289 publications that were reviewed in detail, yielding 21 assessments that met inclusion criteria. The applications of these assessments are described here, in addition to the information about the validation studies of each assessment. Based on the complication of these tools, 5 areas of potential development are highlighted to guide future research, including (i) sensitivity to the mode of cannabis administration as well as sensitivity to (ii) potency of cannabis products alongside frequency and quantity, (iii) unit equivalence, (iv) aligning clinical measures consistently with cannabis use disorder (CUD) diagnostic criteria, and (v) creating measures specific to medical users, their motives for use, and their perceptions of therapeutic benefits or side effects. Clinicians and researchers can pragmatically benefit from this summary of validated measures of cannabis use, and future work could improve the study of and clinical care for cannabis use and CUD by pursuing one or more key areas of development described here.

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INTRODUCTION

Cannabis Use and Assessment Challenges

The legal market for cannabis is rapidly expanding in the United States and internationally,¹ and the products are increasing in diversity and potency at a breakneck rate.² Cannabis research and the clinical significance of cannabis use is also growing. However, researchers and clinicians are unsure of what cannabis use assessments best suit their aims or whether those assessments have been sufficiently validated. Thus, there is an urgent need for a way to easily evaluate the reliability and applicability of cannabis use assessments in both research and clinical contexts.³

There are many unique challenges to assessing cannabis use. First, cannabis can be administered by multiple methods. For example, while alcohol is almost exclusively consumed as a liquid, cannabis can be smoked, vaporized, ingested in food products or by sublingual administration,

or applied topically. Cannabis is also easily mixed with other substances, such as smoked with tobacco or ingested with alcohol.

Second, there is little to no unit equivalence in cannabis measurement. Unit equivalence is the idea of quantitating some consistent component of a substance to meaningfully interpret use patterns, such as the quantity-frequency index unit “1 drink” in alcohol research.⁴ The National Institute for Drug Abuse has recently advised researchers to use 5 mg of tetrahydrocannabinol (THC) as a standard unit,⁵ but cannabis unit equivalence is complicated by the presence of non-THC compounds in cannabis that have differing effects, such as cannabidiol (CBD).

Third, there is inconsistency across current tools in whether they assess the quantity of cannabis consumed, frequency of cannabis consumption, or both. It is challenging to

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quantify regular use, the impact of longer-term use, the acute effects of legal market products, the potency of cannabis products, and the use of cannabinoids other than THC, such as CBD. While the current literature base does not indicate whether product potency is an important predictor of clinical outcomes, the high variability in potency should be studied further to help understand its impact.

Fourth, unlike alcohol and tobacco, cannabis is widely used medically and the field lacks validated assessments relating specifically to use in a medical context. This is important because there is evidence that those who use cannabis for medical purposes may differ from recreational users. For example, some recent work has found a higher risk of problematic cannabis use in dual recreational and medical users versus recreational-only or medical-only users, and others have found that medical users may be more likely to use different potencies or forms of cannabis, such as edibles.^{6,7} Additionally, most of the extant assessments capture only negative effects of use and poorly characterize potential therapeutic effects. New measures such as the Composite Cannabis Assessment Tool (CCAT) could meet this need once validity is established.⁸

Finally, the application of cannabis use disorder (CUD) diagnostic criteria as described in the Diagnostic Statistical Manual (DSM) has been inconsistently applied within measures of CUD. The dimensions of CUD were revised in the fifth revision of the DSM, wherein pathological use patterns are classified under themes of physiological adaptation, social impairment, risky behavior, and impaired control.⁹ The term “cannabis abuse” has also been removed, and the DSM-5 now recognizes cannabis withdrawal as its own diagnosis.¹⁰ Many screening tools do not conform to these updated criteria for CUD or cannabis withdrawal, and screening tools may be unidimensional, such as the Marijuana Craving Questionnaire¹¹ or the Cannabis Withdrawal Scale.¹²

Altogether, the expanding use of cannabis has precipitated the need for validated tools that can assess use behaviors across a broad range of product and administration types, for both medical and recreational users. The field would greatly benefit from the improvement of existing measures or the development of new measures that address the limitations described here, as well as a review

of the currently validated measures to aid researchers and clinicians in assessment selection. Thus, this paper has 2 major goals. First, to provide a comprehensive review of common validated measures currently in use, with the aim of improving access whenever an assessment related to cannabis is needed. Second, to provide a summary of possible future directions for the improvement of existing measures or the development of new approaches.

Methods

The assessments reviewed here were selected after an initial literature search between August and November of 2021 and an additional search within April and May of 2022. The search was conducted by authors RMW, JSE, and PXP. Inclusion criteria for this review indicated that a measure had to (i) be cannabis specific (not a global or mixed measure of substance use); (ii) have any published validation data using high-quality, widely accepted analytical approaches such as factor analysis, convergent validity testing with established measures, or predictive validity testing for the diagnosis of CUD; and (iii) be English language (the limitation of this will be discussed).

