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Evaluating preferences for online psychological interventions to decrease cannabis use in young adults with psychosis: An observational study

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A R T I C L E I N F O

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A B S T R A C T

Innovative technology-based solutions have the potential to improve access to clinically proven interventions for cannabis use disorder (CUD) in individuals with first episode psychosis (FEP). High patient engagement with app-based interventions is critical for achieving optimal outcomes. 104 individuals 18 to 35 years old with FEP and CUD from three Canadian provinces completed an electronic survey to evaluate preferences for online psychological intervention intensity, participation autonomy, feedback related to cannabis use, and technology platforms and app functionalities. The development of the questionnaire was informed by a qualitative study that included patients and clinicians. We used Best-Worst Scaling (BWS) and item ranking methodologies to measure preferences. Conditional logistic regression models for BWS data revealed high preferences for moderate intervention intensity (e.g., modules with a length of 15 min) and treatment autonomy that included preferences for using technology-based interventions and receiving feedback related to cannabis use once a week. Luce regression models for rank items revealed high preferences for smartphone-based apps, video intervention components, and having access to synchronous communications with clinicians and gamification elements. Results informed the development of iCanChange (iCC), a smartphone-based intervention for the treatment of CUD in individuals with FEP that is undergoing clinical testing.

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1. Introduction

In individuals with first episode psychosis (FEP) the prevalence of cannabis use disorder (CUD) is approximately 50%, ten to fifteen times higher than in the general population (Abdel-Baki et al., 2017; Schimmelmann et al., 2012). Treating CUD in these individuals is of high priority because reducing or stopping cannabis use is associated with improved clinical and psychosocial outcomes, including lower rates of psychiatric hospitalizations (Schoeler et al., 2016). Since no medication has been proven effective in treating CUD (Bahji et al., 2021), face-to-face psychological interventions that include cognitive behavioral therapy (CBT) and motivational interviewing (MI) are recommended to address cannabis use in early intervention services (EIS) for psychosis, but their implementation is inconsistent (Aydin et al., 2016; Ouellet-Plamondon et al., 2021). Important implementation barriers include variation in staff training, high staff workload, and patient-level obstacles for care engagement such as anxiety or transportation barriers (Aydin et al., 2016; Lal et al., 2020).

The COVID-19 pandemic has emphasized the importance of integrating technology-based solutions into mental health services. A recent study emphasized that implementation is sub-optimal with only 7.3% of the 12,052 adults 16 years and over with internet access participating in the 2021 Canadian Digital Health Survey using such services (Yu et al., 2022). Mobile phone-based applications represent a unique opportunity to increase accessibility to interventions in people with psychotic disorders as recent studies consistently report that more than 80% of this cohort owns a mobile phone, about 60% use them daily to access the internet, and more than 50% have favorable opinions related to using mobile health services (Firth et al., 2016; Lal et al., 2020; Robotham et al., 2016). However, the development of app-based interventions in the field of psychosis is nascent as only six applications out of 10,000 mental health applications available for download in 2020 were evidence-based and clinically relevant for schizophrenia and psychosis (Beth Israel Deaconess Medical Center, 2020; Lagan et al., 2021a). Importantly, no app-based psychological intervention for CUD in these individuals has yet undergone rigorous clinical testing (Camacho et al., 2019; Firth and Torous, 2015; Tatar et al., 2022, 2020).

One of the major app evaluation criteria included in the mHealth Index and Navigation Database framework, based on the American Psychiatric Association's App Evaluation Model, is optimal user engagement. This model integrates criteria used in 70 app evaluation frameworks (Lagan et al., 2021b; Torous et al., 2018b). To ensure adequate user engagement, recommendations for app development emphasize the importance of using qualitative and quantitative methodologies and a person-based approach tailored to specific clinical populations to account for patient and clinician app preferences and behavioral intervention needs (Mummah et al., 2016; Torous et al., 2018a; Yardley et al., 2015).

In these contexts, we used a person-oriented approach and previously conducted a qualitative study that aimed to explore patient and clinician perspectives related to intervention modalities for treating CUD in individuals with FEP, as well as factors associated with the acceptability of technology-based psychological interventions for CUD (Tatar et al., 2021). The study provided an integrative synthesis of strategies for psychological interventions (e.g., CBT, MI, motivational enhancement therapy [MET], psychoeducation) and preferences related to the format and structure of technology-based psychological interventions (e.g., length and frequency of intervention modules); communication and support (e.g., with clinicians); and application characteristics and technology use (e.g., cannabis use log). Those results subsequently informed the present quantitative study aiming at (1) evaluating patient preferences related to the structure and content of app-based psychological interventions for the treatment of CUD (main objective) and (2) exploring the associations between app preferences and sociodemographic and cannabis use characteristics.

2. Methods

2.1. Study design

We used a cross-sectional design and an electronic survey to collect data at one time-point from eligible participants between January 2020 and July 2022. The study is described using the Strengthening the Reporting of Observational Studies in Epidemiology recommendations (Vandenbroucke et al., 2007). Ethical approval was obtained from the Research Ethical Committee of the Centre hospitalier de l'Université de Montréal (University of Montreal Health center, CHUM; # 19.245; main site) and from the local research ethic boards of other participating study sites.

2.2. Setting and participants

Data collection was conducted at eight specialized early intervention for FEP services (EIS) in Canada: six in the province of Quebec, one in Alberta, and one in Nova Scotia. These EIS offer a wide range of early interventions for psychosis that include psychological interventions (e.g., CBT, MI/MET, psychoeducation) for comorbid substance use disorders (SUD). During the data collection, app-based psychological interventions for CUD were not used at any of the participating EIS. At each site, clinicians (e.g., psychiatrists and case managers—such as nurses, occupational therapists, social workers—hereafter, clinicians) identified potential participants with FEP and CUD and referred them to the research team. Research assistants conducted the informed consent process with participants either in English or French and completed the screening process either in person or using technology, depending on the status of restrictions imposed by the COVID-19 pandemic and participants' preference.

Study candidates were eligible to participate if they met the following criteria: (1) age 18–35 years; (2) receiving treatment or being followed for psychosis at any of the participating EIS for at least 2 months; (3) having used cannabis in the last 30 days; (4) current CUD (any severity) based on DSM-V (American Psychiatric Association, 2021); (5) willing and able (i.e., not presenting significant cognitive impairment) to complete an electronic survey; (6) able to read and comprehend French or English, and (7) willing to provide informed consent. We excluded individuals if they (1) presented any psychiatric, physical, or cognitive conditions that would preclude them from participating or (2) declared no interest in reducing or stopping cannabis use. The study questionnaire was completed either at the clinic using a tablet or remotely using an individualized web-link provided by research assistants. Study-completing participants received a $30 honorarium for their time.

2.3. Variables and measurement

The survey was programmed using the Qualtrics proprietary software. We pilot-tested the survey with five individuals with FEP and CUD (data was not included in the analyses). After each pilot test, we adapted the wording of the informative statements and questions in the survey based on participants' input.

