

Looking at mHealth Digital Application Interventions for youths with Addictive Behavior through the Lens of Beck's Cognitive Model and Cognitive Behavioral Therapy: A Scoping Review

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Objective: To explore the scope of the published research studies on mHealth digital application interventions for youths with addictive behaviors, considering both the development and evaluation aspects. The main goal was to identify the concepts and theories underlying such applied technologies, detect any gaps, and provide recommendations. A secondary goal was to identify the components of mHealth digital application interventions that led to cognitive, emotional, and behavioral change among youths with addictive behaviors by drawing on Beck's cognitive model and cognitive behavioral therapy (CBT).

Materials and Methods: A scoping review was done based on York's five-stage framework outlined by Arksey and O'Malley. Four leading databases were searched, PubMed, Science Direct, Web of Science, and Google Scholar.

Results: There were 16 mHealth digital application interventions being developed to help youth overcome addiction issues. Most of the existing techniques involve dealing with youth's stimuli, emotions, addictive behaviors, and physiology or physical reactions. These were the components of cross-sectional Beck's cognitive model and CBT. In addition, most of the cognitive skill components were focused on managing reflective thoughts such as planning to stop addictive behaviors, intention to stop, encouraging more of creating positive thinking, or benefits of stop doing addictive behavior. No application component focused on identifying any implicit thought influenced of specific memories on addiction outcome expectancies such as the substance or self-intermediate belief, substance or self-core belief contained in Beck's longitudinal cognitive model.

Conclusion: Findings from the present scoping review suggest new routes for working with implicit thoughts. Some opportunities exist here for the development of CBT mHealth applications to raise awareness in youth concerning the implicit substance or self-concept appearing in Beck's longitudinal cognitive model.

Keywords: mHealth applications; CBT; Cognitive model; Beckian; Youth; Addictive behaviour; Substance

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Addictive behaviors have been increasingly found to have health impacts on youth groups,

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including gambling addiction, compulsive shopping, binge eating, internet overuse, and exercise addiction (EA), co-occurring with alcohol consumption, and drug use^(1,2). Responses to the problems usually involve understanding addictive behaviors through conceptualizing the research and social determinants of addictive behavior and developing appropriate preventions and interventions. The term addictive behavior in the present study was defined as taking any illicit psychoactive substance that included alcohol, cigarettes, and marijuana.

In addition, addictive behavior also extends from drug use to behavioral problems such as social network use, eating behavior, binge eating, and sexual risk behavior. In addition, "Youth" refers to people who are young adults, from the ages of 15 to 25 or

enrolled in college or university.

However, an article review related to an intervention used on youths exhibiting addictive behaviors demonstrated the progress of mobile applications known as mHealth applications^(3,4). One reason for the popularity of such applications is that today's society is driven by technology and social media. These applications are easy to access and widely used among people of all genders and ages. Most youths nowadays use the Internet and mobile applications almost every day. The fact that mobile applications are easy to access satisfies the needs of people who have problems with addictive behaviors. For example, when they are provoked by the environment to crave substances, exhibit addictive behavior, or suffer from mental distress leading to have behavioral problems, applications can help with healing and alleviating their suffering⁽⁵⁾.

Recently, several types of effective interventions have been employed for youths with addictive behavior. One such intervention is known as cognitive behavioral therapy (CBT), which has become popular and accepted as an evidence-based intervention for youths with addictive behaviors^(6,7). CBT is based on learning theory and Beck's cognitive model. The underlying principle is that alcohol or drug use and other addictive behavior is a learned behavior composed of five related parts, which are activating events or triggers, thought, emotion, behavior, and physical reactions. Therefore, CBT teaches people to find connections between those five related parts and to increase awareness of how these things encourage their addictive behavior. In addition, CBT encompasses a variety of cognitive behavioral strategies that emphasize different targets. They include components of functional analysis, stimulus control strategies, or behavioral strategies to avoid triggers, and building various cognitive skills such as problem-solving, thought identification, cognitive restructuring, drug refusal, and coping skills^(8,9).