First, Google Scholar, Proquest, and PsychInfo were used to search for assessments that specifically addressed cannabis use, either alone or in the context of other substance use. The search criteria were as follows: ((cannabis) OR (marijuana)) AND ((assessment) OR (survey) OR (question) OR (test) OR (screen) OR (checklist) OR (measure) OR (scale)) AND ((new OR novel OR valid)). The search resulted in 8904 publications before removal of duplicates and 4219 after duplicate removal.

Second, these publications were then screened for titles that indicated a focus on cannabis or cannabis assessments, leaving 289 publications for more detailed abstract review. At this step, it was then determined if the assessment in question had any published validation data using the analytical methods described in the inclusion criteria. At the final step, all authors agreed on the final selection (there were no disputes).

The resultant 21 assessments are briefly described in terms of content and format, and information about their validity and reliability testing is included. Of note, the descriptions of each measure are intentionally brief, toward the goal of providing researchers with a helpful guide to comparing all 21 of the validated assessment options in a standardized way. Figure 1 provides a summarized reporting of the literature review.

These measures of cannabis use and misuse generally fall into 3 broad categories: (i) targeted assessments to quantify cannabis use frequency or quantity; (ii) symptom inventories that assess disordered cannabis use, craving, or withdrawal; and (iii) assessments of use motives, effects, and perceptions. Table 1 summarizes the descriptions provided below, including the citations for each major validation study that was conducted on each assessment.

MAIN POINTS

- There is a need for reliable and standardized tools to meaningfully assess cannabis use in research and clinical contexts.
- A comprehensive review of the most common validated instruments would be of great benefit to the field.
- A synthesis of existing approaches to improve the study of and clinical care for cannabis use and cannabis use disorder is proposed.

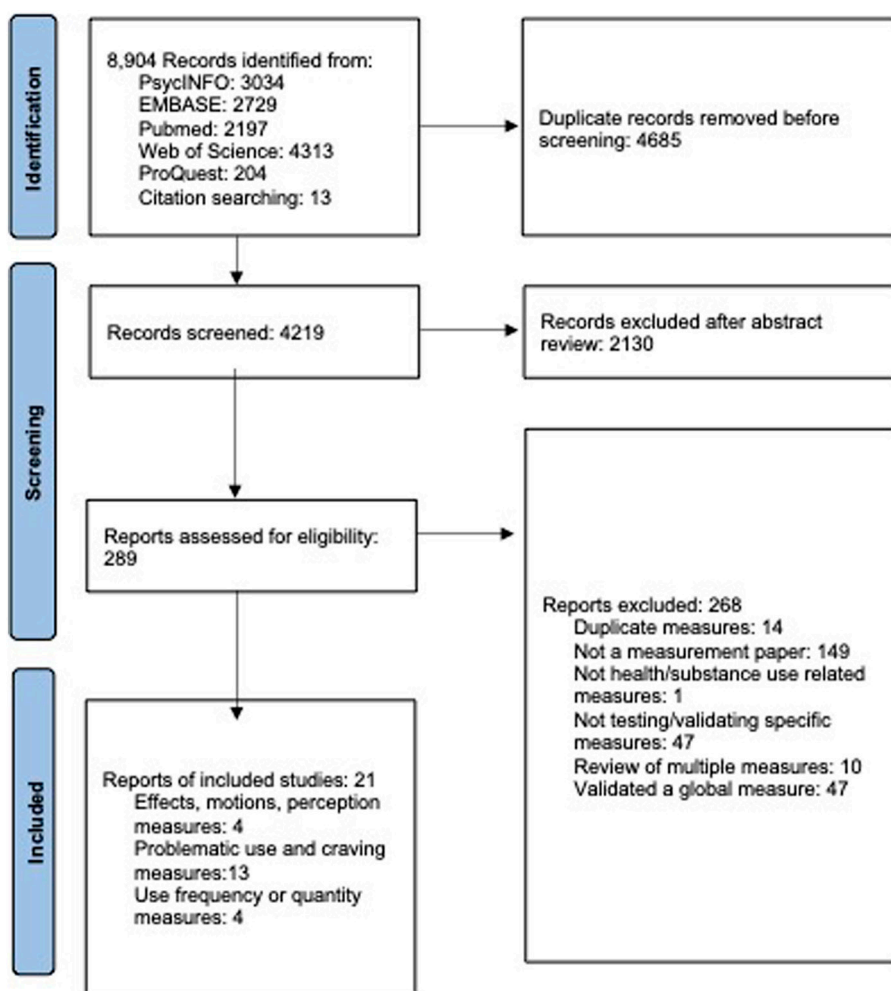


Figure 1. Flow of the study search and review process. Note: Citations for each major validation study associated with assessments are provided with assessment titles in the table.

