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REVIEW ARTICLE

# Assessment of cannabis use disorders: a systematic review of screening and diagnostic instruments

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**Background.** Cannabis use and misuse have become a public health problem. There is a need for reliable screening and assessment tools to identify harmful cannabis use at an early stage. We conducted a systematic review of published instruments used to screen and assess cannabis use disorders.

**Method.** We included papers published until January 2013 from seven different databases, following the PRISMA guidelines and a predetermined set of criteria for article selection. Only tools including a quantification of cannabis use and/or a measurement of the severity of dependence were considered.

**Results.** We identified 34 studies, of which 25 included instruments that met our inclusion criteria: 10 scales to assess cannabis use disorders, seven structured interviews, and eight tools to quantify cannabis use. Both cannabis and substance use scales showed good reliability and were validated in specific populations. Structured interviews were also reliable and showed good validity parameters. Common limitations were inadequate time-frames for screening, lack of brevity, undemonstrated validity for some populations (e.g. psychiatric patients, female gender, adolescents), and lack of relevant information that would enable routine use (e.g. risky use, regular users). Instruments to quantify consumption did not measure grams of the psychoactive compounds, which hampered comparability among different countries or regions where tetrahydrocannabinol concentrations may differ.

**Conclusions.** Current instruments available for assessing cannabis use disorders need to be further improved. A standard cannabis unit should be studied and existing instruments should be adapted to this standard unit in order to improve cannabis use assessment.

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**Key words:** Assessment, cannabis, instruments, screening, THC.

## Introduction

Cannabis is the most widely used illicit drug worldwide. It is conservatively estimated that cannabis has been used at least once (lifetime prevalence) by about 80.5 million Europeans; thus, almost one in four 15- to 64-year-olds have used cannabis. An estimated 23 million Europeans have used cannabis in the last year or, on average, 6.8% of all 15- to 64-year-olds. During the late 1990s and early 2000s, many European countries reported increases in cannabis use (European Monitoring Centre for Drugs and Drug Addiction, 2012). The potency of cannabis products is determined by their content of Δ−9-tetrahydrocannabinol (THC), the primary active constituent. Recent studies have shown that high-potency types have become increasingly available in the last decade (Mehmedic *et al.* 2010; Cascini *et al.* 2012).

Cannabis misuse has been associated with psychiatric, physical and social impairment. Its regular use can induce a range of acute and chronic mental health problems, such as psychosis, mania, anxiety, depression, neurocognitive and structural deficits, and dependence (Johns, 2001; Batalla *et al.* 2013); in addition, it is often a gateway to other illicit drugs (Hurd *et al.* 2014). Cannabis may also cause organic damage, such as chronic bronchitis, increased risk of

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pneumonia, poor respiratory function, increased risk of cancer, hypertension, cerebrovascular disease and ischemic heart disease (Hall, 2009). Finally, social impairment may lead to accidents, violence, school dropouts and job loss (Hall, 2009; Hall & Degenhardt, 2009).

Early detection of risky cannabis users may be highly relevant to avoid long-term cannabis-related problems. Early-stage intervention has been effective in the treatment of addiction disorders. For instance, brief intervention can reduce alcohol consumption in risky drinkers, with benefits remaining a year afterwards (Kaner *et al.* 2009). Counseling approaches, including group and individual sessions of cognitive behavioral therapy (CBT), might also be beneficial for the treatment of cannabis use disorders. Adding voucher-based incentives may enhance treatment when used in combination with other effective psychotherapeutic interventions (Denis *et al.* 2006).

The important characteristics that define the utility of early detection instruments include: reliability, validity, adaptability to different patterns of use, and applicability to daily practice. In addition, shortness, clarity, and usability in different settings and populations should facilitate implementation (Piontek *et al.* 2008; Tiet *et al.* 2008). Reliability describes the consistency of a measure and may be measured with internal consistency, test–retest reliability, or inter-rater reliability. Validity reflects how well a measure corresponds with the real world and may be expressed in terms of content validity [sensitivity, specificity, positive predictive values (PPV) and negative predictive values (NPV) as well as convergent or divergent validity]. There are many instruments to assess cannabis consumption and related problems, but there are no 'gold standard' tools for assessing cannabis use disorders. Some authors have warned about this emergent problem in research and clinical practice (Anderson *et al.* 2005; López-Pelayo *et al.* 2013). For instance, Conway *et al.* (2010) emphasized that the same problem occurred with all substances. In addition, registries of cannabis consumption use different definitions of a current cannabis user according to different frequency patterns.