Several CBT mHealth applications have been developed to help youths having difficulties with both mental health and addictive behaviors⁽¹⁰⁾. CBT mHealth applications are accepted by researchers as being an effective youth intervention^(10,11). CBT applications have evolved to solve poor adherence issues with face-to-face CBT⁽¹⁰⁾. The original aim of the CBT application was to facilitate more engagement and usability for patients⁽¹⁰⁾. It was initially developed to be accessible through a computer, known as computerized cognitive behavioral therapy (C-CBT), before eventually

becoming an application⁽¹²⁻¹⁴⁾. According to the previous studies, users commented that mobile CBT applications were easy to access, useful, and more convenient than a web-based CBT since they are more engaging⁽¹⁵⁾. "Playful Cognitive Behavioral Therapy" gaming applications were even developed to entertain youths. Some studies show corresponding results that CBT applications available in the form of games engage well with users, help them focus, and provide comprehensive information⁽¹⁵⁾.

To date, there are no reviews that have been conducted on mHealth applications based on the theoretical perspective of CBT, especially in terms of cognitive behavioral skill content. This corresponds to the findings of Herbert et al.⁽¹⁶⁾ who stated that the CBT scholars have expressed concerns about clinician practices using CBT. Most of them has abandoned the close ties to the theories that characterized the early days of the field. Furthermore, there is also a common assumption that a greater practical theoretical knowledge leads to better clinical outcomes. In addition, psychological intervention approaches scholars under the broad CBT umbrella have been calling for greater focus on the theory underlying applied technologies, including mHealth applications.

CBT has been developed on the basis of several theories. Behaviorism was influenced by classical conditioning and Operant Conditioning Learning Theories. Then, cognitive psychology started to shift from the perspective of behavioral therapy to CBT since the latter provides a more reasonable and comprehensive explanation. Behavioral therapy simply cannot provide a comprehensive explanation of human behaviors and still loses connection with covert behaviors such as thoughts influencing human behaviors. For this reason, Beck's cognitive model⁽¹⁷⁾ became the main approach in addictive behavioral research. The aim of the present study was to explore the scope of the published research studies on mHealth digital application interventions for youths with addictive behaviors, considering both the development and evaluation aspects.

Expected benefits from the present article included obtaining more knowledge on using preventive applications in youths with addictive behaviors, achieving standards, and gaining acceptance of such applications from academic circles at the international level, leading to recommendations for the further development of preventive applications for youths with addictive behaviors.

Table 1. Identification of key words by using PCC (Population-Concept-Context) framework

PCC Framework	Terms	Keywords	MeSH
Participants	Students	Youth, Adolescents	
Concept	mHealth applications, Intervention	Mobile health applications, mHealth	
	Cognitive behavior therapy	Cognitive behavior therapy	Cognitive behavior therapy
	Addiction	Substance use, Alcohol, Amphetamines	Addictive behavior, Behavioral addiction
Context	Youths	Youths	

MeSH=Medical Subject Headings

Materials and Methods

The present study protocol was based on the York framework outlined by Arksey and O'Malley⁽¹⁸⁾. The framework comprised five stages, 1) the identification of research questions, 2) the identification of research related to the research questions, 3) studies selection for inclusion, 4) the informational charts and data of the included studies, and 5) the collection, summarization, and reporting results.

Stage 1: Identifying the research questions.

- What were the objectives, behaviors, and types of behavioral addiction? (compulsive shopping, social, gambling, or drug dependency)
- What characteristics of mHealth application intervention were used for solving addictive behaviors in youths?
- What characteristics were considered CBT skills? What constructs of the Cognitive Model reflects such characteristics?

- What knowledge gap existed?

Stage 2: Identifying relevant studies.