Global Substance Use Assessments: Brief Overview

Though not the focus of this review, the approach of using more general global measures is extremely common, thus a brief discussion of these measures is warranted. Global substance use assessments take a broad approach to characterizing use and misuse across a range of substance classes. The benefit to this approach is the ability to characterize an individual’s substance use in the context of co-use and other personal factors. However, these assessments do not take a granular approach to each substance or may re-use prompts for different classes of substances. For example, the structured clinical interview for DSM-5 (SCID-5) assesses substance use across eight other categories including cannabis. Other measures such as the Composite International Diagnostic Interview (CIDI) modules,¹³ the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST),¹⁴ and the Adult Substance Use Survey (ASUS)/Adult Substance Use and Driving Survey (ASUDS)¹⁵ similarly take this approach. While some of these tools do have basic measures to quantify use, they focus primarily on disordered use. An interesting exception

to this are the Kreek-McHugh-Schluger-Kellogg (KMSK) scales that measure the maximal exposure to a variety of substances during times of highest use.¹⁶

Cannabis-Specific Assessments

Use Frequency or Quantity Questionnaires

Cannabis Assessment Tool: The Cannabis Assessment Tool (CAT-1) measures frequency and quantity of cannabis use across smoking, vaporization, concentrates, edibles, and topicals. The measure includes a corresponding quantity conversion table (e.g., 1 hit=0.05 g) to aid in creating a standardized “gram-month” outcome across smoked and vaporized use. The measure was validated among a sample of older adult male veterans for the past 30 days and lifetime use. The authors of the validation study noted that non-smoked forms of cannabis were underreported; thus, the reliability of those measures was not determined.¹⁷

Cannabis Engagement Assessment: The Cannabis Engagement Assessment (CEA) is a 30-item questionnaire that assesses cannabis flower, concentrate, and edible use

Table 1. Description of Cannabis-Specific Assessments

Name of Assessment	Number of Citations	Description/Purpose of Assessment
Use frequency or quantity questionnaires		
Timeline followback (TLFB) (cannabis specific) Original form for alcohol consumption (Sobell & Sobell, 1992) ¹⁹ Expansion to different substances (Robinson et al., 2014; ²⁰ Rueger et al., 2012 ²¹) O-TLFB and expansion to cannabis (Martin-Willett et al., 2020; ²² Norberg et al., 2012; ²³ Robinson et al., 2014 ²⁰)	4463 Citations	Uses a retrospective calendar, gathering information about frequency of use over time. Allows measurement of multiple substances. Can assess cannabis quantity across different routes of administration and product types. Some versions use pictorial guides to aid in selecting amounts.
Daily Sessions Frequency Age of Onset and Quantity of Cannabis Use Inventory (DFAQ-CU) (Cuttler & Spradlin, 2017) ²⁵	109 Citations	39-item measure of cannabis use frequency and quantity that incorporates age of first use. Includes pictorial guides and gathers some potency information. Items load into 6 factors including: edibles quantity, concentrates (high THC product) quantity, marijuana (smoked or vaped) quantity, daily sessions, frequency, and age of onset.
Cannabis Engagement Assessment (CEA) (Schluter & Hodgins, 2022) ¹⁸	973 Citations	30-item questionnaire assessing for past month use frequency and quantity of dried cannabis flower, concentrates, and edibles. Visual aids are provided, and questions ask about tools used for consumption (pipes, joints, etc.) as well as THC concentration of products.
Cannabis Assessment Tool (CAT-1) (Kayhani et al., 2020) ¹⁷	1 Citation	Tool assessing for current (last 30 days) and lifetime smoking cannabis users.
Problematic use and craving		
Marijuana Craving Questionnaire (MCQ) (Heishman et al., 2001) ¹¹	709 Citations	Multi-dimensional measure of craving for cannabis use. 47 items are loaded onto 4 factors: purposefulness, expectancy, emotionality, and compulsiveness.
Cannabis Abuse Screening Test (CAST) (Legleye et al., 2007) ²⁶	614 Citations	Two-part, approximately 35-minute-long assessment that measures cannabis use frequency and quantity (along with alcohol, ecstasy, tobacco, and psychotropic drugs) among adolescents. Additionally, 6 measures quantify risk, with a maximum score of 6 and a general threshold of 1-2 for mild risk, 3 for moderate risk, and 4 and above indicating problematic use.
Cannabis Problems Questionnaire (CPQ) Created (Copeland et al., 2001) ²⁸ 22-item version (Copeland et al., 2005) ²⁹ Adolescent version (CPQ-A) (Martin et al., 2006) ³⁰ Short-form version of the CPQ-A (CPQ-A-S) (Proudfoot et al., 2010) ³¹	154 Citations	Originally a 53-item measure to assess problems related to cannabis use. A 22-item version was validated and found to load onto 3 factors: physical effects and relationships, mood and psychological effects, and social consequences of cannabis use. A 27-item adolescent version was found to load on 3 factors (physical impact, acute negative effects, and psychological/financial consequences). A 12-item one factor short form of the adolescent version was later created and validated.
Marijuana Adolescent Problem Inventory (MAPI) Also known as the Marijuana Problems Index or the Marijuana Problem Inventory Modified from the Rutgers Alcohol Problem Index (RAPI) (Johnson & White, 1989) ⁴¹	7 Citations	23-item scale modified from the Rutgers Alcohol Problem Index. Designed to assess for problematic cannabis use in adolescents. All 23 items were found to load onto a single factor.
Cannabis Use Disorders Identification Test Revised (CUDIT-R) Original CUDIT (Bradley et al., 1998) ³⁵ CUDIT-R (Adamson et al., 2010) ³⁶	610 Citations	Modified version of the original CUDIT, which was modeled after the Alcohol Use Disorders Identification Test (AUDIT). Validated in a sample of heavy alcohol users. Revised in 2010 to an 8-item scale that has proven superior to the original in a wide variety of samples in predicting problematic cannabis use.
Cannabis Use Problems Identification Test (CUPIT) (Bashford et al., 2010) ⁴⁰	178 Citations	16 items determined by principal component analysis to load on to 2 subscales discriminating between 3 symptom-based levels of cannabis use: non-problematic, risky and problematic. Follow up found baseline CUPIT still correlated with 12-month post-baseline cannabis use measures.
Cannabis Withdrawal Scale (CWS) (Allsop et al., 2011) ¹²	158 Citations	Unidimensional 19-item assessment developed to monitor for symptoms of withdrawal during treatment for CUD.
Marijuana Dependency Scale (MDS) (Stephens et al., 2000) ⁴⁴	430 Citations	11-items to capture dimensions of dependency in CUD according to Diagnostic Statistical Manual (DSM)-III-R criteria. Three or more endorsed items indicate dependence. Principal component analysis determined the scale to be unidimensional.

