Definition and Validity of the Construct “Problematic Khat Use”: A Systematic Review

Awoke Mihretu^{a, b} Clement Nhunzvi^c Abebaw Fekadu^{a, d, e, h} Sam Norton^f
Solomon Teferra^{a, g}

^aDepartment of Psychiatry, Addis Ababa University, College of Health Sciences, School of Medicine Addis Ababa, Addis Ababa, Ethiopia; ^bAmanuel Mental Specialized Hospital, Addis Ababa, Ethiopia; ^cDepartment of Rehabilitation, College of Health Sciences, University of Zimbabwe, Harare, Zimbabwe; ^dCentre for Innovative Drug Development and Therapeutic Trials for Africa (CDTAfrica), College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia; ^eGlobal Health and Infection Department, Brighton and Sussex Medical School, Brighton, UK; ^fHealth Psychology, Institute of Psychiatry Psychology and Neuroscience, King’s College London, London, UK; ^gHarvard T.H. Chan School of Public Health, Boston, MA, USA; ^hInstitute of Psychiatry, Psychology and Neuroscience, Centre for Affective Disorders, King’s College London, London, UK

Keywords

Khat use · Problematic khat use · Khat use disorder · Substance misuse · Systematic review

Abstract

Background: Problematic khat use, not khat use per se, is a public health and social concern for the public, researchers, and policy makers. However, the construct problematic khat use is not well-established and not fully recognized in the modern definition of substance use disorders including Diagnostic Statistical Manual (DSM-5) and international classification of diseases (ICD-10), although DSM-5 included it in the “stimulant use disorder” category. Existing scoping reviews have focused on khat use, which could not allow the differentiation of khat use from problematic khat use. Thus, the aim of this systematic review was to define and validate the construct problematic khat use. **Methods:** This systematic review was reported following the PRISMA guidelines. We searched all English language studies without publication date restriction from 5 databases; PubMed, EMBASE,

psychINFO, SocINDEX, and Google scholar. All studies that defined, explored, evaluated, or measured the construct problematic khat use were included. Adapted data extraction tool and criteria for quality evaluation were employed. We presented the results in tables and thematic synthesis of the major findings. **Result:** Overall, 30 qualitative and cross-sectional design studies were included. Associated harms with khat use, an increased amount used, increased frequency of use, and withdrawal experiences were indicators of problematic khat use. Using khat on an average of 3 or more times per week and using other psychoactive substances during and after khat use were frequently used to define problematic khat use. The most frequently reported withdrawal symptoms were depressed mood, irritability, fatigue, lack of motivation, increased sleep, and appetite. The existing measures (severity of dependence scale and DSM-5) of problematic khat use had psychometrically acceptable properties in terms of construct, criterion, and convergent validity, but they are poor in terms of other domains of validity including content, conceptual, and semantic validity. **Conclusion:** Problematic khat use constitutes, but is not lim-

ited to, harms, increased use over time, and frequent engagement in other psychoactive substances misuse. Khat use is different from problematic khat use since it is occasional and used for prayer, social, and functional reasons. Strong empirical studies that could establish thresholds for patterns of problematic khat use and a culturally suitable problematic khat use measures that follows a bottom-up approach of scale development are warranted.

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Introduction

Khat (*Catha edulis*) is a plant with psychoactive properties, and the leaves and shoots are chewed for this effect. Khat is considered a “natural amphetamine” containing amphetamine-like stimulant substances such as cathinone and cathine [1]. These 2 substances that are under international control, the main one being cathinone, but the plant khat is not [2]. In the past, khat use was exclusively embedded in culture and practiced as a social custom, among subgroups, especially in Ethiopia, Yemen, Somalia, and Kenya [3]. For example, elder Muslim men in certain ethnic groups or regions chewed khat for concentration during studying religious writings and to stay alert during night prayer. Recently, khat use became popular among other groups of people, and they used it to increase concentration and performance during trading, farming, academic activities, and for socialization and leisure activities [4]. Factional khat use could also include chewing khat to cope with traumatic experiences [5].