Throughout the 1990s, the same limitations were described for the assessment of alcohol and tobacco use disorders. Alcohol assessment was improved by carrying out studies using a standard unit, while reviewing several tools for assessment. Nowadays, the standard drink unit (Gual *et al.* 1999; Kerr & Stockwell, 2012) and Alcohol Use Disorders Identification Test (AUDIT) (Reinert & Allen, 2007) are recognized as the most useful and reliable tools for assessing alcohol-related problems (Anderson *et al.* 2005). The AUDIT scale has a good internal consistency, test–retest reliability ($r = 0.86$), and validity (sensitivity 0.95–0.97 and specificity 0.78–0.85). Furthermore, it is helpful in daily practice because it is fast, clear, and can be applied to different settings, such as the emergency room or in primary health care. Several questions refer to patterns of alcohol use (number of standard drink units per day, number of heavy drinking days). Moreover, the AUDIT scale can distinguish hazardous, harmful, and dependence drinking patterns (Anderson *et al.* 2005). The Fagerstrom test (Fagerstrom & Schneider, 1989) and the smoking pack-years (Weintraub *et al.* 1985) have demonstrated the same usefulness for assessing tobacco problems.

In the present review, we conducted a systematic literature search to describe and evaluate the structured and validated instruments available for screening and assessing cannabis use and related-disorders.

## Method

Data for this systematic review were collected with an advanced document protocol in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Liberati *et al.* 2009; Urrutia & Bonfill, 2010). This protocol provides a checklist for reporting systematic reviews (Table 1).

### *Search strategy*

Electronic searches were performed using Medline (1950–January 2013), Web of Science (1900–January 2013), Journal Citation Reports (1997–January 2013), Science Direct (1823–January 2013), EBM Reviews-Cochrane Database of Systematic Reviews (2005–January 2013), EBM Reviews-ACP Journal Club (1991–January 2013), and EBM Reviews-Cochrane Central Register of Controlled Trials (1991–January 2013). A combination of the following key words were used: psychometric, instrument, scale, tool, assessment, timeframe, measure, DUF (drug use frequency), calendar method, timeline follow-back, quantify, standardized criteria, standard criteria, standard unit; cannabis, marijuana, marihuana, delta-9-tetrahydrocannabinol, THC (delta-9-tetrahydrocannabinol), cannabidiol, cannabinoids, hash, hash oil, and hashish. No language or design restriction was applied. All studies published up to January 2013 were included. The references of selected papers were also screened for relevant articles, yielding 11 additional papers.

### *Selection criteria*

We initially performed a general overview of all assessments of cannabis misuse, which led to a total of 1451

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published papers (Fig. 1). The scales were only included if they were designed to: (1) quantify cannabis use; (2) screen and assess for cannabis misuse (abuse and/or dependence); and (3) quantify problems related to cannabis use: severity of dependence. The scales were excluded if: (1) they were recommendations of international organizations or population survey instruments; (2) laboratory or neuroimaging techniques, and (3) lacked information about the psychometric properties.

### *Data extraction*

Data were extracted by two reviewers (H.-L.P. and A. B.). We asked the opinion of a senior researcher (A.G.) when papers were questionable. From the articles included, the following data were recorded: authorship, year of publication, population target (e.g. adolescents), number and type of questions, time-frame, aim of the instrument, as well as reliability and validity parameters (internal consistency, test–retest reliability, inter-rater reliability, sensitivity, specificity, PPV, NPV, 'gold standard', cut-off, correlations with other instruments).

## Results

From the 1449 studies identified, 1244 did not meet the *a priori* selection criteria and 173 met the exclusion criteria (Fig. 1). The 25 instruments included in the review were classified as: (*a*) specific scales for assessing cannabis use disorders; (*b*) scales for assessing drug use disorders; (*c*) structured interviews; and (*d*) instruments for quantifying cannabis use. Detailed information on all scales is presented in online Supplementary Table S1 and Table 2.

### *Specific scales for assessing cannabis use disorders*

We identified six scales specifically designed to assess cannabis use disorders. Psychometric details are provided in online Supplementary Table S1.