The development of the search strategy plan, including decisions on the search resources, the search terms, the publication period, and the language were considered in this stage. The present study used the Population, Concept, and Context method (PCC) to construct the scoping review questions as a less restrictive alternative to the Patient, Intervention, Comparison, Outcome (PICO), as detailed in Table 1.

The comprehensive searches were conducted on PubMed, Science Direct, and Web of Science databases. These search sources included a number of significant journals that comprehensively covered the area under study, such as articles with medical and health information, science and technology, and computer science. Table 1 also shows numerous keywords that were combined to formulate the search strings (Figure 1).

Stage 3: Studies selected for inclusion in the review.

The selection criteria were formulated to include only studies that generated tailored content

for mHealth Application interventions to address behavioral addictions among adolescents.

The present study applied the following inclusion criteria to the articles under review (a) The article should explicitly study members of the youth. (b) The topic of the article should broadly describe the use of cognitive-behavioral skills in mHealth application through the prevention and behavioral/psychological intervention transmitted via mobile technology with an outcome directly related to addictive behavior. (c) The intervention should be developed. (d) Only English articles should be considered.

The aim of the present study was to explore the development and evaluation approaches used in tailoring interventions, therefore, only original research with sufficient descriptions of the methods applied such as qualitative and quantitative, would be included.

The exclusion criteria were types of research article, excluding non-original research materials such as study reviews, studies describing theoretical concepts or proposing frameworks, specialist commentaries, and editorials.

Stage 4: The charting of information and data within the articles.

Stage 5: The collection, summarization, and reporting of research results.

Ethical considerations

The present research had been approved by the Committee for Research Ethics (Social Science), Mahidol University, No. MU-SSIRB 2020/085.2104.

Results

The present scoping review included 16 articles published between 2010 and 2020^(4,19-33). The details of each study are presented in Table 2.

The results of thematic analysis were grouped into three areas. Firstly, each type of addictive behavior was analyzed, varying from a single addictive behavior like drug use to multiple addictive behaviors like drug use co-occurring with behavioral and mental

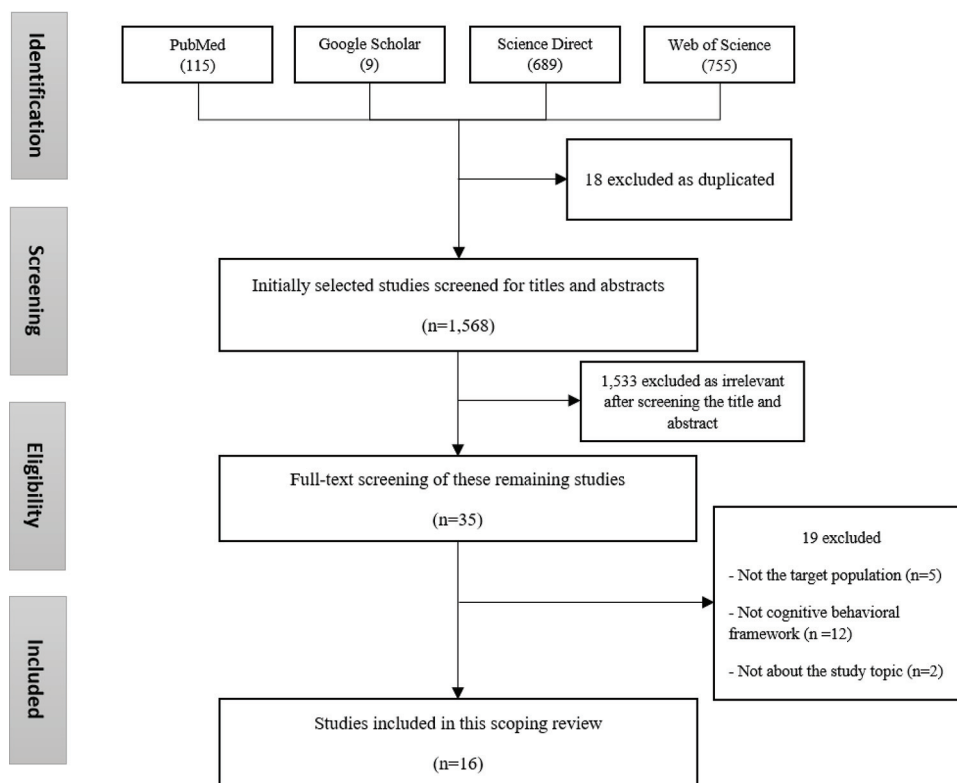


Figure 1. Visual diagram of the scoping review.