Estimates of prevalence range between about one-sixth and one-half of adults using khat, with variation across countries and groups within countries [2, 4, 6]. The studies reported male sex and Muslim religion as important associated factors of khat use. There were not only negative physical, psychiatric, and socioeconomic outcomes of khat use [7, 8] but also harms. Physical health impacts such as myocardial infarction and other cardiovascular disorders, hepatotoxicity, hypertension, upper gastrointestinal tract (gastritis, enteritis), hemorrhoids, and impaired male sexual function [2, 8, 9] were reported to be associated with khat use. Association between khat use and severe mental illness are controversial [10–12]. Studies reported association of heavy khat use with psychotic symptoms in Somalia and among Somali refugees in Kenya and Europe [10, 13, 14]. Among special populations such as individuals with PTSD experiences, the more khat consumption was significantly associated with paranoid ideation [5].

The reported relationship between socioeconomic issues and khat use was also contradictory. Khat users reported increased functioning and socialization, believed to be beneficial, and relationship problems between children and parents, and serious financial problems, as negative consequences [8, 15].

There has been a steady increase in the study of khat use, but not much work done on defining problematic khat use, only limited to a few attempts recently [16–18]. According to reports from Ethiopia, the prevalence of problematic khat use was estimated to be 20% in the general population [19] and 80% among khat users [20]. A study from the United Kingdom also showed 31% of dependency among khat users of Yemeni origin in the United Kingdom as measured by diagnostic criteria of the American Psychiatric Association Diagnostic Statistic Manual (DSM IV, 1994) [21]. Fifty one percent of khat users in Yemen [17] and 52.2% in Saud Arabia [22] were also estimated to use khat in a problematic pattern. In all these studies, psychological dependency was used as a chief marker of problematic khat use.

While risky/hazardous and problematic/harmful use are clearly defined for alcohol and cannabis [23–25], there is no official equivalent definition for problematic khat use. Although khat is one of the oldest psychoactive substances used by humans, little is known about which khat use pattern would lead to the above negative consequences. There are scoping and critical reviews on khat use and associated harms [8, 26], but there is a dearth of evidence on the definition and indicators of problematic khat use.

The existing reviews were not systematic, but important to generate a hypothesis that *problematic khat use is a valid construct*. The reviews [27] define “problematic khat use” as excessive use pattern that is associated to negative health consequences. We still need to establish threshold for excess use pattern and other (if any) additional criteria or domains of problematic khat use should be systematically reviewed. Systematically defining problematic khat use will help the development of public health prevention and clinical intervention guidelines. Therefore, the current systematic review aimed to define and validate the construct “problematic khat use” from the existing literature and whether further studies are needed to address the issue.

Methodology

Search Strategy

The search was conducted in all English language studies without publication date restriction till June 10, 2018. We included databases such as PubMed, EMBASE, PsychINFO, SocINDEX,

and Google scholar. The following search terms were used: (khat OR qat OR miraa OR jaad OR qaad OR kat OR Kafta OR ghat OR chat OR tschat OR “Abessinischer Tee” OR “Abyssinian Tea” OR “Somali Tea” OR “Arabian Tea” OR “natural Amphetamine” OR Catha [MeSH Terms]). A Google scholar search was performed using the term “khat.” We searched for title and abstract only, and backward searching of all included papers was also conducted to find additional relevant studies. Our systematic review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) on August 26, 2017, and was last updated on June 28, 2018 (registration number [CRD42017064183]).

Study Selection

Eligibility

Studies that defined, explored, evaluated, or measured the construct “problematic khat use” among human khat users were included. Studies reporting lifetime and current prevalence of khat use without indicating the problematic pattern of use were not included in this review, since khat use per se was not the concern of interest of the community, especially in countries where cultural use is common such as in Eastern Africa and Yemen [7, 28]. From previous review, many studies didn’t indicate the dose – effect relationship of khat use and harms especially on mental illness [29]. The current systematic review focused on studies that indicated dose – effect relationship of khat use and associated harms or studies with clear indication of problematic khat use.

All qualitative, quantitative, and mixed methods studies were included. The qualitative studies were helpful in understanding how and why khat chewing was considered or experienced as problematic. The quantitative studies were essential in defining problematic khat use and establishing its indicators. Studies on psychometric properties of assessment tools were also used to examine the validity of the construct “problematic khat use,” dimensionality, item wording, and thresholds. Studies that focused on pure cathinone alone were excluded because cathinone is a well-established drug of abuse, which is more harmful than the plant khat that carries low concentration of cathinone.