(Continued)

Table 1. Description of Cannabis-Specific Assessments (*Continued*)

Name of Assessment	Number of Citations	Description/Purpose of Assessment
Marijuana Problems Scale (MPS) Also known as the Cannabis-Associated Problems Questionnaire (CAPQ) Unvalidated 19-item version (Stephens et al., 2000) ⁴⁴ Validated 16-item lifetime version (MPS-L) (Hodgins & Stea, 2018) ⁴⁵ Validated 16-item version called the CAPQ (Altman et al., 2021b) ⁴⁸	1 Citation	19-item scale designed to assess for cannabisuse-related problems in social, legal, occupational, and psychological domains within the last 90 days. A 16-item lifetime use version (MPS-L) was found to load onto 2 factors based on severity (low severity and high severity). A separate 16-item lifetime use version (CAPQ) was found to load onto 4 factors: physical symptoms, reduced self-concept, interpersonal and finance problems, and diminished productivity.
Marijuana Screening Inventory (MSI-X) (Alexander, 2003) ⁴⁹	44 Citations	31-item scale screening for problematic use that was found to load onto 9 factors: job and interpersonal interference, frequent pattern of use, internal consequences, external consequences, memory and physical effects, under the influence, use to feel normal with interpersonal costs, sought help for use, and marijuana arrest.
Protective Behavioral Strategies for Marijuana Scale (PBSM) (Pederson et al., 2017) ⁵¹	97 Citations	A scale assessing behavioral strategies to mitigate harm related to cannabis use amongst young adults.
Marijuana ladder (ML) (Slavet et al., 2006) ⁶⁴	468 Citations	Tool measuring for motivation to change marijuana use among adolescents.
Cannabis Refusal Self-Efficacy Questionnaire (CRSEQ) (Young et al., 2012) ³³	57 Citations	28-item questionnaire assessing for an individual’s confidence or belief in their ability to resist and refuse smoking cannabis across a range of situations.
Effects, motives, and perceptions		
Cannabis Expectancy Questionnaire (CEQ) Unvalidated 60-item version (Young and Kavanagh, 1997) ⁵² Validated 45-item version (Connor et al., 2011) ⁵³ 44-item Cannabis Expectancy Questionnaire for Men who have Sex with Men (CEQ-MSM) (Mullens et al., 2010) ⁵⁴ 42-item Cannabis Experience Questionnaire for intoxication effects checklist (CEQ-I) (Quin et al., 2017)	92 Citations	A 60-item scale answered with 5-point Likert response options indicating how much the respondent agrees that smoking cannabis would have the relevant effect on them. A 42-item CEQ-I measures the frequency of euphoric and dysphoric experiences associated with <u>cannabis use</u> . Responses are rated on a 5-point scale
Marijuana Consequences Questionnaire (MACQ) (Simons et al., 2012) ⁵⁶ Spanish Marijuana Consequences Questionnaire (S-MACQ) (Pilatti and Bravo., 2022) ⁵⁸ 21-item brief version of MACQ (B-MACQ) (Simons et al., 2012) ⁵⁶	157 Citations	A 50-item dichotomous (yes/no) scale that assesses consequences following cannabis use within the past 6 months. Loads onto 8 factors: social-interpersonal consequences, impaired control, self-perception, self-care, risk behaviors, academic/ occupational consequences, physical dependence, and blackout use. A Spanish language version of the MACQ has also been developed and validated. A 21-item brief version (B-MACQ) loads onto a single factor measuring severity of use consequences.
Marijuana Effect Expectancies Questionnaire (MEEQ) (Schafer and Brown, 1991) ⁵⁹ 48-item adult version, validated on clinical sample (Galen and Henderson, 1999) ⁶⁰ 48-item dichotomous version validated on adolescents version (Aarons et al., 2001) ⁶¹ Six-item brief version of the MEEQ (Torrealday et al., 2008) ⁶³ 21-item medical version MEEQ-M (Weiss et al., 2023) ⁶³	253 Citations	57-item scale validated on non-clinical sample and found to load onto 6 factors: cognitive and behavioral impairment, relaxation and tension reduction, social and sexual facilitation, perceptual and cognitive enhancement, global negative effects, and craving and physical effects. A 48-item version scored on a 5-point Likert scale was later validated in an inpatient substance using sample. A 48-item dichotomous version was validated in an adolescent sample seeking substance use treatment. The original 6-factor structure was found in this sample. A 6-item brief form of the MEEQ was assessed in a sample of incarcerated youth with each of the 6 items representing one of the long-form factors. This version was found to have a 2-factor structure, with 3 items loading onto a positive marijuana expectancies factor and 3 onto a negative marijuana expectancies factor.
Marijuana Motive Measure (MMM) (Simons, Correia, Carey, & Borsari, 1998) ⁶⁵	358 Citations	25-item scale of cannabis use motives, spanning 5 factors: coping, conformity, enhancement, social motives, and personal expansion.