In addition to sociodemographic data, the survey measured substance use history (e.g., frequency of cannabis use in the last 3 months) and intentions to reduce or stop cannabis use. The measurement of intention to decrease or stop cannabis use was done at the beginning of the survey as part of assessing eligibility and was informed by and adapted from the seven-stage Precaution Adoption Process Model (PAPM), a multi-stage theoretical model that identifies the readiness to act (i.e., unengaged, undecided, decided not, decided to, and acting) in adopting a health behavior (Weinstein et al., 2008). Participants who did not intend to change their cannabis use were not eligible for the survey. The categories "unengaged" and "undecided" were merged due to low count in the category "unengaged".

The development of questions related to preferences for participating in online psychological interventions to reduce cannabis use was informed by our previous qualitative work (Tatar et al., 2021). These questions measured preferences for: (1) intervention intensity (domain A); (2) autonomy in completing the intervention (domain B); (3) feedback related to cannabis use (domain C); and (4) technology platforms and app functionalities (domain D).

Within domains A to C, we identified three relevant attributes (e.g., session duration, session frequency, and intervention duration for domain A) and attribute-levels for each attribute (e.g., 5, 15, or 30 min for session duration; daily, three times a week, or once a week for session frequency; and 6 weeks, 3 months, or 6 months for intervention duration). Preferences were measured using the case 2 Best-Worst Scaling (BWS) methodology that permits an in-depth evaluation of preferences based on utility trade-off between attributes and their corresponding attribute-levels using multiple questions (Finn and Louviere, 1992; Szeinbach et al., 1999).

Based on the recommended simple orthogonal main effect design methodology (Aizaki and Fogarty, 2019) and the R software packages "DoE.base" (Groemping, 2017) and "support.BWS2" (Aizaki, 2019), we created nine choice sets (questions) with three alternatives for each of the domains A to C. In each question, the attributes (e.g., session duration) remained unchanged (i.e., three attributes), but the attribute-levels (e.g., 5, 15, or 30 min) varied, and participants were instructed to select the best and the worst statement represented by the combination of an attribute and its corresponding attribute-level (i.e., utility trade-off). Participants answered nine questions for each of the domains A to C. (Table 1).

In domain D, we used the ranking methodology to measure preferences separately for six attributes. For each attribute, participants ranked three or four attribute-levels from 1 (most preferred) to 3 (least preferred) or 1 to 4, respectively.

Table 1
Sample questions for domains A, B, and C.

Prefer the least	**Q1 (out of 9) for domain A**	Prefer the most
	Participate in an online psychological intervention, with each session lasting: *5* min.	
	Participate in an online psychological intervention whose frequency is: *every day*	
	Participate in an online psychological intervention whose total duration is: *6 weeks*	
	Q1 (out of 9) for domain B	
	Receive help from the case worker (for example your case manager) to complete the online psychological intervention sessions: *at the start of the intervention only*	
	Complete the psychological intervention sessions with: *the case worker (for example your case manager), in-person*	
	Complete the psychological intervention sessions online: *at the clinic*	
	Q1 (out of 9) for domain C	
	During the psychological intervention, receive feedback from your case worker (for example your case manager): *once a week*	
	During the psychological intervention, receive feedback generated by the application: *every day*	
	During the psychological intervention, receive feedback from: *the application only*	

Note: In Italics are provided attribute-levels (e.g., 5 min) for each attribute. In each question, the attributes were the same (e.g., "Participate in an online psychological intervention, with each session lasting…") but different combinations of attribute-levels were provided. In each question, participants selected one statement that they preferred the least and one statement they preferred the most. Participants were offered a description of "psychological intervention" that read "An intervention (therapy) that aims to change your attitudes, behaviours, ways of thinking or reacting, in order to help you feel better, find answers to your questions, solve your problems, make choices and better understand yourself."

Finally, participants were asked to rate their satisfaction in participating in the survey using a 5-point Likert format ("not satisfying" to "extremely satisfying"). To facilitate the identification of inattentive responders, we randomly inserted in the questionnaire three attention-check questions that were not related to the content of the survey (e.g., "I have never met someone older than me"). The programming of the survey did not allow skipping questions.

2.4. Sample size

Sample calculations were based on the number of observations needed to assess, using conditional logistic regression, preferences for online psychological interventions (main objective) as measured by the BWS questions corresponding to domains A to C. To build the design matrix used for sample calculation, we used the method for BWS case 2 for marginal models (Aizaki and Fogarty, 2019). The sample size calculation was based on de Bekker-Grob et al.'s method for Discrete Choice Experiments (DCE) which is applicable to BWS case 2 scenarios as a DCE variant (de Bekker-Grob et al., 2015). This method accounts for the number of estimated coefficients (i.e., $n = 8$ as one attribute and one attribute level for each attribute was chosen as reference), the number of questions for each domain (i.e., $n = 9$), alternatives per question (i.e., $n = 6$, as for each attribute level there are two possible response options—"best" or "worst"), and the type of design matrix (marginal). Based on these parameters and considering an estimated small to moderate effect size (i.e., conditional regression coefficient beta=0.25 for all eight parameters of interest, a 95% confidence level [for a two-sided significance level α=0.025] and a desired statistical power of at least 80%), we calculated that the minimum required number of participants would be $n = 89$. To prepare an estimated 10% of participants not providing correct answers to all three attention-check questions, we calculated that approximately 100 completed questionnaires were needed for this study (89×100/90=98.8). The required sample sizes for all three domains were the same due to identical design matrix and parameters assumptions.

2.5. Statistical methods

2.5.1. Descriptive analyses

For continuous and Likert-scale variables we calculated the mean (*M*) and standard deviation (*SD*); for categorical variables we reported the number of observations and percentages for each category.

Within each of the domains A to C, corresponding to the nonparametric counting approach for analyzing BWS data (Aizaki and Fogarty, 2019), we calculated for each observation a score by subtracting the number of times an attribute-level (or attribute) was selected as the worst from the number of times an attribute-level (or attribute) was selected as the best among all the questions in a domain. The scores for all observations were summed to calculate the best-worst score (*BWs*) for each attribute and attribute level. See table notes for standardized BWs (*std BWs*) calculations. Higher *BWs* and *std BWs* reflect higher preference levels.

For each of the questions in domain D, we counted the frequency an item was ranked first and divided it by the total number of observations in the dataset to obtain the proportion of an item being ranked first. In addition, for each item corresponding to questions 1 to 6, we calculated the mean rank (a lower mean rank denoting higher preference for an item) and tested whether the provided rankings within each question were random in nature, i.e., mean item rankings were statistically different from 2 for questions with three items and 2.5 for questions with four items (Finch, 2022).

2.5.2. Multivariable analyses of BWS data

For domains A to C, we used conditional logistic regression modeling and the marginal BWS case 2 model approach to estimate the log-odds of preferences for attributes and attribute-levels compared to the reference

categories (Aizaki and Fogarty, 2019). For our BWS design (i.e., three statements combining attribute-attribute levels per question), the marginal model posits that there are three possible most preferred and three possible least preferred statements; if for example the participant selected the first statement in a question as the best and the last statement as the worst, then the utility of the first statement was the highest among the three statements and the utility of the last statement was the lowest (Aizaki and Fogarty, 2019). For each of the eight estimates (one attribute and one attribute-level were used as reference) in the three models corresponding to domains A to C, we report the odds-ratio (*OR*) and 95% confidence interval (*CI*) of preferences for attributes and attribute-levels.