Study Selection and Data Extraction

The first 2 researchers independently screened the articles, did the data extraction, and risk of bias assessment. Emerging discrepancies were resolved collectively. Data were extracted using adapted data extraction tool [30, 31]. The major themes extracted were definitions, concepts, terminologies, indicators, prevalence, and associated factors of problematic khat use. From the psychometric studies, we extracted any reliability and validity characteristics, thresholds, name of the tool, and participants.

Assessment of Risk of Bias and Quality of the Studies

We used Terwee et al. [32] criteria to assess the quality of psychometric studies. The quality assessment tool focuses on 9 major areas of psychometric properties [32]. The instrument includes content validity, internal consistency, criterion validity, construct validity, agreement, reliability, responsiveness, floor and ceiling effect, and interpretability. The authors assigned measures a positive (+), intermediate (?), negative (–) rating, or a rating of (0) when there was no information regarding the relevant criteria. For the cross-sectional survey and qualitative studies, we administered the Assess the Quality of Cross-sectional Studies tools [33] and the Joanna Briggs Institute Critical Appraisal Tool for qualitative

studies [34]. The major data extracted are presented in tables. Mixed method studies are presented under qualitative studies to make the interpretation of the findings from qualitative and quantitative studies more clear. We found it difficult to report a diagnostic status of the quality of the studies. Studies, using Delphi panel, suggest that quality numerical scales can be problematic because the outputs from assessment checklists are not linear and it is also difficult to sum up or weight making them unpredictable at assessing study quality [33, 35]. We synthesized and presented the findings in a narrative way, following thematic analysis.

Results

Of 9,677 studies identified by the search, 30 publications were included in the synthesis (Fig. 1). Many of the excluded studies were focused on cathinone and/or khat use per se without reporting anything about problematic khat use. The studies included in the systematic review were classified in to 3 main categories: (a) qualitative and mixed methods studies that suggested subjective criteria of problematic khat use, (b) cross-sectional studies with indicators of problematic khat use, and (c) psychometric studies that reported validity and reliability of the different tools used to measure problematic khat use.

Regarding geographical area, many of the studies were conducted among Eastern Africa immigrant populations in Australia, USA, UK, Kenya, and Sweden ($n = 13$) and others from Ethiopia ($n = 10$), Saudi Arabia ($n = 3$), Somalia ($n = 3$), and Yemen ($n = 1$).

Qualitative Studies

Using Joanna Briggs Institute critical appraisal tool for qualitative studies, all of the above articles included more than 50% of the items of the tool; the major limitation of the studies was comprehensiveness. Many of the studies inadequately defined the idea of problematic khat use. Few of the studies [36–40] had clear objectives and pre-designed interview or FGD topic guides about the different dimensions of problematic khat use.

From the above studies, we found perceived indicators of both acceptable and problematic khat use. There were also intricate issues of religion (Muslim) and social and symbolic values [41, 42]. Chewing for religious, functional, leisure, and social reasons [6, 37, 38] and chewing khat for perceived health benefits [43] were indicators of culturally acceptable khat use. On the other hand, withdrawal experiences of khat use [37, 38], after chewing distressful experiences [37], perceived addictive nature of khat [43, 44], and associated harms [6, 36, 37, 40, 41, 43, 45], were reported indicators of problematic khat use. Other

Fig. 1. PRISMA flow diagram.

studies [6, 37, 45] also reported impairment of control over khat use as indicator of problematic khat use. The use of khat with other psychoactive substances was also mentioned as a pattern of use deviant from the “normal” khat chewing culture and it was an indicator of problematic khat use [36, 46]. The post chewing experiences of khat use, *mirqaan*, were reported to be both distressing [37] and pleasurable [41] depending on the amount of khat.

Quantitative Studies

All the 11 quantitative studies used cross-sectional study designs. Regarding the quality of the articles, many studies, 7 out of 11 studies, didn’t use adequate sample size, which was <100 participants (Table 2). Thus, they did not use appropriate statistical analysis, poorly addressed confounding variables, and didn’t identify subgroups with objective criteria. The remaining 2 studies with big sample size did not correctly measure the outcome variable, problematic khat use, using a valid instrument [39, 47].

