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Evaluation of Mobile Health apps for Non-Medical Cannabis Use: A Scoping Review

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Abstract

Cannabis use represents the most commonly illicit drug intake worldwide. m-Health interventions have the potential to play a key role in the fight against cannabis intake issues. A steadily increasing number of m-Health apps are currently available on commercial app stores to support psychoactive substance users. This study aims at exploring technical and functional characteristics of available m-Health-apps intended for non-medical Cannabis Use and Dependence (CUD). We carried out a scoping review following guidance from Arksey & O'Malley. We searched in Pubmed, Scopus and Web of Science databases end of March 2021. Only five papers fitted our inclusion criteria out of 113 studies. Four out of five included studies reported a decrease of cannabis use and adequate feasibility and acceptability of m-Health apps. Most of these studies used self-reported questionnaires. More studies are need to rigourously assess the usability and effective of m-Health apps for CUD.

Keywords: cannabis, m-Health, mobile app, usability

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1. Introduction

Cannabis consumption is estimated at 192 million users in 2018 which equals 3.9 per cent of the world community aged between 15 and 64 years. Cannabis use represents the most commonly illicit drug intake worldwide, with around 3.8% one-year prevalence worldwide and 5% in North Africa [1]. Cannabis use may result in a wide range of mental and physical disorders with negative social consequences. Cannabis use may lead to adverse health effects such as heart attacks, brain development issues, lung tissues damage and psychiatric comorbidities [2]; It is also responsible for the decline of cannabis users' living conditions and other social consequences such as poor schooling or week work performance [3][4], family violence [5] stigmatisation, social discrimination [6] and criminality [7], [8]. In addition, cannabis users, victims of social discrimination, are often challenged by many health system challenges such as poor and inequitable access to healthcare, qualified human resource shortage and lack of social and assistance to quit drug use [9].

Recently, ensuring timely access to medical care and adequate support and assistance for cannabis users has become an important concern for policy makers and health system stakeholders [10]. More specifically, increased attention has been placed in using information and communication technologies (ICT) to promote access to quality health care services for cannabis users and help them overcome major health system barriers [11] and better connect with appropriate health services [12][13][14]. Available evidence supports the effectiveness of mobile health technologies in improving patients adherence to treatment and ensuring better symptom monitoring by health professionals [15].

For technology users, m-Health or mobile health is the visible part of ICT iceberg. It is defined as "*medical and public health practices relying on mobile devices, such as cell phones, patient monitoring systems, personal digital assistants and other wireless devices*" [16]. m-Health has benefited from the rise of digital technologies and the emergence of increasingly innovative and intuitive portable technological tools. m-Health interventions range from sending simple text messages [17], [18] to complex telemedicine practices using connected mobile devices (smartphones or tablets) and m-Health applications associated or not with sensors (smart clothes, watches or bracelets) [19][20].

Over 340 mobile and ready-to-wear devices are made available to users around the world [21], and more than 325,000 m-Health applications are currently available on the main commercial virtual stores "Google app" and "Apple iOS" [22], this number estimated at 160,000 in 2015, has doubled after two years with more than 200 mobile apps added every day [21].

m-Health intervention have proved appropriate in managing chronic diseases [23], by allowing useful functionalities for both patients (self-health monitoring, setting appointments, medication reminder services, fitness trackers) [24], and health workers (patient provider interaction, clinical diagnosis support, enhancement of patient engagement) [25]. They are also useful in monitoring epidemics and allowing remote health data collection [16]. Therefore, m-Health interventions may play a key role in the fight against cannabis intake issues.

However, little evidence exists on the functionality, usability and effectiveness of m-Health intervention for cannabis use addiction [26], [27]. In response, we carried out a scoping review that aims at exploring technical and functional characteristics of available m-Health-apps intended for non-medical Cannabis Use and Dependence (CUD). We aimed more specifically to (1) identify mobile applications used as m-Health interventions, (2) describe their characteristics and (3) discuss evaluation outputs of CUD-focused apps.