2.5.3. Ranking data analyses

For ranked response data (domain D), we used the Plackett-Luce model and the maximum likelihood method to estimate the log-worth of items compared to the reference category (Finch, 2022). The worth of an item represents the importance given by participants to that item compared to the chosen reference item and corresponds to its assigned ranking. Thus, higher worth denotes higher ranking or higher preferences. For each question, we reported the item worth from the Placket-Luce model (and the 95% *CI*) and the estimated probability for each item to be ranked first. Each of the six questions with ranking data were analyzed separately.

2.5.4. Exploratory analyses

We used a two-step approach to explore the associations between preferences within each of the domains A to D and sociodemographic data (i.e., biological sex, gender, age, education, living situation, homelessness— "have you spent at least one night without shelter in the last 6 months?"), substance use (i.e., frequency of cannabis use), and intentions to reduce or stop cannabis use. First, we used the likelihood-ratio test to compare the goodness of fit of the two nested conditional logistic or Plackett-Luce models that included attributes (and attribute-levels) only vs. attributes (and attribute-levels) and their interaction with a covariate (e.g., sex); the tests were conducted separately for each categorical exploratory variable. The significance level was set to α=0.05 for the comparison of nested models belonging to domains A to C and α=0.1 for domain D because models in domains A to C were ran using a higher number of data-points (i.e., nine data-points for each attribute) than models in domain D. Second, for exploratory variables for which the likelihood ratio tests were significant, we ran subgroup analyses (e.g., separately for males and females) using the modeling approach outlined above. We used the R software v. 4.2.2 to conduct all analyses (R Development Core Team, 2005).

3. Results

3.1. Sample characteristics

104 observations were included in the analyses (Fig. 1). All participants answered the three attention questions correctly. Participant satisfaction with the survey was high (M = 3.86; SD=0.94), with 66.3% reporting to be "very satisfied" or "extremely satisfied". The median survey completion time was 33.6 min; participants who took >60 min for completion (n = 46) were excluded from mean completion time calculation because most likely they completed the survey in multiple sessions (Table 2).

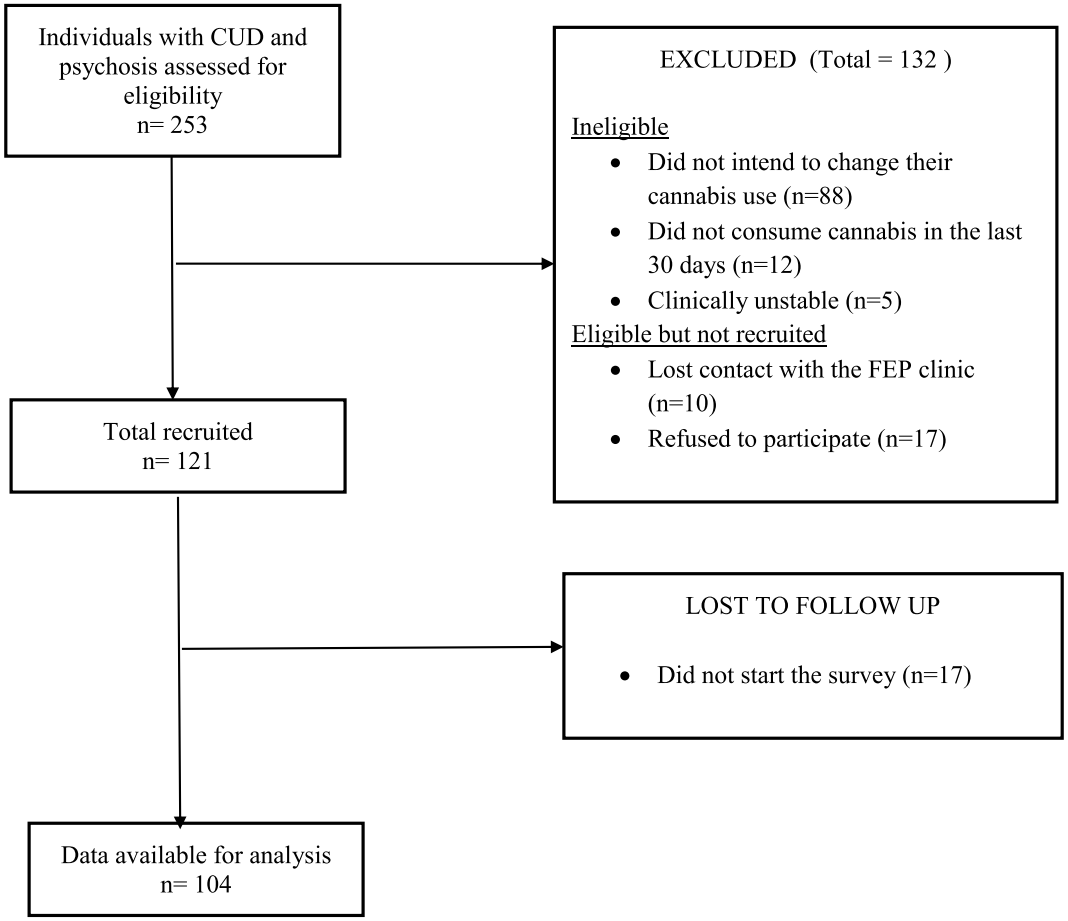

Fig. 1. Study flow diagram.

Table 2
Sample characteristics.

Variable	M (SD) or n (%)
Sociodemographics	
Age (years)	24.15 (3.57)
Gender	
Man	75 (72.1)
Woman	18 (17.3)
Other (Transgender, non-binary)	9 (8.7)
Prefer not to answer	2 (1.9)
Biological sex	
Male	80 (76.9)
Female	23 (22.1)
Prefer not to answer	1 (1)
Relationship status	
In relationship or married	22 (21.2)
Single	80 (76.9)
Other or prefer not to answer	2 (1.9)
Employment status	
Employed	39 (37.5)
Unemployed	47 (45.2)
Student	18 (17.3)
Education	
Secondary or less	73 (70.2)
Post secondary	31 (29.8)
Personal income in the last year before taxes*	
<$10,000	43 (41.3)
$10,000–30,000	36 (34.6)
>$30.000	11 (10.6)
Prefer not to answer or don't know	14 (13.5)
Race/ethnicity	
White	63 (60.6)
Black	18 (17.3)
Indigenous	8 (7.7)
Other (Hispanic, Middle Eastern, Asian)	15 (14.4)
Stable housing	
Yes	92 (88.5)
No	12 (11.5)
Living situation	
Independent housing	42 (40.4)
With family or partner	38 (36.5)
Group home or supervised housing	12 (11.5)
Homeless	12 (11.5)
At least one night without shelter in the last 6 months	
Yes	22 (21.2)
No	82 (78.8)
Internet use	
Yes	104 (100)
No	0 (0)
Internet use location**	
At home	80 (76.9)
Anywhere with mobile data	31 (29.8)
Where free WIFI is available	20 (19.2)
At the clinic	6 (5.8)
Access to a technological device	
Yes	102 (98.1)
No	2 (1.9)
Access to technological device**	
Computer	57 (54.8)
Smartphone	88 (84.6)
Tablet	26 (25)
Substance use history	
Age of first cannabis use (years)	15.27 (2.78)
Cannabis use in the last 3 months	
Less than 4 days per month	10 (9.6)
1–2 days per week	17 (16.3)
3–6 days per week	32 (30.8)
Every day	45 (43.3)
Ever participated in an intervention for cannabis use	
Yes	38 (36.5)
No or don't know	66 (63.5)
Other concomitant substance use	
Yes	68 (65.4)
No	36 (34.6)
Concomitant substance used**	
Alcohol	49 (47.1)
Cocaine	15 (14.4)
Amphetamines	15 (14.4)
Tobacco	57 (54.8)
Other substances	3 (2.9)
Intentions to reduce/stop using cannabis	
Undecided	29 (27.9)
Decided to	25 (24.0)
Changing	50 (48.1)

Note:.
* denotes Canadian Dollars;.
** The total exceeds 100% because multiple answers were permitted; For age, we provided the mean (M) and standard deviation (SD).