Three studies [13, 22, 47, 48] reported prevalence and indicators of psychological dependence in khat use as measured by Severity of Dependence Scale (SDS) except one study [47] that employed DAST. Others [39] employed structured questionnaires to measure withdrawal experiences associated with problematic khat use or they [49, 50] reported subjective experiences of addiction without formal measurement.

Psychological and physical symptoms [22, 51, 52], withdrawal experiences [37, 39, 53], distressing experiences after khat use [49], and impairment of control or stopping [54] were reported indicators of problematic khat use. Nencini et al. [52] reported that reduced respiratory and body temperature was observed among customary khat users, similar to amphetamine abuse. The specific withdrawal symptoms reported were yawning, craving, mood disturbance (feeling depressed, irritability), feeling fatigue and dizziness, hot feeling, slight tremor of the tongue and body, increased appetite, sleep disturbance, headache, and blurring vision [37–39, 43] as shown in Tables 1 and 2.

Table 1. Qualitative and mixed methods studies

Authors	Population	Setting (participants)	Methods	Acceptable use	Indicators of problematic khat use
Stevenson et al. [41]	East Africa migrants in Australia	Community (muslim religion followers; 29 members of men FGD and 35 for women)	FGD and semi-structured interview	Khat social and symbolic value Mirqaan state of buoyant and alertness after Khat linked with muslim faith Children were not allowed to chew	Harms such as sleeplessness, fatigue, constipation, sexual performance, spermatorrhea, and precocious
Douglas and Hersi [42]	Somalia in Australia	Community (114 FGD members)	FGD	Halal (permissible), makruh (disliked or discouraged)	Haram (forbidden) because it is Addictive, intoxicant Negative effects overweight than benefits such as mental disorders
Wondemagegn et al. [38]	Ethiopia	Community ($n = 359$ and 15 IDIs)	Cross-sectional and in depth interview	Functional and social use of khat	Withdrawals symptoms; low mood, headache, blurring of vision, dizziness, irritability Harms; depression and anxiety
Douglas et al. [43]	Somalia in Australia	Community (114 FGD members)	FGD	Khat was widely perceived to be a food, not a drug, and as harmless, even benefited to health (treatment of depression and diabetes mellitus and increases libido and fertility)	Khat addiction 1–4 days per week criteria for addiction Withdrawals associated with heavy use such as lethargy, sleep disturbances, and mood disturbance Impacts on psychosocial function, work performance, and relationships for heavy users Belief khat is addictive Domestic violence Dental problems
Patel et al. [6]	Somalia in UK	Community (602 for survey and 25 participants for the qualitative part)	Survey, IDI and FGD	Brings the community together among men, but women discouraged from chewing, using khat for fun and socialization, self-treatment, cultural tradition Average quantity of khat was 2.5 bundles Average frequency was 3 days a week	Financial problems Health adverse effects (depression, sleeping difficulty and loss of appetite) Chewing khat because users are addictive Urge to chew khat Breakdown of family
Mihretu et al. [37]	Ethiopia	Community ($n = 102$ and 13 IDIs and 43 participants for FGD)	Cross sectional, IDI and FGD	Social and functional uses, but limited in terms of amount and time of khat use	Impairment (in social and occupational functioning) Increase in amount of khat through time Morning session of khat Distressing experience after use Craving Lack of motivation Inability to control and financial, social, and occupational impacts Withdrawal symptoms (increased appetite, increased sleep, yawning, decreased energy, irritability, loss of motivation and concentration, restlessness, craving, depressed mood, and unpleasant dreams)
Omar et al. [36]	Somalia	Community members (37 FGD members) and health professionals	FGD		Khat use is problematic when it results to adverse physical and mental health effects, social isolation, family breakdown, unemployment, neglect of meaningful activities, negative impact on level of functioning Association of khat use with other legal or illegal substances
Osman and Söderbäck [40]	Somalia in Sweden	Community; purposive sample of 8 men and 6 women	Phenomenological interview	Khat is perceived spiritual food and as medium for cultural and community cohesiveness. It is also perceived as benefited to health	Khat is also perceived as drug and haram, that is, forbidden according to Islam Adverse effects on individual health, social, and family life
Alsanusy and El-Setouhy [45]	Saud Arabia	Community (47 interviews with former khat chewers)	Qualitative	A desire to show maturity, using during leisure times	Negative consequences on economic, health, familial, and sexual life of users, but improved after quitting These harms and others such as feeling guilty for giving up prayers and work neglect were reasons to quit. Withdrawal symptoms associated with quitting were experienced bad tempers and nervousness that is expressed via treating their family, feeling sleepy most of the time, sleeping longer, feeling depressed and/or anxiety, easily fatigue and feeling hungry all of the time for about 2 weeks
Mihretu et al. [46]	Ethiopia	Community ($n = 102$ and 13 IDIs and 43 participants for FGD)	cross sectional; IDI and FGD		Using other psychoactive substances during and after khat use was an indicator of problematic khat use