frequency and quantity within the preceding month.¹⁸ Visual aids of concentrate products are provided as are questions about apparatuses used, types of concentrates or edibles used, THC concentration, and strain name. Convergent validity was assessed and moderate correlations for frequency of use of flower and concentrates (but not edibles) were found between the

CEA and the Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory (DFAQ-CU; detailed below). The quantity of cannabis consumed was also weakly correlated between the measures. The CEA was found to strongly correlate to the Timeline Followback (TLFB; detailed later) in regard to both frequency and quantity of product use, and test-retest validity was

moderate. Thus, the CEA could be a briefer alternative to the TLFB.

Timeline Followback Assessments Modified for Cannabis: Timeline Followback Assessments were originally developed to evaluate alcohol consumption utilizing a retrospective calendar tool.¹⁹ The TLFB has since been modified to focus on other substances, including cannabis in multiple administration methods, THC and CBD potencies, and product types using pictorial guides.²⁰⁻²³ A meta-analysis of 29 papers in 2012 found the TLFB to be a valid measure of substance use overall.²⁴ Timeline Followback Assessments can be lengthy depending on usage patterns, and they do not address issues of unit equivalence across cannabis administration and product types.

Daily Sessions, Frequency, Age of Onset, and Quantity of Cannabis Use Inventory: The DFAQ-CU is a 39-item measure of cannabis use frequency and quantity that incorporates age of first use.²⁵ The DFAQ-CU includes THC potency and the use of pictorial guides. It does not address the potency for other cannabinoids such as CBD. Factor analysis demonstrated that items loaded into 6 factors including quantity of edibles, concentrates, and smoked or vaped cannabis, as well as number of daily sessions, frequency of use, and age of onset. The DFAQ-CU was shown to have strong predictive validity when analyzed against symptom measures such as the Cannabis Abuse Screening Test (CAST; detailed later) or the Cannabis Use Disorders Identification Test Revised (CUDIT-R; detailed later).

Problematic Use and Craving

Cannabis Abuse Screening Test: The CAST is a 2-part assessment that combines measures of frequency and quantity, co-use with other drugs, and risk for disordered use.²⁶ The CAST was developed for use among adolescents and young adults and was validated in an inpatient CUD sample.²⁷ Notably, the CAST was developed as part of a public health initiative in France and thus aligns more closely with International Classification of Diseases (ICD) criteria for disordered use than with DSM criteria.

Cannabis Problems Questionnaire: The Cannabis Problems Questionnaire (CPQ) is a scale of problematic cannabis used created by modifying the Alcohol Problems Questionnaire.²⁸ Originally a 53-item measure, the 22-item version was later validated.²⁹ Items were found to load onto 3 factors (physical effects and relationships, mood and psychological effects, and social consequences of cannabis use), and test-retest reliability was very high. It was also found to sensitively classify individuals with cannabis dependence based on DSM-IV CUD criteria. An adolescent version (CPQ-A) was later developed and validated,³⁰ as well as an adolescent-specific short form (the CPQ-A-S), and a Spanish version.^{31,32}