The rest of the paper is structured as follows. Section 2 presents the research methodology. General, technical and functional characteristics of CUD m-Health intervention apps are provided in Section 3 along with evaluation approaches. These results are discussed in Section 4 in terms of usability. The conclusions are included in Section 5.

2. Method

We followed the methodological guidance developed by Arksey & O'Malley [28]. The guidance is a six-stage process, it consists in: research question identification, search for pertinent studies, study selection, data extraction and collection, summing up the results and reporting of the findings. Our review question focused on m-Health apps to help non-medical cannabis consumers reducing or quitting their consumption (see our PICO (population, intervention, comparison, outcome) question, Table 1). We searched Pubmed, Scopus and Web of Science databases during the last week of March 2021. We developed a search strategy using the following keywords ("Cannabis" OR "Hashish" OR "Marijuana" OR "Marihuana") AND "App" for each specific database (see Table 2). Only studies that assessed the characteristics of m-Health apps addressing our PICO question and published after 2008 (launch year of App stores [29]) in English or French were included. Studies addressing medical use of cannabis were excluded.

Table 1: PICO question

PICO Criteria	Description
Population	Individuals with Cannabis Use and Dependence
Intervention	m-Health apps designed to help non-medical cannabis consumers
Comparator	Not applicable
Outcome	Characteristics of CUD-focused apps.

Table 2: Search strategy

Database	Boolean combination
Pubmed	((app[Title/Abstract])) AND ((cannabis[Title/Abstract] OR hashish[Title/Abstract] OR marijuana[Title/Abstract] OR marihuana[Title/Abstract]))
Scopus	((TITLE (cannabis) OR ABS (cannabis) OR TITLE (hashish) OR ABS (hashish) OR TITLE (marijuana) OR ABS (marijuana) OR ABS (marihuana) OR TITLE (marihuana))) AND ((TITLE (app) OR ABS (app)))
Web of Science	(TI=(app) OR AB=(app)) AND (TI=(hashish OR cannabis OR marijuana OR marihuana) OR AB=(hashish OR cannabis OR marijuana OR marihuana))

3. Results

3.1. General characteristics

Of the 113 studies initially identified, 9 full-text papers were examined for eligibility and 104 were excluded after duplicate removal and title and abstract screening (see figure 1). Only 5 studies fitted our inclusion criteria. These studies were published between 2015 and 2021. They included four pilot studies [30]–[33] aiming primarily at evaluating m-Health apps characteristics and one randomized clinical trial [34] focusing on examining therapeutic strategy outcomes using an m-Health app. Participants age range was limited in three studies to adults [30], and adolescents and young adults in two studies [31] [32] (Table 3). All included m-Health interventions were from developed countries, namely, United states (2 apps), Australia (1 app), Hungary (1 app) and Switzerland (1 app).

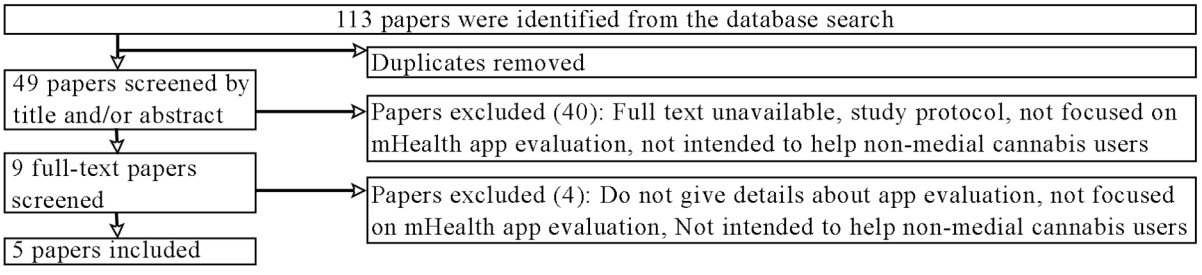

Fig. 1. Prisma Flowchart

Table 3: Characteristics of m-Health interventions apps used in the fight against non-Medical Cannabis Use and Dependence