Table 1. (continued)

Authors	Population	Setting (participants)	Methods	Acceptable use	Indicators of problematic khat use
Estifanos et al. [53]	Ethiopia	Community (n = 840; 3 FGDs and 5 in-depth interviews)	Cross sectional and qualitative (FGD and IDI)		47.8% reported withdrawal effects Khat chewers who had not withdrawal effect were 2.6 more likely to have intention to stop khat chewing compared to those who had withdrawal effect. Frequent khat chewers were 94% less likely to have intention than those who chewed khat sometimes Khat was addictive Impairment of control was common Participant's joblessness was the main barrier to stop khat chewing
Getnet et al. [45]	Ethiopia	University student (n = 112); 11 participants for FGD	Cross sectional and qualitative (FGD)		33% were psychologically dependent as measured by SDS ≥ 6 More depression and anxiety symptoms among dependent groups

Increased frequency of use, the minimum was once in a month [47], ≥ 8 days in a month in another study [49], and the maximum was daily use [16], was an important indicator of problematic khat use. People who chewed for >5 h per session [22], or about more than 12 h per week [47], were also perceived as a sign of being problematic khat user. Another study indicated that chewing more than 24 h without interruption as a sign of *Hazardous* khat use or *binge* khat use [13]. It was very difficult to have a standard measure for khat, but 2 studies [16, 17] found more than 1.5 or 1.25, and another study [10] reported >2 bundles of khat per day as an indicator of problematic khat use. Early age of starting khat chewing at around 18.5 years [10, 47] was also reported as an important predictor of problematic khat use. Odenwald et al. [10] showed that people with psychotic symptoms had started to chew khat about 8.6 years earlier in life than matched controls.

Psychometric Studies

We assessed and observed poor quality in terms of applying the recommended methodology of tool development and validation across the studies. About 50 and 67% of the studies were poor in examining construct and content validity, respectively. Problematic khat use could not be comparably distributed among other psychoactive substance users and nonusers as well as across gender, but the studies didn't report subgroup analysis such as differential item functioning. One study [55] suggested gender by age interaction for problematic khat use. Many of the studies reported that the construct *psychological dependence* is valid and applicable for problematic khat use [17, 21, 55, 56]. Few studies applied constructs-*khat use disorder* [16] and *harmful khat use* [19] to denote problematic khat use.

SDS has been frequently used to screen psychological dependence in problematic khat use. There was a discrepancy in the psychometric properties of SDS. Two studies [17, 56] suggested SDS is a unidimensional scale, but another study [55] found 2 factors where items 3 and 4 could be collapsed into one domain desire to stop. Kassim et al. [17] recommended ≥ 6 points cutoff, whereas Duresso et al. [56] established ≥ 3 using DSM-5 stimulant use disorder as a gold standard and ≥ 5 cutoff for another study [55].

Kassim et al. [21] and Duresso et al. [16] suggested that problematic khat users endorsed many criteria of DSM-IV substance use dependence and DSM-5 stimulant use disorder criteria. Duresso et al. [16] found a unifactorial model to both DSM-IV dependence and DSM-5 substance use disorder items for problematic khat use, but Kassim et al. [21] found 2 factors: behavioral and withdrawal symptoms of DSM-IV for problematic khat use. Harmful khat use measure [19] was with 11 items and ≥ 11 was the cutoff point. Exploratory factor analysis revealed 2 significant dimensions of the scale, but confirmatory factor analysis was not reported. The process of designing the scale was assembling items from existing measures of other psychoactive substances use. The study lacks conceptual validity as the process was not informed by qualitative study. The detail characteristics and psychometric properties of the individual studies is presented in Table 3.