#### *Cannabis Problems Questionnaire (CPQ)*

The CPQ is a scale adapted from the Alcohol Problems Questionnaire, designed for screening cannabis abuse and dependence (Copeland *et al.* 2005; Martin *et al.* 2006; Lavender *et al.* 2008; Proudfoot *et al.* 2010; Fernandez-Artamendi *et al.* 2012*b*). It has been validated for adolescents (14–20 years old) and adult populations. The CPQ and Adolescent CPQ (CPQ-A) showed greater validity when the 'gold standard' was Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV criteria, but sensitivity was lost when compared with a measure of consumption such as 'daily use'. The CPQ-A-S (short form) had good validity compared with DSM-IV criteria and there was significant correlation with heavy cannabis use. The S-CAP had good correlation with indices of cannabis use, but no data about sensitivity or specificity were available.

#### *Cannabis Abuse Screening Test (CAST)*

The CAST was designed for screening problematic cannabis use. The CAST was tested in young adult (18–25 years old) users in the last month (Fernandez-Artamendi *et al.* 2012*b*), adolescent and young adult (16–20 years old) regular users (at least 12 times in the past 12 months) (Cuenca-Royo *et al.* 2012), and in French Army adults (Gheorghiev *et al.* 2009; Marimoutou *et al.* 2010). It showed good content validity when the 'gold standard' was DSM-IV criteria or urine sampling.

#### *Cannabis Use Disorder Identification Test (CUDIT)*

The CUDIT screens for current cannabis use disorders (dependence/abuse) and was constructed from the AUDIT. It was tested in adolescents and young adults who were regular users (defined by once in the past 6 months) (Annaheim *et al.* 2008) and adult cannabis users who reported cannabis use in the past 3 months (Thake & Davis, 2011). The CUDIT-Revised was tested in adults taking part in a clinic trial of CBT for depression and substance misuse (Adamson *et al.* 2010). The CUDIT had high validity when the 'gold standard' was the Structured Clinical Interview for DSM-IV (SCID), but it was lower when the 'gold standard' was related to the consequences of cannabis such as driving after cannabis use, use of other illicit drugs, harm after past use, smoking at work or school, depressive symptoms, smoking to cope, or self-perception. The best validity data was for the CUDIT-Revised when the 'gold standard' was the SCID.

#### *Marijuana Screening Inventory (MSI-X), Marijuana Problem Scale (MPS) and Risk and Consequences Questionnaire-Marijuana (RCQ-M)*

The MSI-X was designed for screening problematic cannabis use (Alexander & Leung, 2006). It was studied in adults referred to specialized addiction treatment. This study only provided data on validity through correlation with other scales. However, the authors referred to a previous study in clinical and community samples that reported data on validity and reliability. The MSI-X had high content validity and convergent validity with other scales in patients referred to specialized treatment.

The MPS is used to measure recent cannabis-related problems (Jungerman & Laranjeira, 2008). It was

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**Table 1.** *PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) checklist*[a]

| Section | No. | Checklist item | Reported on page no. |
|---|---|---|---|
| Title | | | |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both | 1 |
| Abstract | | | |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number | 3 |
| Introduction | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known | 4–5 |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to PICOS | 5 |
| Methods | | | |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g. web address), and, if available, provide registration information including registration number | 6 |
| Eligibility criteria | 6 | Specify study characteristics (e.g. PICOS, length of follow-up) and report characteristics (e.g. years considered, language, publication status) used as criteria for eligibility, giving rationale | 6 |
| Information sources | 7 | Describe all information sources (e.g. databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched | 6 |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated | 6 |
| Study selection | 9 | State the process for selecting studies (i.e. screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis) | 6 |
| Data collection process | 10 | Describe method of data extraction from reports (e.g. piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators | 6 |
| Data items | 11 | List and define all variables for which data were sought (e.g. PICOS, funding sources) and any assumptions and simplifications made | 7 |
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis | – |
| Summary measures | 13 | State the principal summary measures (e.g. risk ratio, difference in means) | 7 |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g. $I^2$) for each meta-analysis | – |
| Risk of bias across studies | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g. publication bias, selective reporting within studies) | – |
| Additional analyses | 16 | Describe methods of additional analyses (e.g. sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified | – |
| Results | | | |
| Study selection | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram | 8–16 |
| Study characteristics | 18 | For each study, present characteristics for which data were extracted (e.g. study size, PICOS, follow-up period) and provide the citations | 8–16 |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12) | – |

