

Categoría: Decisiones basadas en la evidencia

## REVISIÓN SISTEMÁTICA

# The impact of smartphone use on childhood depression: A pediatric perspective

## El impacto del uso de teléfonos inteligentes en la depresión infantil: Una perspectiva pediátrica

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Cite as: Rangel Portal PV, González-Argote J. The impact of smartphone use on childhood depression: A pediatric perspective. Salud, Ciencia y Tecnología - Serie de Conferencias 2023; 2:335. <https://doi.org/10.56294/sctconf2023335>

Recibido: 24-05-2023

Revisado: 25-07-2023

Aceptado: 26-09-2023

Publicado: 27-09-2023

### ABSTRACT

**Introduction:** the profound social and family changes experienced in recent decades have also played a decisive role in the rise of depression, especially changes in family models, competition as the axis of life (which is more important than other dimensions of existence) and the availability of mass media, which promote personal distancing.

**Objectives:** to describe the scientific evidence on the impact of smartphone use on childhood depression from a pediatric perspective and what are the underlying factors that influence this relationship.

**Methods:** a search was conducted in Pubmed, Scopus, Web of Science from January 2000 to October 2023.

**Results:** this systematic review included several studies that evaluated different mental health interventions in various populations. Overall, we found that interventions based on smartphones, online cognitive behavioral therapy, and telemedicine had a positive impact on mental health. For example, postnatal mothers who received smartphone interventions experienced a significant reduction in depression. In addition, online therapy was shown to alleviate parental anxiety and depression and improve their quality of life. However, some studies had limitations, such as small samples or lack of effect on certain outcomes. More research would be needed to fully understand the scope and efficacy of these digital interventions.

**Conclusion:** this review highlights the promising efficacy of smartphone-based interventions to improve mental health in different populations. Despite limitations and challenges, the use of mobile technology in mental health care is an evolving area that could offer significant benefits in the future, transforming the way we approach and treat childhood mental health disorders.

**Keywords:** Depression; Telemedicine; Mobile Phones; Childhood; Adolescence.

### RESUMEN

**Introducción:** los profundos cambios sociales y familiares experimentados en las últimas décadas también han jugado un papel decisivo en el auge de la depresión, especialmente en los cambios en los modelos familiares, la competencia como eje de la vida (que es más importante que otras dimensiones de la existencia) y la disponibilidad de medios masivos de comunicación, que promueven el distanciamiento personal.

**Objetivos:** describir la evidencia científica sobre el impacto del uso de teléfonos inteligentes en la depresión infantil desde una perspectiva pediátrica y cuáles son los factores subyacentes que influyen en esta relación.

**Métodos:** Se realizó una búsqueda en Pubmed, Scopus, Web of Science desde enero de 2000 hasta octubre de 2023.

**Resultados:** esta revisión sistemática incluyó varios estudios que evaluaron diferentes intervenciones de salud mental en diversas poblaciones. En general, se encontró que las intervenciones basadas en teléfonos inteligentes, terapia cognitivo-conductual en línea y telemedicina tuvieron un impacto positivo en la salud mental. Por ejemplo, las madres posnatales que recibieron intervenciones de teléfono inteligente experimentaron una reducción significativa en la depresión. Además, se demostró que la terapia en línea alivió la ansiedad y la depresión de los padres y mejoró su calidad de vida. Sin embargo, algunos estudios tenían limitaciones, como muestras pequeñas o la falta de efecto en ciertos resultados. Se necesitaría más investigación para comprender completamente el alcance y la eficacia de estas intervenciones digitales.

**Conclusiones:** esta revisión destaca la prometedora eficacia de las intervenciones basadas en teléfonos inteligentes para mejorar la salud mental en diferentes poblaciones. A pesar de las limitaciones y desafíos, el uso de la tecnología móvil en la atención de la salud mental es un área en evolución que podría ofrecer beneficios significativos en el futuro, transformando la forma en que abordamos y tratamos los trastornos mentales infantiles.