Discussion

This systematic review is very important to answer the question: what constitutes problematic khat use? This will have important clinical and policy implication. The current review includes studies with different study designs that allowed us to have a comprehensive under-

standing about the validity of the construct problematic khat use from different dimensions: theoretical and empirical perspectives.

Box 1. Indicators of problematic khat use

- Increased khat use over time as indicated by increased amount, frequency and duration of khat session.
- Associated financial, social, mental and physical health harms
- Despite absence of comparative studies, symptoms of dependence and withdrawal experiences including irritability, depressed mood, lack of motivation, feeling fatigued, increased appetite and sleep, unpleasant dreams and excessive stimulant consumption or chewing khat in the morning, but there are no controlled studies on problematic khat use withdrawals.
- The use of other psychoactive substances with or after khat chewing was also another important indicator of problematic khat use.

Compared to other psychoactive substances misuse, little progress is made on defining different levels of “problematic khat use” in particular and “khat use-related harms” in general. Institutions such as National Institute on Alcohol Abuse and Alcoholism, European Monitoring Centre for Drugs and Drug Addiction, and other scientists with extensive research backgrounds on substance misuse clearly defined risky, hazardous, harmful, heavy, and substance use disorders, especially for alcohol and cannabis [25, 57, 58]. There are more than 44 instruments for cannabis [59] and alcohol [60] misuse, which are screening or diagnostic tools to be used at different settings. Therefore, there are important lessons that could be adopted for studies on problematic khat use.

Indicators of problematic khat use, listed in box 1, were consistent with other psychoactive substances misuse. Patterns of use, dependency, tolerance, withdrawal experiences, and negative consequences were the main indicators across different problematic substances use [58, 59, 61, 62]. Absence of controlled studies for dependence, tolerance, and withdrawal symptoms of problematic khat use is a major limitation of evidence across the individual studies in this systematic review. Cannabis withdrawal was recently recognized as a criterion for cannabis use disorder in the DSM-5 using evidence from longitudinal studies [23, 58]. The same could be done to establish khat withdrawal symptoms. Regarding harms, 2 very strong studies, using Delphi procedure, classified khat among the lowest risk list of drugs [61, 62]. The studies were actually from the Western countries where the

problematic status of khat could not be comparable to other countries such as Ethiopia and Yemen where khat chewing is widespread.

Increased khat use over time, which was indicated by amount, frequency, and duration of session, was very important to define problematic khat use. Recent studies on definition of substance use disorders recommend the use of heavy substance use over time for defining substance use disorders for different reasons [63]. Heavy use over time clearly explains both the social life and neurobiological changes associated with current status of the substance use on the individual. In addition, heavy use over time would avoid the cultural specificity and sensitivity of the domains of measures such as loss of control and social consequences associated with the substance. Therefore, substances that are embedded to the culture such as khat use, heavy khat use over time as suggested by the empirical studies could be used as an important indicator of problematic khat use.

Additional indicator of problematic khat use that is different from other substances misuse definition was using other psychoactive substances with or after khat chewing. This doesn't only mean that the individual will be affected by the adverse consequences of the poly psychoactive substances, but it was also reported that using other psychoactive substances with khat is against the cultural definition of khat use. Khat use can be a gateway drug for other psychoactive substances misuse [46], which could be an evidence for indirect contribution of khat for morbidity and mortality.

The use of DSM-IV [21] and DSM-5 [16] criteria for amphetamine-like substance dependence and stimulant use disorders respectively for problematic khat use were also important for clinical diagnosis but not for screening of problematic khat use by nonmental health professionals. The studies suggested that the 2 measures are psychometrically acceptable to apply for problematic khat use, but their focus was mainly on structural validity. The studies didn't properly conceptualize problematic khat use, and they were not informed by qualitative studies. The recommended emerging area of research on tool development would be exploratory and theory driven [64]. Cochrane handbook of a systematic review also recommended the use of qualitative studies in the development of measurements [31]. SDS is the most widely used measure of problematic khat use, but SDS only measures a narrow concept of psychological dependence. Its psychometric properties, dimensionality, and threshold were not also yet well-established. Severity of dependency scale was also a marker of psychological dependence [65], which didn't include other content areas of problematic