Cannabis Refusal Self-Efficacy Questionnaire: The Cannabis Refusal Self-Efficacy Questionnaire (CRSEQ) was developed to measure an individual's "situational confidence" in their ability to abstain from cannabis use. Factor analysis revealed that the 28-item scale loaded onto 3 factors, including social facilitation, opportunistic facilitation, and emotional relief. Among these factors, items loading to emotional relief were found to be most predictive of cannabis dependence.³³

Cannabis Use Disorders Identification Test Revised: The CUDIT is a modification of the widely known Alcohol Use Disorders Identification Test (AUDIT)³⁴ and was initially validated among a clinical sample of heavy alcohol users.³⁵ Subsequent research on the 10 items of the CUDIT suggested that some items, such as dealing with injury due to cannabis use, were found to be sub-optimal in community-based samples. Thus, the authors of the CUDIT revised the scale in 2010 to 8 items that have since performed better than the original.³⁶ The CUIDT-R has concurrent validity with DSM-5 criteria and discriminant validity among CUD severity categories,³⁷ though less so among veterans who use medicinal cannabis.³⁸ A 3-item short form (CUDIT-SF) was recently proposed as a screening tool but it requires further validation.³⁹

Cannabis Use Problems Identification Test: The 16 items on the CUPIT were determined by principal component analysis to load on to 2 subscales, with significant ability to discriminate between non-problematic, risky, and problematic cannabis use.⁴⁰ The validation study of the CUPIT included a follow-up that indicated baseline scores correlated with other cannabis use measures that were repeated 12 months later, suggesting that this assessment may be uniquely suited for longitudinal symptom measurement. The CUPIT was also validated among both adults and adolescents.

Cannabis Withdrawal Scale: The CWS, adapted from the marijuana withdrawal checklist, was developed to monitor symptoms of withdrawal during treatment for CUD and was validated among a sample of dependent users (N = 49). The CWS demonstrated strong psychometric properties in the validation study¹² and is widely used. Like the Marijuana Craving Questionnaire (MCQ; detailed later), the CWS is a unidimensional assessment of withdrawal.

Marijuana Adolescent Problem Inventory: Originally modified from the Rutgers Alcohol Problem Index (RAPI) and sometimes referred to as the Marijuana Problems Index or the Marijuana Problem Inventory, the Marijuana Adolescent Problem Inventory (MAPI) is a 23-item scale that assesses for problematic cannabis use in adolescent populations.⁴¹ The MAPI was validated in a large composite sample from substance abuse treatment studies in adolescents. In this validation, internal consistency was strong, test-retest validity was demonstrated, and all

23-items were found to load on to one factor.⁴² There is also evidence that MAPI scores are predictive of CUD diagnosis and days of cannabis use.

Marijuana Craving Questionnaire: The MCQ is a multi-dimensional measure of cannabis craving that was validated with a sample of current cannabis users.¹¹ It was determined by factor analysis that the 47 items in the scale loaded on to 4 factors of purposefulness, expectancy, emotionality, and compulsiveness. A 12-item short form version (MCQ-SF) was later developed and validated, loading on to the same 4 factors.⁴³

Marijuana Dependency Scale: The MDS is an 11-item scale that was designed to measure dimensions of cannabis dependency according to the DSM-III-R criteria for CUD.⁴⁴ The MDS was first developed for use in a study comparing treatment modalities for CUD. Diagnostic Statistical Manual criteria were directly converted into survey items, with tolerance and withdrawal both requiring 2 items each. Principal component analysis indicated a unidimensional structure and internal consistency was adequate at the time of development.

Marijuana Problems Scale: Also referred to as the Cannabis-Associated Problems Questionnaire (CAPQ), the Marijuana Problems Scale (MPS) is a 19-item questionnaire designed to assess social, legal, occupational, and psychological problems resulting from cannabis use within the last 90 days.⁴⁴ A lifetime version, the MPS-L, has also been validated,⁴⁵ but evidence for gender bias was later presented.^{45,46} Subsequently, the authors validated a 16-item form of the MPS/CAPQ in a sample of nearly 4000 users with evidence for a 4-factor structure (physical symptoms, reduced self-concept, interpersonal and finance problems, and diminished productivity).⁴⁷ This iteration demonstrated good test-retest reliability.

Marijuana Screening Inventory: This 31-item scale was validated and found to load onto 9 factors: job and interpersonal interference, frequent patterns of use, internal consequences, external consequences, memory and physical effects, under the influence, use to feel normal with interpersonal costs, sought help for use, and marijuana arrest.^{48,49} Cut-off scores have been proposed for high-risk individuals (6 or greater items endorsed), moderate-risk individuals (3-5 items endorsed), and low-risk individuals (less than 3 items endorsed).