Paper	Study purpose	App name / Country	Participants
Albertella et al (2019) [30]	Pilot study: evaluates the feasibility and acceptability of the app intervention with regards to the stage of change of participants (Action and contemplation [35])	APTT (Assess, Plan, Track, & Tips) / Australia	N=111; aged 18-50 years old; recruitment through print and online media advertisements
Coughlin et al (2021) [31]	Pilot study: evaluates the feasibility and acceptability of the app	MiSARA (substance abuse research assistant) / United States	N=39; aged 16-24 years old; recruitment through online media advertisements
Kapitany et al (2018) [32]	Pilot study: assesses the effectiveness of the app	Once Upon a High (VoltEgySzer) / Hungary	N=386; aged 14-18 years old; recruited from 2 vocational schools and 2 high schools
Monney et al (2015)[33]	Pilot study: Reports on cannabis users' characteristics, suggestions and satisfaction related to the app	Stop-cannabis / Switzerland	N=482; 469 (97,3%) were 14-59 years old, and 13 (2.7%) gave no answer; recruitment through online media advertisements
Prince et al (2020) [34]	Randomized clinical trial: examines Protective Behavioural Strategies (PBS) outcomes using the app	Mapp (Marijuana Smartphone App) / United States	N=37; average age 20.36 years (SD = 1.71); recruitment through print and broadcast media advertisements

3.2. Technical characteristics of CUD m-Health intervention apps

We summarised in table 4 the main characteristics as well as the evaluation approaches, dimensions, measurement instruments used to assess the usability and effectiveness of CUD focused apps on decreasing cannabis consumption. These apps are named APTT [30], MiSARA [31], Once Upon a High (VoltEgySzer) [32], Stop-cannabis [33] and Mapp [34]. All apps in included studies were developed for iOS platform and two apps [32], [33] offer a second version for Android devices. Of these apps, only the "Once upon a High" [32] and "Stop-cannabis" [6] apps were available when searched from Morocco on Google play and Apple app stores as of the 7th of June 2021.

Three m-Health apps were designed for users wishing to reduce or quit cannabis use [30], [33], [34] or to prevent relapse from cannabis use [33], whereas the MiSARA app, and the Once Upon a High app (VoltEgySzer) targeted respectively additional addictions (Alcohol [31], and Classic and Novel Psychoactive Substances (NPS) [32]). Four studies out of five reported a decrease of cannabis use and associated problems [30], [31], [33], [34]. For instance, Coughlin et al (2021) showed a negative correlation between the number of times the MiSARA app [31] was used and the cannabis intake quantity. Kapitany et al. [32] showed that the Once Upon a High app when used as an adjunct in CUD intervention programs, enhance self-efficacy, knowledge and awareness of young adults and may prove appropriates in the prevention of cannabis use. Prince et al. [34] emphasizes that the engagement of young adults with m-Health apps , emphasise the development of protective behavioural strategies (PBS) along with physical exercise and lead to a decrease of cannabis use.

3.3. CUD apps evaluation approaches

As outlined in Table 4, most studies employed questionnaires with questions developed especially for the given study. Only Albertella et al. adapted the evaluation questions, from a standardised measurement tool, i.e. the Client Satisfaction Questionnaire [36]. Users' free comments were collected and analysed in two studies [31], [33].

CUD apps evaluation focused mainly on the following dimensions: users' engagement, apps' usefulness, helpfulness and acceptability as perceived by users using a broad range of terms (see Table 4). Technical features

were assessed in two studies out of five [31], [34]. Helpfulness was the mostly assessed dimension by using participants' free comments [31], [33] or as assessed by authors [30], [32], [34]. The dimension 'users' engagement with apps' was measured by the frequency of CUD-apps use [30], [31]. For instance, Coughlin et al [31] did not report an engagement of cannabis users with the MiSARA app whereas in Albertella et al. (2019) study, the frequency of APTT app was high. Albertella et al. [30] indicated that the frequency of application use is not a specific indicators of users engagement and need to be associated with other measures. More attention should be paid to the measurement during the action phase rather the contemplation phase during CUD change processes. Table 4 give a detailed list of evaluation parameters by m-Health interventions. We used Weichbroth [37] definitions to categorise the evaluation parameters reported in the included studies.