3.2. Main analyses

3.2.1. Preferences for intervention intensity, autonomy, and feedback related to cannabis use

Descriptive analyses of preferences for intervention intensity (domain A) showed that among all attributes and attribute-levels, participants preferred most the duration of individual sessions (*std BWs*=0.21) with a length of 15 min (*std BWs*=0.29) and a session frequency of once a week (*std BWs*=0.20). Results of conditional logistic regression modeling showed significantly higher preferences for the length of intervention sessions (*OR*=1.63; *CI*: 1.45; 1.82) compared to the total length of the intervention, for sessions lasting 15 min compared to 5 min (*OR*=1.19; *CI*: 1.03; 1.37), and for completing sessions once a week compared to every day (*OR*=2.06; *CI*: 1.79; 2.37) (Table 3).

Concerning participant autonomy in completing the online intervention (domain B), preferences were highest for the mode of receiving the intervention (*std BWs*=0.20), either exclusively technology-based (*std BWs*=0.23) or a combination of in-person and technology-based (*std BWs*=0.23). Results of multivariable analyses showed higher preferences for the mode of receiving the intervention than for the frequency of assistance from the clinician in completing the online intervention (*OR*=1.63; *CI*:1.46; 1.83). We found lower preferences for in-person compared to technology-based interventions (*OR*=0.86; *CI*: 0.75; 0.98). Participants expressed higher preferences for once-per-week (*OR*=1.16; *CI*: 1.01; 1.33) and lower preferences for one-time (i.e., at the beginning of the intervention; *OR*=0.78; *CI*: 0.68; 0.89) assistance from the clinician in completing the online intervention compared to assistance offered at every session. We found higher preferences for participating in an online intervention either outside the clinic (*OR*=1.24; *CI*: 1.08; 1.42) or in a hybrid format (i.e., both at the clinic and outside the clinic; *OR*=1.15; *CI*: 1.002; 1.32) compared to exclusively at the clinic (Table 4).

Concerning preferences for receiving feedback related to cannabis use (domain C), analyses show that participants most preferred receiving feedback from both the application and clinician (*std BWs*=0.29) with clinician feedback once-per-week (*std BWs*=0.13). Correspondingly, regression analyses show higher preferences for a combined clinician-application feedback delivery method (*OR*=1.74; *CI*: 1.51; 2.00) compared to application only and higher preferences for receiving feedback from the clinician once-per-week (*OR*=1.29; *CI*: 1.13; 1.48) compared to twice-per-week. Participants had lower preferences of receiving feedback from the clinician only compared to application only (*OR*=0.85; *CI*: 0.74; 0.98) (Table 5).

3.2.2. Preferences for technology platforms and app functionalities (domain D)

With respect for platforms, the highest preferences were for using a smartphone (58.7%), to watch a video with an actor (42.3%), and for having access through the application to games (31.7%), a cannabis use log (43.3%), a chat interface to communicate with the clinician (43.3%), and a rewards points table (54.8%).

These results were supported by the probabilities of highest rank

Table 3
Best-Worst Scaling results for intervention intensity (domain A).

Attributes and attribute-levels	BWs; std BWs	OR	95% CI
Attributes			
Session duration	199; 0.21	**1.63*** **	**1.45; 1.82**
Session frequency	−105; −0.11	0.98	0.87; 1.09
Intervention duration	−94; −0.10	Reference	
Attribute-levels for *session duration*			
5 min	56; 0.18	Reference	
15 min	89; 0.29	**1.19***	**1.03; 1.37**
30 min	54; 0.17	0.91	0.79; 1.05
Attribute-levels for *session frequency*			
Every day	−118; −0.38	Reference	
Three times a week	−49; −0.16	0.91	0.79; 1.05
Once a week	62; 0.20	**2.06*** **	**1.79; 2.37**
Attribute-levels for *intervention duration*			
6 weeks	−26; −0.08	1.04	0.91; 1.20
3 months	−22; −0.07	1.07	0.93; 1.23
6 months	−46; −0.15	Reference	

Note: Significance levels *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. In bold are presented significant odds ratios (OR) and 95% confidence intervals (95% CI); BWs denotes best minus worst score; std BWs denotes standardized BWs; std BWs =BWs/9*104 for attributes and BWs/3*104 for attribute-levels. Concordance of the conditional logistic regression model including attributes and attribute-levels=0.63 (standard error= 0.01).

Table 4
Best-Worst Scaling results for autonomy in completing the intervention (domain B).

Attributes and attribute-levels	BWs; std BWs	OR	95% CI
Attributes			
Frequency of assistance from the clinician	−114; −0.12	Reference	
Preferred mode of receiving the intervention	185; 0.20	**1.63*** **	**1.46; 1.83**
Preferred location for participating in the intervention	−71; −0.08	1.07	0.96; 1.20
Attribute-levels for *frequency of assistance from the clinician*			
At the start of the intervention only	−72; −0.23	**0.78*** **	**0.68; 0.89**
Every session	−24; −0.08	Reference	
One time per week	−18; −0.06	**1.16***	**1.01; 1.33**
Attribute-levels for *preferred mode of receiving the intervention*			
In-person	41; 0.13	**0.86***	**0.75; 0.98**
Technology-based	71; 0.23	Reference	
In-person and technology-based	73; 0.23	1.09	0.95; 1.25
Attribute-levels for *preferred location for participating in the intervention*			
Outside the clinic	5; 0.02	**1.24** **	**1.08; 1.42**
At the clinic and outside the clinic	−5; −0.02	**1.15***	**1.002; 1.32**
At the clinic	−71; −0.23	Reference	

Note: Significance levels *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. In bold are presented significant odds ratios (OR) and 95% confidence intervals (95% CI); BWs score denotes best minus worst score; std BWs denotes standardized BWs; std BWs=BWs/9*104 for attributes and BWs/3*104 for attribute-levels. Concordance of the conditional logistic regression model including attributes and attribute-levels=0.60 (standard error=0.01).

Table 5
Best-Worst Scaling results for feedback related to cannabis use (domain C).