health problems. Secondly, the characteristics of cognitive-behavioral skills appearing in the mHealth application intervention were analyzed, revealing that most mHealth applications focus on management of the thought content contributing to addictive behavior. Interestingly, most of the cognitive skill components had been designed to focus on managing reflective thought processes at the level of consciousness, such as planning and behavioral intention, rather than implicit thought processes at the level of autonomous information processing. Thirdly, no mHealth applications appeared to provide comprehensive functions, including addictive behavior assessment and reduction of the severity of addictive behaviors.

The types of addictive behavior under study varied from one addictive behavior such as drug use of alcohol, cigarette, or marijuana, to multiple addictive behaviors like drug dependency co-occurring with behavioral and mental health problems. Some interesting findings indicated that behavioral goals developed from an addiction to one substance to more than one. Addiction also extended from drug use to behavioral problems. Furthermore, the behavioral objective of mHealth applications was to decrease the amount and severity of addictive

behaviors and increase access to treatment, including engagement and compliance with the intervention process. Six addictive behaviors were targeted for the usage of mHealth applications as alcohol consumption, marijuana use, cigarette smoking, social network use, eating behavior, binge eating, and sexual risk behavior. Addiction to drug use could lead to other addictive behaviors, resulting in co-occurring problems.

According to the findings, the mHealth applications for addictive behaviors had been in existence for over seven years, with the first article published in 2013, while applications for co-occurring groups have been available since 2016. Health professionals are beginning to realize that it is important to apply unique mHealth interventions to target such youths.

Second, the characteristics of the cognitive-behavioral skills appearing in the mHealth application intervention were analyzed, revealing that most mHealth applications focus on management of the thought content contributing to addictive behavior. The mHealth application interventions, the goal of thinking focused on working on conscious and reflective thoughts such as planning and behavioral

Table 2. Constructed cognitive models underpinning cognitive-behavioural skills appearing in the mHealth applications