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**Table 1** (*cont.*)

| Section | No. | Checklist item | Reported on page no. |
|---|---|---|---|
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group; (b) effect estimates and confidence intervals, ideally with a forest plot | – |
| Synthesis of results | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency | – |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see item 15) | – |
| Additional analysis | 23 | Give results of additional analyses, if done (e.g. sensitivity or subgroup analyses, meta-regression; see item 16) | – |
| Discussion | | | |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g. healthcare providers, users, and policy makers) | 17 |
| Limitations | 25 | Discuss limitations at study and outcome level (e.g. risk of bias), and at review level (e.g. incomplete retrieval of identified research, reporting bias) | 18–19 |
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research | 17–19 |
| Funding | | | |
| Funding | 27 | Describe sources of funding for the systematic review and other support (e.g. supply of data); role of funders for the systematic review | 20 |

PICOS, Participants, Interventions, Comparisons, Outcomes, and Study Design.
[a] Adapted from Moher *et al.* (2009).

studied in adult marijuana users seeking treatment and showed high correlation with data about use patterns, such as the mean number of joints per day or percentage of days smoked.

The RCQ-M is an instrument to measure cannabis- or alcohol-related problems (Stein *et al.* 2010). The population studied was incarcerated adolescents. The RCQ-M short version had high internal consistency, but test–retest reliability was low and there were no data about sensitivity or specificity. In contrast, there was high convergent validity with measures of consumption (days used marijuana), dependence symptoms (Marijuana Dependence Symptoms Count), and social impairment (Conduct Disorder Symptom Count).

### *General scales to assess drug use disorders*

We found four scales designed to assess drug use disorders, including cannabis. Psychometric details are provided in Table 2.

#### *Severity Dependence Scale (SDS)*

The SDS assesses severity of dependence and may be used to screen abuse or dependence (Cuenca-Royo *et al.* 2012). It was tested in a sample of young adult regular cannabis users (18–25 years old). Regular use was defined by use at least 12 times in the past 12 months. The SDS has shown low sensitivity to diagnose cannabis dependence and low specificity to diagnose cannabis abuse. In contrast, it had high sensitivity to identify cannabis abuse patients and high specificity to confirm dependence. The DSM-IV criteria were always used as the 'gold standard'.

#### *Car, Relax, Alone, Forget, Friends, Trouble (CRAFFT)*

The CRAFFT is a brief screening instrument for adolescents, which assesses alcohol and other substance disorders. It was tested in secondary and post-secondary students (12–26 years old) using the Problem Oriented Screening Instrument for Teenagers (POSIT) or frequency patterns as the 'gold standard' (Karila *et al.* 2007). The CRAFFT showed high variability of validity parameters.

#### *Drug Use Disorder Identification Test (DUDIT)*

The DUDIT was adapted from the AUDIT. The DUDIT was tested for adult drug users and adult alcohol users (Voluse *et al.* 2012), adult HIV-infected patients (Kader *et al.* 2012) and adult drug users (Berman *et al.* 2005). The DUDIT showed high sensitivity and specificity

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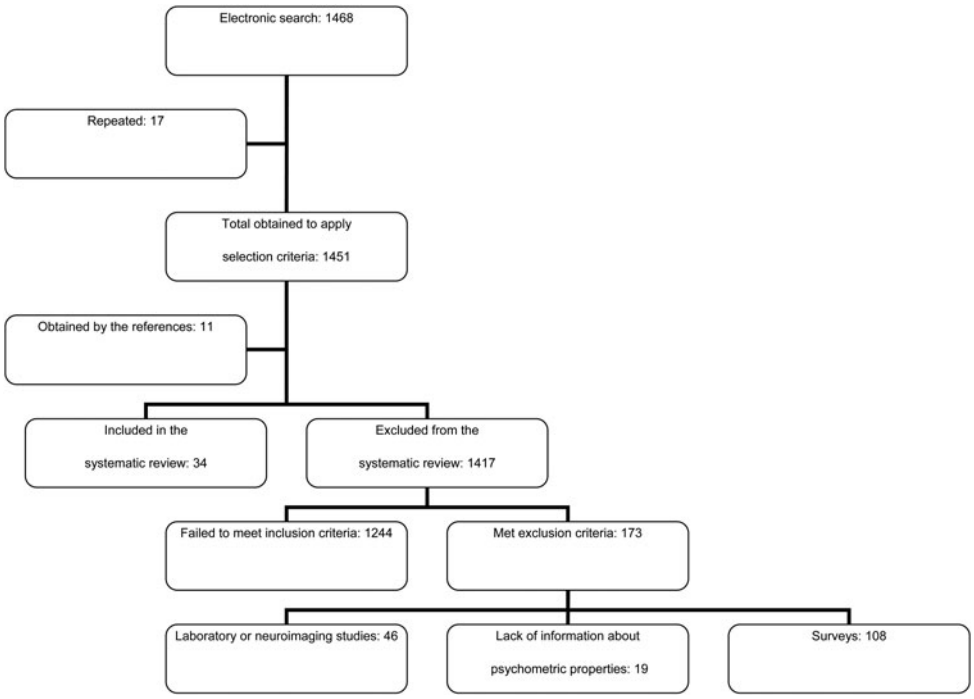