Protective Behavioral Strategies for Marijuana Scale: The PBSM was developed to assess strategies users employ to mitigate risk when using cannabis products. The PBSM was validated in both a 36-item form and a 17-item short form. The current iterations of the PBSM were built upon a previous 50-item version developed by principal component analysis. They were found in the most recent work to correlate to each other as well and to be unbiased according to demographic factors such as dichotomously

measured race and ethnicity, gender, and the legal status of the state of residence of respondents.⁵⁰

Effects, Motives, and Perceptions

Cannabis Expectancy Questionnaire: The Cannabis Expectancy Questionnaire (CEQ) was originally a modified version of the Drinking Expectancy Questionnaire.⁵¹ The first validation study yielded a 45-item version loading onto 2 factors: positive and negative cannabis expectancy. Higher negative expectancies were found among those who met cannabis dependence criteria.⁵² A 44-item version of the CEQ (the CEQ-MSM) was validated among men who have sex with men wherein predictive and discriminative validity were established, test-retest reliability was good, and items loaded onto 6-factors: enhanced sexual experience, sexual negotiation, cognitive impairment, social and emotional facilitation, enhanced sexual desire, and social inhibition.⁵³ Exploratory factor analysis was also conducted on a 12-item sleep-related CEQ (SR-CEQ), finding a 2-factor model composed of positive and negative sleep-related cannabis expectancies.⁵⁴

Marijuana Consequences Questionnaire: Created by modifying the Young Adult Alcohol Consequences Questionnaire (YAACQ), the Marijuana Consequences Questionnaire (MACQ) is a 50-item scale that assesses cannabis use consequences in the past 6 months. It was found to load onto 8 factors, including social-interpersonal consequences, impaired control, self-perception, self-care, risk behaviors, academic/occupational consequences, physical dependence, and blackout use.⁵⁵ A 21-item brief version (B-MACQ) was also validated, loading onto a single factor measuring severity of consequences. Convergent validity was established between the MACQ and the B-MACQ as compared to the MAPI, and test-retest reliability was good for both measures. Further work with the B-MACQ indicated good measurement invariance across gender in an international sample⁵⁶ and a study using the CUDIT as a comparator determined gendered cut-off risk scores for males and females. A Spanish language version of the MACQ (S-MACQ) has also been developed and validated.⁵⁷

Marijuana Effect Expectancies Questionnaire: The Marijuana Effect Expectancies Questionnaire (MEEQ) was created following content analysis from structured interviews. Principal component analysis identified a 6-factor structure with good test-retest reliability, including cognitive and behavioral impairment, relaxation and tension reduction, social and sexual facilitation, perceptual and cognitive enhancement, global negative effects, and craving and physical effects.⁵⁸ A later 48-item Likert-scale version demonstrated an association between non-users and higher negative expectancies,⁵⁹ while a 48-item dichotomous version was found to have the same 6-factor structure and moderate-to-good test-retest validity.⁶⁰ A French-language validation demonstrated a

4-factor structure,⁶¹ and finally, a 6-item brief form of the MEEQ was assessed with each of the 6 items representing one of the long-form factors. This version was found to have a 2-factor structure, with 3 items loading on to positive expectancies and 3 on to negative expectancies.⁶² Finally, a medical version of the MEEQ has also been recently validated.⁶³

Marijuana Ladder: Rating scales and “ladders” assessing individual readiness to discontinue or reduce problematic substance use are well-established tools used clinically in concert with motivational interviewing (MI) therapy strategies. The ML was thus developed as a marijuana-specific version of the well-established contemplation ladder to gauge engagement with treatment for disordered marijuana use.⁶⁴ The authors of the development study found good predictive validity of the ML for both marijuana use and treatment engagement among incarcerated adolescents. It was thus proposed that the ML was a useful tool not only clinically but for researchers seeking a quick visual analog measure of treatment motivation.

Marijuana Motives Measure: This 25-item scale probes dimensions of cannabis use motives spanning 5 factors as determined by factor analysis: coping, conformity, enhancement, social motives, and personal expansion.⁶⁵ Predictive validity of past 30-day cannabis use was also established.⁶⁶

Discussion

This review details 21 validated tools for the assessment of cannabis use, demonstrating a broad range of utility in research and clinical settings. These measures have varied applicability to different contexts, groups, and research-focused or clinical goals. It is our hope that the summary of measures here serves to aid researchers and clinicians in study design and clinical practice, but there is also potential for the field to continue work in this area. For example, while individual factor analyses facilitate a better understanding of individual measures, they don't facilitate the field overall. Larger factor analyses across measures could move the field forward by identifying common facets of assessments that are consistently meaningful. There have been previous efforts in this area, such as a 2008 systematic review of 4 screening tools that found moderate to high internal consistency across measures, though the authors noted some of the tools lacked validity data.⁶⁷

Based on the various strengths and weaknesses of these validated assessments, the field would also benefit from continued work that (i) accounts more wholly for diverse modes of administration, (ii) examines potency of cannabis products alongside frequency and quantity, and (iii) employs unit equivalence across these many products. Additionally, (iv) most measures of CUD or misuse have been created many years before recent updates to the ICD

and DSM criteria for CUD, withdrawal, and craving, and there is an even greater need for measures that are (v) specific to medical users, their motives for use, and their perceptions of therapeutic benefits or side effects. A brief discussion of each of these areas of growth follows.