Application name (first author, year)	Type of cognitive-behavioural skills appearing in the application	Focused constructs in cognitive model
SmarTrek (Kazem, 2019)	<ol style="list-style-type: none"> 1) Collect data: Functional analysis 2) Monitor behaviors: Functional analysis 3) Provide incentives for behavioral changes (rewards/positive reinforcement) 	Part 3 (action/behavior) of the cross-sectional conceptualized cognitive model*
A fully automated push-based, multiple-session alcohol intervention (Bendtsen, 2014)	<p>- Provide interventions through text messaging and email messaging by sending four forms of messages; food for thoughts, tasks, challenges, and reflective messages.</p> <p>- This text messaging or email messaging will be sent to a receiver once a week, and then they will be linked to a web page that provides information about safe drink limits and one-time alcohol use assessment website.</p>	Part 1 (activating events) of the cross-sectional conceptualized cognitive model emphasizes stimulus control/arranging new antecedents.
Text messaging (Mason, 2014)	Deliver personalized text messages to the receiver 4-6 times using Motivational Interviewing principles and social network counseling approach, together with the concept of risk reflection and peer protection.	Part 1 (activating events) of the cross-sectional conceptualized cognitive model level 1 emphasizes stimulus control/arranging new antecedents.
Text messaging (Moore, 2013)	<p>Having sent one text message on alcohol use to each receiver through mobile phone in the past month, taking into account their records of alcohol consumption on a daily basis during the past month. When a person realizes the amount of alcohol they drink, they are expected to become aware of the problem, which will lead them to reduce their drinking behaviors.</p> <p>"Expecting the development of coping skills that lead to reduced drinking behaviors."</p>	Part 3 (action) of the cross-sectional conceptualized cognitive model emphasizes behaviors.
An orientation week on ecological momentary intervention (Riordan, 2015)	EMA: Sending a message whenever there is an orientation week, along with sending messages that are the consequences of drinking, including health and social messages. This is aimed to encourage students to realize the amount of alcohol they drink and its negative consequences, their negative outcome expectations or reflective thought will be developed, eventually leading to reduced drinking behaviors. In addition, the development of coping skills that lead to reduced drinking behaviors will be delivered"	Part 2 (thought) and Part 3 (action) of the cross-sectional conceptualized cognitive model.
Interactive voice response (IVR) approach to provide brief alcohol interventions (Andersson, 2015)	Personalized normative feedback and protective behavioral strategies will be provided When a person realizes that the amount of alcohol, they drink is greater than the average consumed by the general public, they are expected to become aware, leading them to reduce their drinking behaviors.	Part 2 (thought) and Part 3 (action) of the cross-sectional conceptualized cognitive model*.
"Promillekoll" and "PartyPlanner" (Gajecki, 2014)	<p>There are 2 intervention strategies as follows;</p> <ol style="list-style-type: none"> 1) "Promillekoll" - Users register their own alcohol consumption in real time. Estimated blood alcohol concentration (eBAC) data as well as feedback on how to keep the alcohol intake lower than specified limit will be provided through the app. The strategy involves sending an alert message to the receiver whenever their recorded alcohol consumption is at the harmful level. 2) "PartyPlanner" - The eBAC will be calculated on a real-time basis when users record their alcohol consumption through the app. Users can plan their alcohol consumption activities in advance and check their eBAC data in all events. 	Part 1 (activating events) of the cross-sectional conceptualized cognitive model emphasizes the arrangement of new antecedents or self-talk.
BASICS-Mobile (Witkiewitz, 2014)	The app typically provides personalized feedback on drinking behaviors combined with CBT, information on the effects of alcohol on the brain and behavior, skills training, risk awareness, expectation, suggestions for low-risk drinking behaviors such as brainstorming on options for heavy drinking, etc. Other functions also involve providing feedback on smoking and urge-surfing, which is a mindfulness-based technique. This intervention will send such information in real time to the smartphone for 14 days.	Part 5 (physical reactions) of the cross-sectional conceptualized cognitive model emphasizes the use of mindfulness techniques to manage cravings.
Mobile health application CBT-based app for treating body-focused repetitive behaviors (BFRB) (Pretlow, 2020)	Gross things pictures, Avoiding triggers, Gross videos, Urge surfing, Distractions, Extreme obesity pictures, Rubber band, Deep breaths, Squeezing hands, Weight change	<p>Part 1 (activating events) emphasizes trigger avoidance, inappropriate images, extreme obesity images</p> <p>Part 3 (action) - emphasizes competing behaviors/distraction</p> <p>Part 4 (feeling) - emphasizes stress reduction</p> <p>Part 5 (physical reactions) emphasizes Distress tolerance surfing urges, rubber bands, deep breathing, hand squeezing</p>
Reality therapy mobile application (Esmaeili, 2018)	Users manage their time spent on Internet and replace the use of Internet with other activities and entertainments	Part 3 (action) of the cross-sectional conceptualization of the cognitive model deals with the consequences of Internet use behaviors by inventing new behaviors that produce similar outcomes (pleasure and enjoyment) as the old ones.