**Fig. 1.** PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart detailing study selection.

compared with the Drug Abuse Screening Test (DAST), DSM-IV or International Classification of Diseases (ICD)-10 criteria. Convergent validity with DAST-10 was also high. However, the cut-off was highly variable between studies with similar sensitivity and specificity, with values from eight in drug and alcohol users to 25 in in-patients of addiction centers.

*Alcohol, Smoking, and Substance Involvement Screening Test (ASSIST)*

The ASSIST was developed by the World Health Organization (WHO) to identify psychoactive substance use and related problems in a primary care setting. The ASSIST was tested in adults from general medicine service and addiction treatment centers (WHO ASSIST Working Group, 2002) and adult cannabis users (at least once in the past 90 days) (Thake & Davis, 2011). The ASSIST for cannabis showed high internal consistency, but quite low test–retest reliability. When compared with the Mini International Neuropsychiatric Interview (MINI) plus, it showed a wide range of validity. On the contrary, validity decreased when the instrument was compared with risky behaviors.

### *Structured interviews*

Of the structured interviews, seven included drug modules. Psychometric details are provided in online Supplementary Table S2.

*Adolescent and young adults*

*Minnesota Multiphasic Personality Inventory-Adolescent (MMPI-A).* The MMPI-A is a personality inventory, which includes subscales about drug and alcohol problems. Subscales focused on drug problems are 'alcohol/drug problem acknowledgment' (ACK) and 'alcohol/drug problem proneness' (PRO). MMPI-A subscales were tested in 123 incarcerated adolescents (Stein & Graham, 2001), and it had high sensitivity compared with other structured interviews and a cut-off of 55 points. Specificity improved with higher cut-offs (70), but sensitivity fell.

*Child and Adolescent Psychiatric Assessment (CAPA-C).* The CAPA-C is a diagnostic interview for children and adolescents to evaluate all psychiatric pathologies, including drug problems. It was studied in psychiatric patients aged 10–18 years (Angold & Costello, 1995). The CAPA-C had high internal consistency and test–retest validity, but it did not show validity parameters.

*Drug Use History Form (DUHF).* The DUHF is a structured interview that assesses 12 classes of drugs for use and problems. The DUHF was tested in adolescents and young adults (16–25 years) seeking treatment for drug use disorders (Martin *et al.* 1998). There were no data about validity.

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*Adult structured interviews*

*Psychiatric Research Interview for Substance and Mental Disorders (PRISM).* The PRISM is a structured interview developed for dual diagnosis of primary and secondary mental illnesses. The PRISM was tested in 105 substance abuse users in treatment centers (Torrens *et al.* 2004) and showed low convergent validity for cannabis use disorders. A significant correlation was only shown between the PRISM and LEAD (Longitudinal evaluation performed by an Expert, using All Data available) for past cannabis abuse.

*MINI.* The MINI is a diagnostic interview in accordance with DSM-III-R criteria. It is useful for substance and other psychiatric disorders. The MINI was tested in adult patients (Lecrubier *et al.* 1997), showing high validity compared with other structured interviews.

*Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS).* The AUDADIS is a structured diagnostic interview developed to use in the National Longitudinal Alcohol Epidemiologic Survey of the National Institute on Alcohol Abuse and Alcoholism. It includes several modules, including drug assessment. The AUDADIS showed high convergent validity compared with DSM or ICD criteria, but there was no content validity and validity data were not compared with pattern of use or cannabis-related problems other than abuse/dependence (Grant *et al.* 1995).

*SCID.* The SCID is a structured interview based on DSM-IV criteria used to diagnose mental illness including drug use disorders. The SCID was tested in 105 substance abuse users in treatment centers (Torrens *et al.* 2004) and showed low convergent validity.