Attributes and attribute-levels	BWs; std BWs	OR	95% CI
Attributes			
Frequency of feedback from the treating clinician	15; 0.02	**1.14***	**1.02; 1.28**
Frequency of feedback from the application	−66; −0.07	Reference	
Preference for the feedback delivery method	51; 0.05	**1.21*** **	**1.08; 1.36**
Attribute levels for *frequency of feedback from the treating clinician*			
Twice a week	−19; −0.06	Reference	
Once a week	40; 0.13	**1.29*** **	**1.13; 1.48**
Once a month	−6; −0.02	0.92	0.80; 1.06
Attribute levels for *frequency of feedback from the application*			
Every day	−33; −0.11	Reference	
Twice a week	−21; −0.07	1.01	0.88; 1.16
Once a week	−12; −0.04	1.08	0.94; 1.24
Attribute-levels for *preference for the feedback delivery method*			
From case worker (clinician) only	−4; −0.01	**0.85***	**0.74; 0.98**
From application and case worker (clinician)	92; 0.29	**1.74*** **	**1.51; 2.00**
From the application only	−37; −0.12	Reference	

Note: Significance levels *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. In bold are presented significant odds ratios (OR) and 95% confidence intervals (95% CI); BWs denotes best minus worst score; std BWs denotes standardized BWs; std BWs=BWs/9*104 for attributes and BWs/3*104 for attribute-levels. Concordance of the conditional logistic regression model including attributes and attribute-levels=0.57 (standard error=0.01).

Table 6
Results of rank analyses for technology platforms and app functionalities (domain D).

Item	Descriptive statistics		Luce model estimates	
	Item ranked first (%)	Mean rank	Item worth (95% CI)	Probability of highest rank (%)
(Q1)…prefer to use following technology for the online psychological intervention§				
Smartphone	58.7	1.63	**1.65 (1.14; 2.38)****	50.2
Tablet	12.5	2.38	**0.63 (0.44; 0.91)***	19.3
Computer (desktop or laptop)	28.8	2.00	*Ref*	30.5
(Q2)…prefer the following format for the online psychological intervention§				
Video with an actor	42.3	2.13	1.08 (0.77; 1.51)	33.1
Video with an animated character	26.9	2.29	*Ref*	30.6
Written text	15.4	2.82	**0.57 (0.41; 0.81)****	17.6
Audio (text-to-speech)	15.4	2.77	**0.61 (0.43; 0.86)****	18.7
(Q3)…in the application used for the online psychological intervention I would like to have access to				
Games	31.7	2.52	*Ref*	22.1
Modules to help you relax	20.2	2.60	1.06 (0.75; 1.50)	23.6
Modules to track your mood and anxiety	27.9	2.33	1.35 (0.94; 1.92)	29.8
Testimonials from people who've succeeded in reducing their cannabis use	20.2	2.56	1.11 (0.78; 1.57)	24.5
(Q4)…in the application used for the online psychological intervention I would like to have access to				
Physical activity log	36.5	1.95	*Ref*	34.7
Budget tracking log	20.2	2.15	0.83 (0.58; 1.17)	28.7
Cannabis use log	43.3	1.89	1.05 (0.73; 1.51)	36.5
(Q5)..in the application used for the online psychological intervention I would like to have the possibility of§				
Speaking with clinician via chat	43.3	2.01	**1.47 (1.03; 2.10)***	37.9
Contacting other users during the intervention (e.g., forum)	15.4	2.86	**0.61 (0.43; 0.89)****	15.8
Emailing clinician	6.7	2.80	0.80 (0.57; 1.12)	20.6
Texting clinician	34.6	2.34	*Ref*	25.7
(Q6)…in the application used for the online psychological intervention I would like to have§				
A reward points table	54.8	1.69	**1.67 (1.16; 2.40)****	47.1
The possibility of personalizing the application	21.2	2.13	*Ref*	28.2
A contact list	24.0	2.18	0.88 (0.62; 1.25)	24.8

Note: § denotes significant Chi-square test ($p < 0.05$) showing non-random rankings; Ref denotes reference category; In bold significant worth estimates; Question 1 (Q1); Q4; Q6 include rankings 1 to 3 and Q2; Q3; Q5 include rankings from 1 to 4. Significance levels *$p < 0.05$; **$p < 0.01$.

estimated using the Plackett-Luce models except for the preferences for games and cannabis use log; for these items, based on the Chi-square test ($p > 0.05$), we could not reject the null hypothesis that the ranking was random. Luce models showed higher perceived worth (w) for using a smartphone compared to a computer ($w = 1.65$; *CI*: 1.14; 2.38) and lower worth for written text format ($w = 0.57$; *CI*: 0.41; 0.81) or audio format of the online intervention ($w = 0.61$; *CI*: 0.43; 0.86) compared to video using an animated character. The Luce models estimates showed higher worth of speaking with the clinician via the chat function in the app ($w = 1.47$; *CI*: 1.03; 2.10) than communicating via text messages and for access to a reward points table ($w = 1.67$; *CI*: 1.16; 2.40) compared to having the possibility to personalize the application that hosts the psychological intervention. Preferences for having the option to contact other users through the app were lower compared to using text communications with the clinician ($w = 0.61$; *CI*: 0.43; 0.89) (Table 6, Fig. 2-results summary).

3.3. Exploratory analyses

3.3.1. Preferences for intervention intensity, autonomy in completing the intervention, and feedback related to cannabis use

Female respondents preferred an online session duration of 15 min (*OR*=1.39) and receiving assistance from the clinician to complete the online intervention once-per-week (*OR*=1.76) and had lower preferences for receiving feedback about cannabis use from the clinician only (*OR*=0.73); these effects were not significant in male respondents. Conversely, male respondents preferred participating in the online intervention outside the clinic (*OR*=1.24). Younger participants (18–24 years) had lower preferences for receiving feedback from the clinician only; these effects were not found in older participants. Lower education was associated with lower preferences for receiving assistance from the clinician at the beginning of treatment (*OR*=0.76) and for receiving the intervention in-person (*OR*=0.81), and higher education attainment was associated with higher preferences of receiving assistance from the clinician once per week (*OR*=1.37). We found significant effects (same direction and similar effect size as in the main model) in the subgroups with higher living autonomy (i.e., independent housing or living with a family or partner) and housing stability (i.e., with stable housing in the last 6 months) related to the autonomy in participating in the intervention (domain B), but these effects were not significant in those with lower living autonomy and housing stability.

No subgroup differences based on intentions to decrease cannabis use were found for attribute-levels related to intervention intensity. Subgroup estimates for intentions to decrease cannabis use and frequency of cannabis use pertaining to receiving feedback related to cannabis use from both the application and clinician (domain C) fully support the findings of the regression models without covariates (Appendix A).

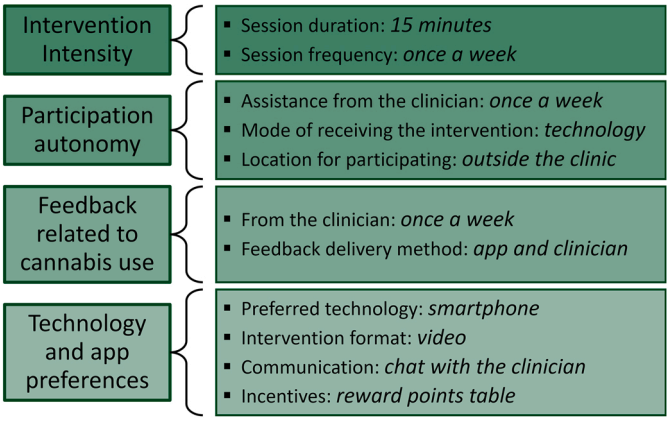

Fig. 2. Summary of main findings.