Table 2. Results from quantitative studies

Authors	Population	Setting (participants)	Prevalence of problematic khat use and respective measurements	Indicators of problematic khat use
Abdelwahab et al. [47]	Saud Arabia	Community (n = 603)	80.7% psychological dependency as measured by DAST-10*	PDK Early age (18.5 years) of starting khat chewing and frequency of khat chewing (greater than once a month) were main indicators of PDK
Abdeta et al. [39]	Ethiopia	University students (n = 651)	68.2% reported that they had experienced various withdrawal symptoms	Withdrawal symptoms of problematic khat use were feeling depressed, craving, feeling fatigued, hot feeling, slight tremor of the tongue and body, irritability, increased appetite, sleep disturbance, headache
Griffiths et al. [48]	Somalis in UK	Community (n = 207)	30% prevalence of psychological dependency as measured by SDS ≥6	PDK Indicators of PDK were increased in amount and worried about the amount of money
Young et al. [49]	Immigrants in Australia	Community (n = 52)		8 days or more in khat use frequency in the last 30 days Increased risk of self-reported problematic loquaciousness Experiencing 3 or more psychological problems after khat use
Kassim et al. [21]	Yemeni, in UK, 75	Community (n = 75)		The main indicators of PDK were – Chewing more than 12 h per week – Not washing khat before chewing – Oral health problems
Khatib et al. [50]	Somalia in UK	Community (n = 62)		Self-reported psychological khat addiction was found Different attitudes on the health harms of khat use and its negative impact on family
Nencini et al. [52]	Somali	Community (n = 16 volunteers)		Tolerance develops to the sympathetic effects of khat Reduced respirator rate and body temperature observed among customary khat users. Systolic blood pressure appears to rise both in customary and khat naïve groups
Duresso et al. [54]	Ethiopia	Community (n = 60)		Among the 59 participants who achieved initial abstinence, 93% lapsed Days to lapse ranged from 2 to 25 days With regard to relapsing, 41% of those who quit chewing relapsed and only 7% of the participants maintained continuous abstinence throughout the study period.
El-Setouhy et al. [22]	Saudi Arabia	Community (n = 70 male khat chewers)	52.2% psychological dependency using SDS >4	Longer khat sessions (≥6 h), and physical and psychological symptoms were main indicators
Odenwald et al. [10]	Somalia	Community (n = 4,854)		On average, cases with psychotic symptoms had started to use khat earlier in life than matched controls and had been using khat 8.6 years before positive symptoms emerged In most cases with psychotic symptoms, a pattern of binge use (>2 “bundles” per day) preceded the onset of psychotic symptoms, in contrast to controls of the same age
Widmann et al. [13]	Somalia refugees in Nairobi	Refugees living in a disadvantaged urban settlement area (n = 33 healthy male khat chewers and 15 comparable nonchewers)	72% psychological dependence (using SDS) and a of them fulfilled the DSM-IV-criteria for dependence	Hazardous khat use or binge chewers patterns like chewing for more than 24 h without interruption 85% reported functional khat use

* DAST items include (use of khat with other drugs, flashbacks as a result of khat, over involvement with family affairs, neglect family, feeling guilty, inability to stop, legal issues, withdrawal symptoms and induced medical problems).

** SDS = Impairment of control, distress when not using, worry about the behavior, wish to stop and difficulty to stop.

PDK, psychological dependency of khat; DSM, Diagnostic Statistic Manual; SDS, Severity of Dependence Scale.

khat use. The validity of SDS was also in question to screen problematic cannabis use in the general adolescent population [66].

The studies didn't consider subgroup analysis across important variables, which suggest significant variation in problematic khat use. The psychometric studies from Ethiopia [16, 19] were also mainly focused on college students, which could affect acceptability and appropriateness for the general population, especially the rural population. Another limitation of the current system-

atic review could be the inability to report pooled quantitative results because of the heterogamous nature of studies.