### *Instruments to quantify cannabis use*

We found eight instruments designed to quantify cannabis use. Psychometric details are provided in online Supplementary Table S2.

*Timeline Follow-Back (TLFB)*

The TLFB is a measure used to collect detailed alcohol and other drug use information for clinical trials and clinical populations. The traditional TLFB involves a structured interview with the use of a calendar to allow participants to indicate the occasions when they used alcohol and/or other drugs over a particular time period. The TLFB can yield extensive information about patterns, frequencies and quantities of behavior. High reliability was demonstrated but no sensitivity or specificity data were found (Norberg *et al.* 2012; Pedersen *et al.* 2012).

*Other instruments*

The Cannabis Use Daily (CUD) is an instrument assessing only the daily use of cannabis. It was tested in adults who reported cannabis use in the past 3 months (Thake & Davis, 2011) and showed low sensitivity and high specificity when the 'gold standard' was social or individual harm.

The Paired Method is a type of instrument that attempts to reduce under-reporting of drug use by using the theory of a privileged access interviewer, in which trained students interview other students. Rodriguez *et al.* (2011) compared this method with self-reporting in a sample of 301 adolescents and showed earlier onset, more cigarettes per week, and a greater percentage of marijuana used in the past year and currently.

Barry *et al.* (1995) compared a screening question about drug use and related-problems with the DIS-R (brief diagnostic interview based on DSM-III-R criteria) in a sample of 253 patients with severe mental illness. They used questions to assess substance use in the last year, blackouts, the inability to stop, others' concerns about drinking, perception of a past problem, and perception of the present problem. They concluded that the best predictor of a client's present alcohol or drug problem was whether the case manager thought that the client had substance use problems at some time in his or her life (sensitivity = 0.86, specificity = 0.75).

Serre *et al.* (2012) studied the feasibility and validity of computerized ambulatory monitoring of daily life experiences and substance use (Daily Online Assessment). Their sample included 109 adults from out-patient treatment centers, with 21 being cannabis users. Participants were given electronic personal digital assistants (PDAs) to carry with them for 14 days, and each PDA was programmed to administer four electronic interviews per day. The correlation with the Addiction Severity Index was significantly positive for all drugs.

The Audio-Computer Assisted Self-Interview (ACASI) aims to increase substance use reporting. Colón *et al.* (2010) studied its validity in a household survey of 532 adults compared with urinalysis. In the ACASI, the questions are presented on the computer screen and read to the respondent through headphones. The sensitivity of responses for drug use during the last 3 days was 80.0% for marijuana (the 'gold standard' was urinalysis).

The Smoking Topography measures cannabis smoking behavior (volume of smoke, puff duration, puff velocity, and interval). It aims to measure cannabis smoking topography characteristics during periods of use *ad libitum* and to correlate topography assessments with measures of self-reported cannabis use,

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**Table 2.** *Scales for assessing drug use disorders*

| | Items | Time-frame | Aim | *n* | Sample | Internal consistency (Cronbach's α) | Test–retest reliability | Inter-rate reliability | Sensitivity/specificity (positive predictive value/ negative predictive value) compared with 'gold standard' (in bold) | Correlations with other instruments or other data (κ, Spearman or Pearson coefficient) |
|---|---|---|---|---|---|---|---|---|---|---|
| SDS (adapted for cannabis assessment). Cuenca-Royo *et al.* (2012) | 5 | 12 months | Severity/ screening | 241 | 18–25 years, regular cannabis users, use at least 12 times in last 12 months | 0.82 | ICC: 0.83 | N/A | **DSM-IV dependence:** 0.56/ 0.90 (cut-off: 7) | N/A |
| | | | | | | | | | **DSM-IV abuse:** 0.86/0.56 (cut-off: 3) | |
| CRAFFT. Karila *et al.* (2007) | 9 | 12 months or lifetime | Screening | 1 728 | Secondary and post-secondary school students. Age range: 12–26 years | N/A | N/A | N/A | **Cannabis regular use:** 0.49–0.99/0.52–0.95. Cannabis daily use: 0.77–1.00/0.49–0.94 **Problem Oriented Screening Instrument for Teenagers:** moderate risk: 0.21–0.86/0.69–1.00 Cut-off: 1–4 | N/A |
| DUDIT | 11 | 12 months | Screening | | | | | | | |
| Voluse *et al.* (2011) | | | | 153 | Drug and alcohol users | 0.94 | N/A | 0.71 | **DAST:** 0.90/0.85 (0.94/0.73). Cut-off: 8 | **DAST-10:** 0.85 ($p < 0.01$) |
| Kader *et al.* (2012) | | | | 30 | HIV-infected out-patients | N/A | N/A | N/A | **Biomarkers (hair/urine):** 0–1.0/0.66–0.7 (0–0.10/1.00) | |
| Berman *et al.* (2005) | | | | 160 | In-patients (addiction center) | 0.80 | N/A | N/A | **DSM-IV/ICD-10:** 0.90/0.78–0.88. Cut-off: 25 | |
| ASSIST | 12 | Lifetime or 3 months | Screening | | | | | | | |
| WHO ASSIST Working Group (2001) | | | | 236 | Volunteers (100 cannabis users) from general medicine services and addiction treatment center | 0.85 | κ (only for cannabis): 0.64 | N/A | **MINI plus:** 0.58–1.0/0.64–0.91 | N/A |