3.3.2. Preferences for technology platforms and app functionalities

The worth of having access to modules for mood tracking (compared to having access to games) through the application was significant in women ($w = 3.74$), and preferences for having access to a reward points table was significant in men ($w = 2.10$). Older participants had higher preferences for a reward points table ($w = 2.12$) compared to personalizing the application, but the effect was not significant in younger participants. Individuals with higher education attainment had lower preferences for an audio format of the intervention ($w = 0.32$) compared to an animation video, for contacting other users during the intervention using a forum ($w = 0.33$) compared to texting the clinician and showed higher preferences for having access to a reward points table ($w = 3.49$). An autonomous living situation (i.e., independent housing) was associated with higher preferences for having access to modules for mood tracking ($w = 1.83$) compared to having access to games, and participants consuming cannabis on more than 3 days per week preferred less ($w = 0.51$) to have access to a budget tracking log compared to a physical activity log (Appendix B).

4. Discussion

The main objective of this study was to assess preferences for an online app-based psychological intervention to treat CUD in individuals with FEP, regarding intensity, autonomy in completing the intervention, feedback related to cannabis use, and technology platforms and app functionalities. As a secondary objective we explored subgroup differences in preferences based on sociodemographic characteristics and cannabis use patterns. To our knowledge, this is the first study that used advanced methodologies to capture and analyze preferences for an app-based psychological intervention to treat CUD in this population.

The results show higher patient preferences for a moderate intensity app-based intervention that includes modules with a length of 15 min scheduled once per week. Preferences for the total duration of the app-based intervention were equivocal. In individuals without psychosis, substantial evidence indicates that psychological interventions that include more than four sessions (in total) delivered for a period greater than one month are more effective in decreasing the frequency of cannabis use compared to less intensive interventions (Gates et al., 2016; Olmos et al., 2018). Consequently, for higher intensity app-based interventions to be acceptable by individuals with psychosis, these should extend over longer periods of time and should not be too demanding in terms of session length and expected frequency of participation.

Previous research has reported that app-based interventions could provide higher autonomy and facilitate engagement with services among individuals with psychosis (Gire et al., 2021). Similarly, present study participants indicated a need for autonomy when participating in psychological interventions for CUD. They preferred app-based compared to in-person interventions, which may be due to the former's greater accessibility and convenience. Importantly, clinicians' concerns that using an app-based intervention could impede the maintenance of regular contact with the clinic and the clinician-patient relationship (Tatar et al., 2021) were not supported by the result of this study. Participants favored receiving guidance from clinicians on how to navigate the intervention and getting feedback related to their cannabis use at a frequency of once per week. Results of a meta-review of meta-analyses, show that in individuals without psychosis who have greater symptom severity (i.e., anxiety, depression, stress, post-traumatic stress disorder), providing human support integrated in digital mental health interventions can improve outcomes (Werntz et al., 2023). However, considering the intensive nature of interventions received by individuals in EIS for psychosis that implies regular (weekly) face-to-face contact with clinicians, more research is needed to understand whether and how embedding human support in app-based interventions for CUD affects outcomes in this population.

In our study, participants expressed higher preferences for chat enabled synchronous communications over asynchronous communications using text messages. Therefore, an app-based intervention for CUD that supports real-time patient-clinician communications could facilitate engagement of individuals who have difficulties in attending in-person appointments, for example due to anxiety or accessibility issues (Lal et al., 2020).

Participants favored having video intervention components over access to written text. Including videos (e.g., patient testimonials) alongside text-based content could improve participant experience and is supported by previous research showing that individuals with psychosis favored a mixed format (Lal et al., 2015) and considered videos more personal and engaging than text-based components, while acknowledging that written text facilitated completing a smartphone intervention (e.g., FOCUS-AV) at their own pace (Ben-Zeev et al., 2018). A recent systematic review concluded that the three most frequently used gamification elements in mental health and well-being apps (including apps for SUD) were levels or progress feedback (80%), points or scoring (56%), and rewards or prizes (50%) (Cheng et al., 2019). In this study, high preferences for having access to a reward points table (especially among men, those with postsecondary education, and those older than 24 years of age) supports the option of including gamification elements in apps for the treatment of CUD in individuals with psychosis to facilitate their engagement with the app and potentially improve intervention outcomes (Cheng et al., 2019).

Evaluating the severity of CUD and stage of behavioral intention related to cannabis use are important early steps in the assessment of individuals with FEP and CUD as these evaluations can guide the intensity and type of implemented interventions (Ouellet-Plamondon et al., 2021). Our exploratory analyses showed that individuals who were undecided, who had decided to change, or who were already changing their cannabis use preferred completing intervention sessions and receiving feedback related to their cannabis use from clinician once per week. Independent of the frequency of cannabis use, participants preferred a combined approach that included receiving feedback from the app and the clinician. These results suggest that an app-based intervention could complement the assistance offered by clinicians in treating CUD.

The exploratory analyses found that preferences for participating in an intervention for CUD (e.g., in-person or technology-assisted) among participants with housing instability were less clearly defined. Possibly, these individuals had lower needs for treatment autonomy and interest in participating in interventions for CUD, including app-based interventions, compared to those with a higher living stability. Subgroup analyses revealed that females (i.e., biological sex) had clearly defined preferences for the frequency of assistance from the clinician and higher preference for mood tracking modules while males had better defined preferences related to the location of participating in the intervention (e.g., outside the clinic). Although the literature on the influence of sex and gender on acceptability of technology-based interventions for SUD is scarce, our results suggest that women may favor in-person interactions with their clinicians (i.e., less autonomy needs) when participating in interventions for CUD and may have different expectations from an app-based intervention than men. This aligns with Campbell et al.'s study which found lower acceptability of the Therapeutic Education system (62 video-based modules) in women with SUD (23% cannabis-related) without psychosis but no effect in men (Campbell et al., 2015). Consequently, women may experience unique psychosocial challenges that can impact their engagement in SUD treatments; more research is needed to untangle how app-based interventions could address these barriers (Greenfield et al., 2007).

This study is not without limitations. First, we did not measure all preferences using the BWS methodology, although it is considered superior to the item ranking approach (Ben-Akiva et al., 1992). Although BWS allows a more in-depth analysis of preferences, it also lengthens the total questionnaire response time which could be problematic in participants with psychosis-related cognitive difficulties. Second, results of

the exploratory subgroup analyses should be interpreted with caution due to the small number of observations. Third, we did not collect data about symptom severity, overall functioning and medication status and more research is needed to investigate the associations between these clinical characteristics and preferences for app-based psychological interventions for CUD in individuals with FEP. Fourth, our results cannot be generalized to all individuals treated in EIS for psychosis because in our study participants reported very high access to technological devices and internet use. Fifth, we included only individuals open to change their cannabis use and their preferences for app-based psychological interventions could be different from those who refuse to decrease or stop their cannabis consumption. Finally, the variability in the type and intensity of face-to-face interventions for SUD between EIS for psychosis could affect patient preferences for an app-based intervention for CUD and limits the generalizability of our findings.