Conclusion

Comparative studies are necessary to establish symptoms of dependence and withdrawal experiences of problematic khat use. Strong empirical studies that

Table 3. Results of psychometric studies

Authors	Setting	Prevalence of PKU, Measure and cut off	Name of the construct	Instrument properties	Major psychometric methods done	Major psychometric findings	Indicators of problematic khat use
Gebrehananna et al. [19]	Ethiopia, students	20.6%, HKU, ≥ 11	Harmful khat use	11 items HKU is a new instrument which suggests measuring harms related to khat use, but there are also items related to dependency	Content validity, structural validity (EFA) and internal consistency Chewing twice per week was the gold standard	2 dimensions Cronbach's alpha = 0.87 About 60% sensitivity and 20% specificity	Chew in khat cafeterias Chew in group with other people who are not students <18 years start age
Nakajima et al. [55]	Yemen	SDS**	Psychological dependency	SDS measures impairment of control, distress when not using, worry about the behavior, wish to stop and difficulty to stop	Structural validity (PCA and EFA) and reliability	2 dimensions Cronbach's alpha = 0.6	Old age and men Male and female chewers had different patterns of khat use as well as symptoms related to dependence.
Kassim et al. [21]	Yemeni in UK	31%, DSM-IV, ≥ 3	Dependency	DSM-IV criteria of substance dependence are withdrawal symptoms, repeated attempts to quit, tolerance, time, psychological/physiological problems related to use and give up of activities	Structural (EFA) and concurrent validity, and reliability	Bidimensional; factor 1 consisted of biobehavioral items and factor 2 withdrawal items, Cronbach's alpha coefficient = 0.78 Sensitivity of 62% and specificity of 81.1% were reported for SDS	3 days or more per week Tolerance Unsuccessful attempts to reduce or cut down Continued use despite health impacts Abandoned other social activities to chew khat Great deal of time spent using or recovering Use more or longer than intended Withdrawal symptoms (depression, increase in appetite, and interrupted sleep) Nicotine dependency
Duresso et al. [16]	Ethiopia	73.8%, DSM-5, >1	Khat use disorder	DSM-5 substance use disorders include hazardous use, neglected major roles to use, social/interpersonal problems related to use, and the above DSM-IV criteria of dependency	Construct (CFA and IRT), and concurrent validity	Unifactorial model for khat use disorder Failure to fulfill major role obligations, continued use despite interpersonal problems and continuing to use despite knowledge of physical/psychological problems' were frequently reported using IRT difficulty report	Daily chewing Using khat more than once per week Using ≥ 1.5 bundles of khat Financial problems
Kassim et al. [17]	Yemeni in UK*	51%, SDS, ≥ 6	Psychological dependency		Structural and concurrent validity, and reliability	Uni-dimensionality of the scale Cronbach's alpha = 0.76) and the test retest intraclass correlation coefficient (ICC) was 0.93	3 days or more per week 1.25 bundle or more per session but not duration of session Subjective reasons for khat chewing such as "being dependent," "habit" or "cannot work or study without khat chewing"
Duresso et al. [60]	Ethiopia	60.3%, SDS, ≥ 3					Male, age below 25, being full-time student, using khat daily in the last 12 months, 1.5 bundles per session, daily tobacco and alcohol use, financial and academic problems, poor quality of life
Kassim et al. [21]	Yemeni's in UK	24 khat users	Dependency	Validating self-reported khat chewing behaviours by measuring levels of cathinone, norephedrine, and norpseudoephedrine in saliva	Criterion validity, but biomarkers are unlikely to validate problematic khat use since they only show excessive recent intake of khat	Statistically significant association of score of SDS and biomarker levels in saliva	

SDS, Severity of Dependence Scale; DSM, Diagnostic Statistic Manual.

could establish thresholds for amount, duration, and frequency for problematic khat use are warranted. Meanwhile, novel psychometric methods such as item response theory could be employed to identify important indicators of problematic khat use such as frequency, dose, and duration of khat use session. Measuring khat alkaloid and establishing standard amount of khat could be important for different reasons, but this might not facilitate epidemiological studies. Therefore, in order to facilitate early detection and intervention, culturally suitable problematic khat use screening tools with entails behavioral criteria are also important. Future studies should also clearly define different types of problematic khat use such as dependency, harmful, hazardous, or heavy khat use. Future studies are also important to explore additional indicators of problematic khat use (if any).

Finally, problematic khat use constituted, but didn't limit to, harms, increased use over time, and frequent engagement in concurrent use of other psychoactive substances which was different from occasional khat chewing used for prayer, social, and functional reasons.

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Statement of Ethics

Since this is a review paper, guidelines for human studies and animal welfare regulations are not directly applicable, but this study was reviewed, and ethical approval was secured from institutional Review Board of College of Health Sciences, Addis Ababa University under protocol number 008/18/psy.

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Author Contributions

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