| | | | | |
|---|---|---|---|---|
| Thake *et al.* (2011) | 1 179 | ⩾18 cannabis users (past 3 months cannabis use) | 0.70 | **Driving after cannabis use at least once in past 12 months:** 0.54–0.86/0.52–0.78 (0.48–0.56/0.77–0.88). **Use of other illicit drugs in past 12 months:** 0.52–0.80/0.43–0.70 (0.31–0.37/0.82–0.87). **One harm from use in past 12 months:** 0.69–0.82/0.47–0.77 (0.20–0.33/0.94) |

SDS, Severity Dependence Scale; ICC, intra-class correlation; DSM, Diagnostic and Statistical Manual of Mental Disorders; N/A, not available; CRAFFT, Car, Relax, Alone, Forget, Friends, Trouble; DUDIT, Drug Use Disorder Identification Test; DAST, Drug Abuse Screening Test; ICD-10, International Classification of Diseases-10; ASSIST, Alcohol, Smoking, and Substance Involvement Screening Test; MINI, Mini International Neuropsychiatric Interview.

withdrawal and craving during abstinence, and cognitive task performance. A dose–effect relationship between cannabis consumption and relevant outcomes was described (McClure *et al.* 2012).

Lennox *et al.* (2006) proposed assessing substances by combining three self-reported (recentness, peak quantity, and frequency) and two biometric (urine and saliva) measures of different substances in regular users compared with six 'gold standards'. For marijuana use, the biomarkers generally did not correlate with other problems, while the psychometric measures did correlate.

## Discussion

We have identified 25 instruments to assess cannabis use and cannabis-related problems, which were classified in four groups: cannabis scales ($n = 6$), drug scales ($n = 4$), structured interviews ($n = 7$) and tools for quantifying cannabis use ($n = 8$). Even though most showed good psychometric properties, none can be considered a 'gold standard'. At the present time there are many instruments available to assess cannabis use and misuse, but they have limitations which restrict their use in daily practice. For instance, instruments usually are too long to be routinely used. This is a problem for all structured interviews and several scales for assessing only cannabis use. In fact, this is one of the reasons why structured interviews are mainly used in research or in specific situations, such as the differential diagnoses in specialized treatment (Tiet *et al.* 2008). Another limitation is the time-frame, which is often not appropriate; for example, short periods (usually under 12 months) are used in the CUDIT and CPQ (Tiet *et al.* 2008). Furthermore, scales are usually tested in cannabis or drug users; data are limited for psychiatric patients, different genders or different age ranges. Other studies have shown similar problems with the implementation of instruments in patients with mental illness (Piontek *et al.* 2008; Tiet *et al.* 2008).

On the other hand, the data available on validity are incomplete. In addition, the 'gold standard' is usually dependence or abuse criteria (Piontek *et al.* 2008; Conway *et al.* 2010). This focus of interest is important to validate a scale but it does not consider other users who may be relevant, such as risky cannabis users. Furthermore, validity decreases when 'gold standards' are the consequences of cannabis use or patterns of cannabis use.