Sensitivity to Mode of Administration

Differing modes of administration are increasingly recognized as highly relevant to the assessment of cannabis use, yet among the scales described here, only the O-TLFB and the DFAQ-CU assess these. Current research suggests that administration mode is especially relevant for problematic cannabis use as people increasingly turn to alternative forms of cannabis at high concentrations of THC.⁶⁸ It has also been suggested that as more people turn to cannabis for medical reasons, those users are less likely to smoke cannabis.⁶⁹ The development of future measures or changes to existing measures should be sensitive to these unique trends in cannabis use.

Capturing Potency with Quantity and Frequency

Closely related to differing modes of administration, potency is also highly relevant to the study of cannabis use and the treatment of CUD. This issue is particularly salient in the case of cannabis concentrates that can contain THC potencies upwards of 90%⁶⁸ but is also important to consider in the context of medical use. Consider the theoretical example comparing 3 cannabis users: a weekly concentrate user, a weekly recreational smoker using a product at 35% THC, and a daily medical user of edibles with 2 mg of THC and 50 mg of CBD. Though the medical user would report the most frequent use on most traditional measures, the risk profile for that user is not necessarily elevated compared to the other 2 users. Nor could you assume that the weekly user who is smoking and the weekly concentrate user would have equivalent risk profiles for disordered use. Thus, future work will need to consider both frequency *and* potency to help understand their relationship to each other and to use behaviors. This could in turn inform the development of unit equivalence with real user data.

Unit Equivalence

If cannabis use assessments continue to increasingly incorporate the diversity of modes of cannabis administration and different THC and CBD potencies, the issue of addressing unit equivalence will become more urgent. As mentioned previously, this issue is just emerging in the literature, with early calls to standardize cannabis use with units of THC.⁵ This may prove to be the best path forward toward understanding risk, but it would not be applicable to quantifying other cannabinoids like CBD that the public is increasingly consuming. Unit equivalence may need to be developed for both THC and CBD, as well as separately across recreational and medical cannabis use

and for different routes of administration. The issue most certainly will deserve greater attention in the coming years.

Aligning Clinical Measures with Updated Diagnostic Criteria

There have been notable updates to the criteria defining CUD between the ICD, DSM-IV-TR, and the DSM-5. Briefly, substance use and substance dependence were collapsed into descriptions of adverse symptoms across acute and chronic use, and the term “cannabis abuse” was dropped in the DSM. Furthermore, the DSM-5 characterizes chronic abuse symptoms in terms of disordered behaviors, while acute symptoms primarily include withdrawal and intoxication and other secondary symptoms such as psychosis, delirium, or anxiety. However, as demonstrated in this review, most of the commonly used cannabis use assessments were developed prior to the revision of CUD criteria 2013. These revisions in diagnostic criteria reflect our evolving understanding of disordered cannabis use in the DSM and ICD, for example, in the case of distinguishing cannabis withdrawal among other acute and chronic symptoms.¹⁰ Thus, future work could revisit the common validated instruments that we already have to align them more closely with the current science of cannabis use and CUD.

Assessing Therapeutic Effects or Side Effects of Medical Cannabis Use

Research on medical use of cannabis has exploded in the last decade. In the current landscape, researchers and clinicians are either making use of motive- or effect-focused measures that do not address therapeutic benefits or side effects. Other tools like general quality-of-life measures are also used to try and understand outcomes related to cannabis use. However, this approach limits our ability to appropriately characterize outcomes related to medical use specifically. It may also serve to alienate medical users and inadvertently stigmatize or bias research on medical cannabis use by not explicitly investigating perceived positive benefits. While some recent work is moving toward the development of measures that assess the positive effects of use,⁸ health research is in desperate need of measures that are specific to medical use.

Strengths and Limitations

This is the first comprehensive review of validated cannabis use assessments to date, unique in its summary presentations of 21 commonly used and validated measures. As a result, it can be a valuable resource to researchers in designing cannabis studies as well as to clinicians assessing recreational or medical use. This review also has some notable limitations. For example, this review was not a systematic review or meta-analysis and the field would benefit from additional rigorous examination

of the psychometric properties of these various measures. Relatedly, while it was noted when an assessment was available in languages other than English, this review was not wholly inclusive across all languages. Future work would benefit the field by incorporating literature across multiple languages more systematically.

CONCLUSION

The rapidly expanding use of cannabis has precipitated the need for an accessible way to compare and select validated cannabis use measures. Many effective and useful tools have been described here that aid the field in understanding cannabis use patterns and risks. However, there are some inconsistencies as to the methods of validation, inconsistent or redundant naming and implementation of various measures, and a lack of recent updates or revisions. As the field continues to advance, the evaluation of measures more broadly, the use of standardized potency and administration sensitive measures, the development of standardized units, and measures of medical use will provide a shared language for research on cannabis use.

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