3.4. Description of CUD Apps' functional characteristics

Our scoping review identified five m-Health apps, their relevant functionalities and characteristics are summarized below:

- Assess, Plan, Track, and Tips (APTT) app: developed based upon Cognitive Behavioural (CB) and Motivation Enhancement (ME) therapies. It allows to collect information and gives personalised feedback about levels, reasons, and perceived consequences of cannabis use. This app helps users to set a goal and a plan to quit or reduce their consumption, by tracking progress with daily records of cannabis use and wasted money. Strategies to face stimulants of cannabis use, feedback on pros and cons and optional reminders are included to encourage engagement with the APTT app intervention.

- MiSARA app: designed following health behavioural change models. It employs surveys to collect information and personalized feedback about users' psychological state and substance use frequency, reasons and consequences. It includes behavioural activation tasks and engagement strategies and tools. The MiSARA app involves game concept to support the user engagement with the app.

- Once Upon a High app: mainly based on gamification tools such as role-play game and dialogue system with brightness effects, comic-style animated tales and quizzes. It includes preventive and educational content on epidemiology and risk factors, types of treatments and healthy behaviour. Once Upon a High app integrates activities to sensitize students on the effects of stigma against psychoactive substance users and change attitudes to psychoactive substances addiction. This app also gives practical information on treatment units in seeking professional help.

- Stop-cannabis app: allows cannabis dependence screening and gives personalised feedback on cannabis-related questions from the Alcohol, Smoking and Substance Involvement Screening Test (ASSIST). The app aims to help quitting cannabis addiction using personalised text messages, a discussion forum, and positive reinforcement strategies to reward progress in terms of abstinence days and saved money. It includes patterns of Ecological Momentary Assessment (EMA) and Ecological Momentary Interventions (EMI) methods.

- Marijuana Smartphone app (Mapp): accompany users in their quitting plan by providing information and support in real-world contexts based upon EMA and EMI methods. Self-reported data focus on user's personal factors and on Circumstances surrounding use.

Table 4: Overview of CUD-focused apps characteristics and evaluation

App name OS / Language Date of Launch	Targeted Substance	Newly designed app	Functional characteristics	Usablility Evaluated parameters	Evaluation approach / tool	Measure tool	Findings (authors' conclusions)
[d]APTT (Assess, Plan, Track, & Tips) - Albertella et al. (2019) [30] iOS Not available	Cannabis	Yes	CB and ME therapies personalised feedback Daily records and reminders	Usefulness Engagement	Questionnaire / A modified version of the Client Satisfaction Questionnaire [36]	Predetermined variables using ordinal rating scale	The study stated a decrease in cannabis dependence. The APTT app is an engaging and helpful app. Findings supports its acceptability and feasibility
[d]MiSARA - Coughlin et al (2021) [31] iOS Not available	Cannabis and Alcohol	Modified existing app (based upon SARA (substance abuse research assistant) app [38])	Health behavioral change models, personalised feedback, behavioral activation tasks, game-like activity	Acceptability (Appearance, Enjoyment, Content, Data acceptability, Technical issues) and Engagement	Questionnaire Free comments/ specific questions to the study	Predetermined variables using rating scale	The study stated a consumption reduction of cannabis. It also suggests the integration of both passive and self-report data, and highlights a need for collaboration with software developers. MiSARA was acceptable and easy to use Game-like activities were below users' expectations
Once Upon a High (VoltEgySzer) - Kapitany et al (2018) [32] iOS[d] - Android / Hungarian[c] 20 April 2016[c]	Classic and Novel Psychoactive Substances	Yes	preventive and educational content, behavioral change activities, game-like activity	utility, subjective preference, General evaluation	Questionnaire/ specific questions to the study	Predetermined variables using ordinal rating scale	The Once Upon a High app study did not demonstrate effectiveness in reducing cannabis use. However, this app can be used as an adjunct in preventive intervention programs due to its usefulness in enhancing knowledge and self-efficacy. The use of game-like activities was highlighted in enhancing users' knowledge on substance use.
[a]Stop-cannabis - Monney et al (2015) [33] iOS[d]/Android / French[b] February 2013[b] / 13 December 2013[c]	Cannabis	Yes	Screening Test, personalised feedback, discussion forum, positive reinforcement, EMA and EMI methods	Use Satisfaction helpfulness	Survey Free comments / Questions of the survey were designed especially for this study	Predetermined named variables using nominal rating scale	Stop-cannabis app is a helpful tool to stop or reduce cannabis use, acceptable and evaluated as useful by the users.
[d]Mapp (Marijuana Smartphone App) - Prince et al (2020) [34] iOS Not available	Cannabis	Yes	EMA and EMI methods	Using (easy to use, helpfulness) , physical features (layouts, colors)	Questionnaire/ Specific questions to the study	Predetermined variables using ordinal rating scale	The Mapp app is an engaging tool for young adults to moderate cannabis consumption. Its content helped decrease cannabis use.