* Cross-sectional conceptualized cognitive model is composed of five part including Part 1 (activating events), Part 2 (thought), Part 3 (action), Part 4 (feeling), Part 5 (physical reactions)

Table 2. (continued)

Application name (first author, year)	Type of cognitive-behavioural skills appearing in the application	Focused constructs in cognitive model
A web and text messaging-based intervention (Haug, 2013)	- Online feedback and SMS messages were sent. Feedback included graphical and textual information content and number of text messages were tailored according to participants' baseline. - SMS messages about motivation of sensible drinking and risks of binge drinking and information will be customized depending on the group.	Part 2 (thought), Part 3 (action) of the cross-sectional conceptualized cognitive model proposes that when a person realizes that the amount of alcohol, they drink is greater than the average consumed by the general population, they become aware of the problem, and this is expected to lead to a reduction in drinking behavior.
Ready4life (Haug, 2017)	Information on practice of self-management skills, social skills, as well as substance use resistance skills and life skills trainings are provided via mobile phones	Part 1 (activating events) of the cross-sectional conceptualized cognitive model. Individuals can be helped to change by applying stimulation control techniques and utilizing the external environment to replace old stimuli with new (arranging new antecedents).
TMAP (Text Message Alcohol Program) (Bock, 2016)	Text messages composed of alcohol facts, behavioral strategies to limit alcohol use and related risks, and motivational messages.	Part 1 (activating events) of the cross-sectional conceptualized cognitive model emphasizes stimulus control/arranging new antecedents.
A Multilevel Mobile Health App for Substance Use, Sexual Risk Behaviors (Cordova, 2020)	The goal of improving preventive knowledge, self-efficacy, and refusal skills while connecting teenagers to significant adult figures.	Part 2 (thought) emphasizes the information available on sexual risk behaviors and substance use behaviors Part 1 (activating events) emphasizes stimulus control/arranging new antecedents skills, which
The Remote Food Photography Method and SmartIntake App for assessing alcohol use in young adults (Fazzino, 2018)	- Students are asked to take pictures and provide the number of the alcoholic beverages they drink as well as submit a food photo and alcohol photo via mobile photography in real-time. After that, alcohol use will be measured via mobile photography in real time. - It is hoped that by tracking youths' drinking habits, the number of beverages they consume, and their calorie intake, food intake, and calorie intake, the information will help raise awareness of the potential obesity consequences, which may affect their image and lead to reduced drinking and eating behavior.	Part 2 (thought) and Part 3 (action) of the cross-sectional conceptualized cognitive model addressing reflective thought relating to decision making to change actions towards alcoholic beverages and food consumption.
BASICS, telehealth, and face-to-face delivery of a brief alcohol intervention (King, 2019)	To encourage youth's awareness the amount of alcohol they consume that is greater than the average consumed by the general public. They will reduce their drinking habits.	Part 2 (thought) addressing reflective thought relating to decision making to change

* Cross-sectional conceptualized cognitive model is composed of five part including Part 1 (activating events), Part 2 (thought), Part 3 (action), Part 4 (feeling), Part 5 (physical reactions)

intention processed at the conscious information processing level. Most strategies involved the provision of information and knowledge, encouraging people to think positively and used their thoughts to prevent themselves from drinking alcohol. However, few studies provided strategies that focus on identifying implicit substance self-concepts or thoughts processed at the autonomous information processing level.

Third, mHealth applications did not provide comprehensive functions such as addictive behavior assessment and reducing the severity of addictive behaviors. There were also reasons why users needed to use mHealth applications in a real-time manner. This meant that some tools should be available to help them in the event of succumbing to addictive behaviors. However, only one application is available for that purpose.

Discussion

What objectives, behaviors, and types of behavioral addiction are targeted in the application?