This study fills an important gap in the literature as research related to app-based interventions for CUD in individuals with FEP is nascent. Our study was informed by state-of-the-art scientific insights that highlight the importance of considering patient preferences for app-based interventions to facilitate patient engagement towards improving intervention outcomes. The use of BWS and ranking methodologies facilitated a reliable assessment of patient preferences that informed the development of iCanChange (iCC), a novel mobile app-based intervention for the treatment of CUD in individuals with FEP. The iCC is used in the experimental group of ReCAP-iCC, an ongoing pilot two-arm RCT that will provide important information about feasibility (use patterns and completion rates) and short-term intervention outcomes (Tatar et al., 2022). The findings of this study may provide important insights for researchers and clinicians interested in developing app-based interventions for CUD and potentially for other SUD in individuals with early psychosis.

Authors' contributions

OT wrote the initial manuscript draft, tables, and figures. OT and AD conducted formal analyses. OT, AA-B, AD, HB, AB, PGT, DC, M-AR, JanC, BF, TL, JoséC, CO-P, SL, MV, and DJ-A, contributed to the study conceptualization, critically reviewed, and edited the manuscript. DJ-A obtained funding and supervised the study development and conduct. All authors approved the manuscript.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.psychres.2023.115276.

References

Abdel-Baki, A., Ouellet-Plamondon, C., Salvat, E., Grar, K., Potvin, S., 2017. Symptomatic and functional outcomes of substance use disorder persistence 2 years after admission to a first-episode psychosis program. Psychiatry Res. 247, 113–119. https://doi.org/10.1016/j.psychres.2016.11.007.

Aizaki, H., Fogarty, J., 2019. An R package and tutorial for case 2 best–worst scaling. Journal Choice Model. 32 https://doi.org/10.1016/j.jocm.2019.100171.

Aydin, C., Tibbo, P.G., Ursuliak, Z., 2016. Psychosocial interventions in reducing cannabis use in early phase psychosis: a Canadian survey of treatments offered. Can. J. Psychiatry 61 (6), 367–372. https://doi.org/10.1177/0706743716639931.

Bahji, A., Meyyappan, A.C., Hawken, E.R., Tibbo, P.G., 2021. Pharmacotherapies for cannabis use disorder: a systematic review and network meta-analysis. Int. J. Drug Policy 97, 103295. https://doi.org/10.1016/j.drugpo.2021.103295.

Ben-Akiva, M., Morikawa, T., Shiroishi, F., 1992. Analysis of the reliability of preference ranking data. J. Bus. Res. 24 (2), 149–164. https://doi.org/10.1016/0148-2963(92)90058-j.

Ben-Zeev, D., Brian, R.M., Aschbrenner, K.A., Jonathan, G., Steingard, S., 2018. Video-based mobile health interventions for people with schizophrenia: bringing the "pocket therapist" to life. Psychiatr. Rehabil. J. 41 (1), 39–45. https://doi.org/10.1037/prj0000197.

Camacho, E., Levin, L., Torous, J., 2019. Smartphone apps to support coordinated specialty care for prodromal and early course schizophrenia disorders: systematic review. J. Med. Internet Res. 21 (11), e16393. https://doi.org/10.2196/16393.

Campbell, A.N., Nunes, E.V., Pavlicova, M., Hatch-Maillette, M., Hu, M.C., Bailey, G.L., Sugarman, D.E., Miele, G.M., Rieckmann, T., Shores-Wilson, K., Turrigiano, E., Greenfield, S.F., 2015. Gender-based outcomes and acceptability of a computer-assisted psychosocial intervention for substance use disorders. J. Subst. Abuse Treat. 53, 9–15. https://doi.org/10.1016/j.jsat.2014.12.006.

Cheng, V.W.S., Davenport, T., Johnson, D., Vella, K., Hickie, I.B., 2019. Gamification in apps and technologies for improving mental health and well-being: systematic review. JMIR Ment. Health 6 (6), e13717. https://doi.org/10.2196/13717.

de Bekker-Grob, E.W., Donkers, B., Jonker, M.F., Stolk, E.A., 2015. Sample size requirements for discrete-choice experiments in healthcare: a practical guide. Patient 8 (5), 373–384. https://doi.org/10.1007/s40271-015-0118-z.

Finch, H., 2022. An introduction to the analysis of ranked response data. Pract. Assess. Res. Eval. 27 (7) https://doi.org/10.7275/tgkh-qk47.

Finn, A., Louviere, J.J., 1992. Determining the appropriate response to evidence of public concern: the case of food safety. J. Public Policy Market. 11 (2), 12–25. https://doi.org/10.1177/074391569201100202.

Firth, J., Cotter, J., Torous, J., Bucci, S., Firth, J.A., Yung, A.R., 2016. Mobile phone ownership and endorsement of "mHealth" among people with psychosis: a meta-analysis of cross-sectional studies. Schizophr. Bull. 42 (2), 448–455. https://doi.org/10.1093/schbul/sbv132.

Firth, J., Torous, J., 2015. Smartphone apps for schizophrenia: a systematic review. JMIR mHealth uHealth 3 (4), e102. https://doi.org/10.2196/mhealth.4930.

Gates, P.J., Sabioni, P., Copeland, J., Le Foll, B., Gowing, L., 2016. Psychosocial interventions for cannabis use disorder. Cochrane Database Syst. Rev. 2016 (5), CD005336 https://doi.org/10.1002/14651858.CD005336.pub4.

Gire, N., Caton, N., McKeown, M., Mohmed, N., Duxbury, J., Kelly, J., Riley, M., P, J.T., Taylor, C.D.J., Naeem, F., Chaudhry, I.B., Husain, N., 2021. Care co-ordinator in my pocket': a feasibility study of mobile assessment and therapy for psychosis (TechCare). BMJ Open 11 (11), e046755. https://doi.org/10.1136/bmjopen-2020-046755.

Greenfield, S.F., Brooks, A.J., Gordon, S.M., Green, C.A., Kropp, F., McHugh, R.K., Lincoln, M., Hien, D., Miele, G.M., 2007. Substance abuse treatment entry, retention, and outcome in women: a review of the literature. Drug Alcohol Depend. 86 (1), 1–21. https://doi.org/10.1016/j.drugalcdep.2006.05.012.

Lagan, S., Camacho, E., Torous, J., 2021a. Is there a clinically relevant, publicly accessible app for that? Exploring the clinical relevance and availability of mobile apps for schizophrenia and psychosis. Schizophr. Res. 230, 98–99. https://doi.org/10.1016/j.schres.2020.11.007.

Lagan, S., Sandler, L., Torous, J., 2021b. Evaluating evaluation frameworks: a scoping review of frameworks for assessing health apps. BMJ Open 11 (3), e047001. https://doi.org/10.1136/bmjopen-2020-047001.