[a] Available to download from Google Play and Apple App Store as reported in the study, [b] as reported in the study, [c] as mentioned on Google Play, [d] Not found on google play or Apple app store when searched from Morocco

4. Discussion:

Our scoping review aimed at exploring technical and functional characteristics of available m-Health-apps intended for non-medical CUD. Our review identified five m-Health apps APTT [30], MiSARA [31], Once Upon a High (VoltEgySzer) [32], Stop-cannabis [33], and Mapp [34]. Our findings support the availability of promising m-Health solutions to address CUD. However as stated earlier, pilot study design was the predominant type of m-Health interventions, thus indicating that the application of m-Health technologies in the fight against cannabis use and dependence is at an early stage, which is consistent with previous reviews [39], [40].

4.1. Usability of CUD-focused apps:

Measuring app usability is promising avenue for app developers and researchers. It allows to get insights about how it meet users' expectations in line with CUD-apps objectives. To date, there is no mobile apps usability specific definition [37]. A starting point would be a general definition as follows : "*The extent to which a system, product, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use*" [41].

Most frequent attributes use for the measurement of CUD -app usability dimension are efficiency, satisfaction and effectiveness. Evaluation methods of these attributes include controlled observation and predetermined statements with rating scale, where the rating scale is the only way to measure satisfaction [37]. Evaluation parameters reported in the five studies could be summarized in four categories: users' engagement, apps' usefulness, helpfulness and acceptability as perceived by users; Similarly, in a review on usability evaluation of mental Health apps [42], it appears that apps evaluation were also limited to user's self-reported satisfaction scales. More attention need to paid to reliable measurement scales for usability such as tracking software.

4.2. Internationalization and localisation features:

Guidelines from Apple[43] and Google play[44] form the design basis for usable mobile apps. Important features, of these guides, which deserves to be emphasised are internationalization (i18n) and localization (l10n): processes guiding the development of applications adapted in terms of languages, regions, and cultures of users' place of residence. Out of five included m-Health interventions, only two applications were commercially available however inaccessible to French-speaking countries. Our scoping review, in line with other studies [45], supports the need for more investigation of the usage of m-Health technologies to assist cannabis users, particularly in low and middle income countries where health systems often lack appropriate mental health and addictions services, and suffer from acute human resource shortage and increasing social stigma of cannabis users and other mental health disorders.

Despite the legal prohibition of cannabis use in Morocco, cannabis lifetime use is steadily increasing since 2010 [46][47][48]. Evidence has shown that cannabis use ranked second after tobacco [48], and is the most highly accessible and available consumed illicit substance among young adults in Morocco[49][48][50][51]. Thus, more empirical studies are required to test and to develop CUD apps adapted to the specific context of Morocco and to the middle east and north Africa (MENA) region that remains an underexplored research area.

5. Conclusion:

This scoping review supports the acceptability and feasibility of m-Health interventions to help cannabis users. However, there is a need for more empirical investigations involving closer partnership between healthcare professionals and software developers, especially with regard to assessment tools such drug use intervention apps in particular and mental health in general. Particular attention need to be paid to standards and guidelines that frame the development of quality mobile applications use in healthcare.

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