The objectives identified vary from one

drug addictive behavior to several, involving drugs, behavior, and mental health problems. The implications of these findings are likely to confirm the expansion of the definition for addiction in mHealth, corresponding to the related principles. According to van Staaden et al.⁽³⁴⁾, the study of addiction begins with drug users, substances that make people addicted, the action of the substances, and their effects. Over time, a number of studies have shown a connection between addictive behaviors involving elements other than drugs, such as alcohol, caffeine, anabolic steroids, food, sex, gambling, and gaming. Furthermore, shared genetic vulnerability has also been identified among pathological gamblers and people with alcohol dependence. According to Orford⁽³⁵⁾, studies on addictive behaviors are limited by their focus on object-based addiction, which affects the central nervous system. This limitation has hindered the comprehensive development of theory and understanding toward addictive behaviors. Academicians and researchers studying addictive behaviors in modern times suggest that the reasons why people become addicted are less important than

the process of addiction. Orford⁽³⁵⁾ also emphasizes that addictive behaviors should not be viewed merely in relation to substances, but in the operation of the central nervous system. This narrow view can lead to problems concerning access to services among people with other addictive behaviors and the further development of theory and understanding.

The review of studies in this field reveals that the engagement and willingness of mHealth application users can help indicate progress. Liese and Beck⁽³⁶⁾ stated that engagement and compliance in intervention programs are key factors for providing effective help. One disadvantage of CBT is that the dropout rate among service users is relatively high. Liese and Beck⁽³⁶⁾ also realize the significance of this issue, stating that prior to engaging drug users to change their addictive behaviors with the use of cognitive-behavioral skills, it is necessary to create intervention engagement. As an example, service users should be encouraged to observe their thoughts and feelings toward an activity, referred to as thought regulation skills. However, the goal of this is to encourage target groups to cooperate and participate in the intervention. Service providers can then validate or reflect their thoughts and feelings to promote good therapeutic alliance and collaboration, as well as apply other techniques as detailed by Liese and Beck⁽³⁶⁾.

What characteristics of mHealth application intervention apply to behavioral addiction in youth and considered to be cognitive-behavioral skills? What construct is formed by such characteristics in the cognitive model?

The characteristics of the cognitive-behavioral skills appearing in mHealth applications mapped with the theory construct contained in the cognitive theory model developed by Beck et al.⁽⁸⁾ are shown in Table 2. Beck et al.⁽⁸⁾ developed the cognitive theory to understand problematic behaviors, using the following logic.

The hypothesis of the cognitive model is that people's perception of events influences emotions, behaviors, and physiology. Addiction vulnerability occurs when these negative perceptions become integrated with organized cognitive schemata, enduring, trait-like, representations of knowledge and experience, generally developed during childhood, that guide the processing of current situational information. This also involves with Individual's fundamental core beliefs, personal and other's people assumptions, and the way the world operates⁽⁸⁾.

Two important findings emerging from the status of mHealth applications for youth with addictive behaviors are illustrated in Table 2. Firstly, it is argued that the content appearing in the study on mHealth application is suitable for people with uncomplicated addictive behaviors. This is because the most existing cognitive behavioral techniques are involved in dealing with people's 1) stimuli such as teaching stimulus control strategies and arranging new antecedents, 2) emotions such as teaching distress tolerance skills, 3) behaviors such as replacing addictive behaviors with other activities and entertainments, 4) physiology or physical reactions such as teaching, surfing urges skills, and deep breathing, 5) reflective thought such as encouraging youth's awareness the amount and frequency of his or her own addictive behavior, and improving the preventive knowledge.

According to Beck et al.⁽⁸⁾ and Padesky et al.⁽⁹⁾, both explain that complicated drug addictions and other behaviors usually occurred because of attempting to cope with the activation of negative automatic thoughts, underlying assumptions, and core beliefs. In this case, negative automatic thoughts are processed at the autonomous information processing.

According to Beck et al.⁽⁸⁾ and Beck⁽³⁷⁾, there are two kinds of information processing in humans 1) consciousness processing, a state of awareness in which decisions can be made on a rational/reflective/more obvious surface level of thinking, and 2) autonomous information processing, in which decisions can be made precociously and unconsciously, activated by associations. These behaviors are processed without much conscious effort and channels the available information using subconscious pattern recognition based on similarity of prior situations. It may even function in parallel with consciousness processing.