Lal, S., Abdel-Baki, A., Sujanani, S., Bourbeau, F., Sahed, I., Whitehead, J., 2020. Perspectives of young adults on receiving telepsychiatry services in an urban early intervention program for first-episode psychosis: a cross-sectional, descriptive survey study. Front. Psychiatry 11, 117. https://doi.org/10.3389/fpsyt.2020.00117.

Lal, S., Dell'Elce, J., Tucci, N., Fuhrer, R., Tamblyn, R., Malla, A., 2015. Preferences of young adults with first-episode psychosis for receiving specialized mental health services using technology: a survey study. JMIR Ment. Health 2 (2), e18. https://doi.org/10.2196/mental.4400.

Mummah, S.A., Robinson, T.N., King, A.C., Gardner, C.D., Sutton, S., 2016. IDEAS (Integrate, Design, Assess, and Share): a framework and toolkit of strategies for the development of more effective digital interventions to change health behavior. J. Med. Internet Res. 18 (12), e317. https://doi.org/10.2196/jmir.5927.

Olmos, A., Tirado-Munoz, J., Farre, M., Torrens, M., 2018. The efficacy of computerized interventions to reduce cannabis use: a systematic review and meta-analysis. Addict. Behav. 79, 52–60. https://doi.org/10.1016/j.addbeh.2017.11.045.

Groemping, U. (2017). DoE.base: full Factorials, orthogonal arrays and base utilities for DoE packages. https://cran.r-project.org/web/packages/DoE.base/index.html. (accessed: May 23, 2023).

American Psychiatric Association, (2021). Substance-related and addictive disorders. https://dsm.psychiatryonline.org/doi/10.1176/appi.books.9780890425787.x16_Substance_Related_Disorders. (accessed: May 23, 2023).

R Development Core Team. (2005). R: a language and environment for statistical computing. R Foundation for Statistical Computing. http://www.R-project.org/. (accessed 23 May 2023).

Aizaki, H., (2019). Support.BWS2: basic functions for supporting an implementation of Case 2 best-worst scaling. https://CRAN.R-project.org/package=support.BWS2. (accessed: May 23, 2023).

Ouellet-Plamondon, C., Abdel-Baki, A., Jutras-Aswad, D., 2021. Premier épisode psychotique et trouble de l'usage de substance concomitants : revue narrative des meilleures pratiques et pistes d'approches adaptées pour l'évaluation et le suivi. Santé mentale au Québec 46 (2). 10.7202/1088186ar.

Robotham, D., Satkunanathan, S., Doughty, L., Wykes, T., 2016. Do we still have a digital divide in mental health? A five-year survey follow-up. J. Med. Internet Res. 18 (11), e309. https://doi.org/10.2196/jmir.6511.

Schimmelmann, B.G., Conus, P., Cotton, S., Kupferschmid, S., McGorry, P.D., Lambert, M., 2012. Prevalence and impact of cannabis use disorders in adolescents with early onset first episode psychosis. Eur. Psychiatry 27 (6), 463–469. https://doi.org/10.1016/j.eurpsy.2011.03.001.

Schoeler, T., Monk, A., Sami, M.B., Klamerus, E., Foglia, E., Brown, R., Camuri, G., Altamura, A.C., Murray, R., Bhattacharyya, S., 2016. Continued versus discontinued cannabis use in patients with psychosis: a systematic review and meta-analysis. Lancet Psychiatry 3 (3), 215–225. https://doi.org/10.1016/s2215-0366(15)00363-6.

Szeinbach, S.L., Barnes, J.H., McGhan, W.F., Murawski, M.M., Corey, R., 1999. Using conjoint analysis to evaluate health state preferences. Drug Inf. J. 33 (3), 849–858. https://doi.org/10.1177/009286159903300326.

Tatar, O., Abdel-Baki, A., Tra, C., Mongeau-Perusse, V., Arruda, N., Kaur, N., Landry, V., Coronado-Montoya, S., Jutras-Aswad, D., 2021. Technology-based psychological interventions for young adults with early psychosis and cannabis use disorder: qualitative study of patient and clinician perspectives. JMIR Form. Res. 5 (4), e26562. https://doi.org/10.2196/26562.

Tatar, O., Abdel-Baki, A., Wittevrongel, A., Lecomte, T., Copeland, J., Lachance-Touchette, P., Coronado-Montoya, S., Cote, J., Crockford, D., Dubreucq, S., L'Heureux, S., Ouellet-Plamondon, C., Roy, M.A., Tibbo, P.G., Villeneuve, M., Jutras-Aswad, D., 2022. Reducing cannabis use in young adults with psychosis using iCanChange, a mobile health app: protocol for a pilot randomized controlled trial (ReCAP-iCC). JMIR Res Protoc 11 (11), e40817. 10.2196/40817.

Tatar, O., Bastien, G., Abdel-Baki, A., Huynh, C., Jutras-Aswad, D., 2020. A systematic review of technology-based psychotherapeutic interventions for decreasing cannabis use in patients with psychosis. Psychiatry Res. 288, 112940 https://doi.org/10.1016/j.psychres.2020.112940.

Torous, J., Firth, J., Huckvale, K., Larsen, M.E., Cosco, T.D., Carney, R., Chan, S., Pratap, A., Yellowlees, P., Wykes, T., Keshavan, M., Christensen, H., 2018a. The emerging imperative for a consensus approach toward the rating and clinical recommendation of mental health apps. J. Nerv. Ment. Dis. 206 (8), 662–666. https://doi.org/10.1097/NMD.0000000000000864.

Torous, J.B., Chan, S.R., Gipson, S.Y.T., Kim, J.W., Nguyen, T.Q., Luo, J., Wang, P., 2018b. A hierarchical framework for evaluation and informed decision making regarding smartphone apps for clinical care. Psychiatr. Serv. 69 (5), 498–500. https://doi.org/10.1176/appi.ps.201700423.

Vandenbroucke, J.P., von Elm, E., Altman, D.G., Gotzsche, P.C., Mulrow, C.D., Pocock, S. J., Poole, C., Schlesselman, J.J., Egger, M., Initiative, S., 2007. Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. PLoS Med. 4 (10), e297. https://doi.org/10.1371/journal.pmed.0040297.

Weinstein, S., Sandman, P., Blalock, S., 2008. The Precaution Adoption Process Model, 4 ed. Jossey-Bass, San Francisco, CA.

Werntz, A., Amado, S., Jasman, M., Ervin, A., Rhodes, J.E., 2023. Providing human support for the use of digital mental health interventions: systematic meta-review. J. Med. Internet Res. 25, e42864. https://doi.org/10.2196/42864.

Yardley, L., Morrison, L., Bradbury, K., Muller, I., 2015. The person-based approach to intervention development: application to digital health-related behavior change interventions. J. Med. Internet Res. 17 (1), e30. https://doi.org/10.2196/jmir.4055.

Yu, E., Xu, B., Sequeira, L., 2022. Determinants of e-mental health use during COVID-19: cross-sectional Canadian study. J. Med. Internet Res. 24 (11), e39662. https://doi.org/10.2196/39662.

Beth Israel Deaconess Medical Center, (2020). M-health index & navigation database (MIND). https://mindapps.org/Apps. (accessed: May 23, 2023).