The current instruments do not assess the organic consequences of cannabis or minimize the impact of the scale (Hall, 2009; Conway *et al.* 2010). Hazardous patterns of use are often not assessed. Only the CUDIT and DUDIT considered the different patterns

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of cannabis use but not frequency or amount (Berman *et al.* 2005; Annaheim *et al.* 2008; Adamson *et al.* 2010; Thake & Davis, 2011; Kader *et al.* 2012; Voluse *et al.* 2012). Therefore, it is confusing to use the concept of regular use and risky use as synonyms. In consequence, smoking one cigarette per day would correspond to the same level of risk as smoking 10 cigarettes per day. Daily users consume larger quantities of illegal drugs (Johnson & Golub, 2007). Recently, a strong correlation was reported between the frequency of use and quantity consumed per day of use, suggesting that consumption is more skewed toward the minority of heavy users and knowing the number of users cannot predict the prevalence of cannabis use. This report proposed to examine the frequency and amount used to understand the market and user behavior (Burns *et al.* 2013). The concept of regular use is unclear in different studies. Some authors consider regular use to be at least once a month; however, other studies consider it to be once every 3 months or daily use. The patients do not have the same risk of adverse effects when smoking one cigarette in 90 days as 10 cigarettes every day (Hall & Degenhardt, 2009). Thus, the amount and frequency of cannabis use are relevant to explore cannabis-related problems. Moreover, it is difficult to compare different instruments used in regular users to differentiate problematic and risky use.

Finally, instruments to quantify consumption are available, but they do not quantify grams of psychoactive substance per unit of consumption. It is difficult to generalize results because the concentration of THC may change according to the country, region, or type of users (European Monitoring Centre for Drugs and Drug Addiction, 2012). According to preliminary analyses from Arrestee Drug Abuse Monitoring (ADAM) data, there were no differences in the average size of cannabis unit consumption in the 2000s (Burns *et al.* 2013). Thus, a standard cannabis unit is feasible to improve measures of illegal drug use, according to previous studies (Johnson & Golub, 2007). Nowadays, the amounts contained in marijuana remain poorly documented (Johnson & Golub, 2007). However, there are serious efforts to improve strategies for obtaining details about cannabis consumption (Mariani *et al.* 2011). Limitations in this study were: a restricted sample population and a lack of psychoactive measures. Norberg *et al.* (2012) suggested combining a marijuana substitute (called 'marijuanilla') with the TLFB to reflect grams of cannabis use when assessing consumption. However, there were no attempts to measure the psychoactive substance.

The results presented here highlight some important methodological differences across studies, which limit generalization of the results. Inclusion criteria vary widely and there were few exclusion criteria. We found an enormous range of techniques and instruments for assessing cannabis consumption, which hampered comparisons between the different tools and comparisons with high levels of detail. Nevertheless, our findings did not conflict with the objectives of the systematic review, which was to expose the most methods available for assessing cannabis use, even if it was difficult to compare them. Another limitation was the lack of subgroup analysis; for example, we did not analyse population or gender differences among instruments.

Our review also had many positive features. To our knowledge, there has been no previous systematic review that included so many types of instruments for assessing cannabis use and misuse. Furthermore, our systematic review analysed instruments for assessing cannabis in different populations. We concluded that well-performed psychometric properties are not enough to implement effective early systematic identification.

Despite the limitations of the present review, the instruments with the best performance were the CAST, CUDIT, DUDIT and ASSIST. In fact, three of them (DUDIT, CUDIT and ASSIST) ask about cannabis use patterns in their initial questions. In conclusion, there are several instruments for assessing cannabis use in different populations but it is difficult to implement them because the frequency and amount of use are not recorded. According to the results of our systematic review, existing instruments should be used in populations where they have shown good psychometric properties and combined with new strategies, which focus on frequency and amount measurements, to improve early identification and intervention in target populations. This paper proposes to use similar methods of assessment as used for alcohol-related problems in the 1990s. Based on the results of the present review, we conclude that current instruments available for assessing cannabis use disorders need to be further improved. Future instruments for assessing risky cannabis use and cannabis use disorders should demonstrate good psychometric properties and be practical and clinically useful for practitioners. A useful drug screen needs to be brief and focus on current drug use disorders and problems using an appropriate time-frame. In addition, it should be validated in primary health care patients, psychiatric populations and adolescents. Finally, new instruments should consider cannabis potency, dose, patterns of use and health consequences. A standard cannabis unit might prove useful for future instruments in order to improve cannabis use assessment.

## Supplementary material

For supplementary material accompanying this paper visit http://dx.doi.org/10.1017/S0033291714002463

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## Declaration of Interest

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