Consciousness processing leads to the outcome referred to as reflective or deliberate thought, while autonomous information processing leads to implicit thoughts, perceptions embedded in one's perspective such as feeling loved and valued, providing meaning for addictive behaviors as implicit thoughts. This is an important factor in predicting behavioral expressions. Therefore, it is important to help people identify their thoughts to help them express the undesired behaviors mentioned earlier before encouraging them to have deliberate thoughts to change such behaviors. One aspect of Beck's cognitive model is the focus on implicit thought at the autonomous level of information processing.

Therefore, it is important to encourage service users to stimulate the implicit thoughts at the autonomous level of information processing, leading them to realize and understand the root meaning of their behavioral addictions, and become aware of the reasons for such addictive behavior.

Thoughts at the conscious or reflective level of information processing can lead to the intention to change behavior. For example, encouraging a person to consider both the positive and negative effects of addictive behaviors, plan their behavioral intention, acquire knowledge and information, and prepare themselves with positive thoughts in the hope they will use such thoughts to refrain from using substances or exhibiting addictive behaviors.

This corresponds to the observations made by Hagger⁽³⁸⁾, who found that the circles of education and public health over recent years have focused on studying the thoughts of individuals at the conscious or reflective level. However, in reality, a person's decision to express their behaviors, especially risk behaviors stigmatized by the mainstream such as alcohol consumption, drug use, condom use, and high-risk sexual behavior are usually under the influence of implicit, preconscious, or subconscious thoughts. Moreover, Lindgren et al.⁽³⁹⁾ recommended that those involved in the development of any preventive measure should focus on the implicit substance self-concept, conduct a routine assessment, and encourage the power of implicit thoughts to be realized.

In addition, focusing on implicit or autonomous thoughts for information processing also appears in the face-to-face CBT program such as the gay-specific cognitive behavioral therapy (GCBT) intervention program⁽⁴⁰⁾. This GCBT program also focuses on encouraging people to become aware of their own implicit thoughts, and the rules underlying assumptions, or intermediate belief that people have concerning the meaning and definition of crystal methamphetamine, their identity toward drugs, and implicit thoughts toward other people⁽⁴⁰⁾. However, no such content can be found in any mHealth applications reported in the present scoping review. Therefore, there is a research gap in helping people identify their core beliefs and underlying assumptions.

Conclusion

The addictive behaviors addressed in all the mHealth applications include alcohol consumption, social network use, eating behavior, tobacco smoking co-occurring with alcohol consumption, and two

or more addictions including alcohol use, tobacco smoking, cannabis use, binge eating, and high-risk sexual behavior. It appears that the component constructs of cognitive models tend to focus on activating events and problematic behavior. The status of the content appearing in the study on existing CBT mHealth applications for addictive behavior is suitable for people with uncomplicated dependencies. In addition, based on the findings in relation to the research gap, it appears none of the studies indicate the characteristics of applications that encourage awareness in the implicit substance self-concept, particularly the core and intermediate beliefs contained in Beck's cognitive model. It can be concluded that the content status and characteristics of CBT mHealth applications mostly focus on reflective thoughts. Consequently, the opportunity exists to develop CBT mHealth applications to raise awareness in people of the implicit substance self-concept, an important factor in addictive behaviors.

What is already known on this topic?

CBT mHealth applications have been developed to help youths having difficulty with addictive behaviors. There is no review conducted on mHealth applications based on the theoretical perspective of CBT, especially in terms of cognitive behavioral skill content.

What this study adds?

From using the Cognitive model as a lens to explore cognitive-behavioral skills appearing in mHealth applications, the content status, and characteristics of CBT mHealth applications mostly focus on reflective, deliberative thoughts. Therefore, there is an opportunity to develop CBT mHealth applications to raise awareness in youth of the implicit substance self-concept, an important factor in addictive behaviors.

Conflicts of interest

The authors declare no conflict of interest.

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