**Palabras clave:** Depresión; Telemedicina; Teléfonos Móviles; Infancia; Adolescencia.

## INTRODUCTION

Depression can be defined as a form of mood disorder consisting of a variable decrease in the degree of interest or loss of pleasure in experiencing usual activities, accompanied by various psychological symptoms (sadness, inability to concentrate, memory loss, etc.). And the body (loss of libido, anorexia, bulimia, etc.).<sup>(1)</sup>

There are many causes of depression. It is reasonable to assume that there are often multiple causal relationships, and that the appearance of symptoms often coincides with environmental and conflict situations in the form of a certain biographical biological tendency.<sup>(1)</sup>

In the face of a pathology with a high and possibly increasing prevalence, it is very important to understand its effects on the family and society. In addition to their spousal and parental roles, depressed individuals may fail to fulfill their responsibilities in the home to varying degrees.<sup>(2)</sup>

In addition, depression is associated with increased mortality from cardiovascular disease, especially suicide. Much of this is estimated to be due to mental illness, particularly depression and bipolar disorder. Postpartum depression is known to cause serious marital difficulties and affect children's cognitive development; in addition to changing mother-child relationships, children are more likely to experience relationship difficulties and mental illness, especially depression and alcoholism, in adulthood.<sup>(3)</sup>

Fortunately, most depressions develop gradually, i.e., in processes. They tend even to recover spontaneously, and the key to treatment is to reduce the duration of emotional distress, the consequences of the illness and significantly reduce the risk of suicidal behavior. It is worth repeating that the prognosis is quite favorable with the various treatments available. However, this disorder is often misdiagnosed or treatment with antidepressants is insufficient or inadequate.<sup>(4)</sup>

Depression was officially recognized as a disease affecting children and adolescents only in the 1970s. Until then, the scientific community maintained that children cannot suffer from affective disorders simply because their emotional and cognitive development does not allow them to do so. One of the many myths and prejudices about mental illness in children. The first consequence of this assumption is that childhood depression goes undiagnosed and untreated, the clinical course is unclear, and patients must fend for themselves.<sup>(5)</sup>

The profound social and family changes experienced in recent decades have also played a decisive role in the rise of depression, especially changes in family models, competition as the focus of life (which is more important than other dimensions of existence) and the availability of mass media,

which promote personal distancing. There is no doubt that children and young people are the most vulnerable to these influences.<sup>(6)</sup>

Unlike adults, childhood depression manifests itself not so much in an altered mood clearly defined by the patient, but in a different set of symptoms depending on the stage of development, that in behavioral changes (delinquent behavior, aggressiveness, consumption of toxins), which can lead to psychomotor disability, decreased academic performance or the development of physical symptoms, making diagnosis difficult. To date, childhood depression has remained an underdiagnosed entity, leading to further complications and comorbidities, as well as an increased risk of chronic or late onset mental illness in adulthood.<sup>(7)</sup>

Other than depression, anxiety disorders are among the most common disorders among children and adolescents, affecting 10 % to 20 % of children and adolescents. Although observable anxiety behaviors mark normal development in infants, anxiety disorders in childhood predict a wide range of psychological problems in adolescence, including other anxiety disorders, panic attacks, and depression. Fear is an expected response to a real or perceived threat, whereas anxiety is the anticipation of future danger. Anxiety disorders are characterized by repeated emotional and mental arousal caused by an exaggerated perception of threat or danger. The most common disorders among young people are separation anxiety disorder, generalized anxiety disorder, social anxiety disorder and selective mutism. Anxiety is divided into disorders according to how it is experienced, the situations that trigger it, and how it develops.<sup>(8)</sup>

The prevalence of anxiety disorders varies according to the age group of children. Across the lifespan, anxiety disorders in children and adolescents range from 10 % to 27 %. Anxiety disorders are common in toddlers and have a similar epidemiology in older children. An epidemiological study using the Preschool Psychiatric Assessment (PAPA) found that 9,5 % of children met criteria for an anxiety disorder, of whom 6,5 % had an anxiety disorder. Overall, 2,4 % met criteria for separation anxiety and 2,2 % met criteria for social phobia separation anxiety. It is estimated that about 4 % of children and young adults suffer from separation anxiety. It is more common in young children than in adolescents, and no gender differences in frequency have been described. 8 It can begin at preschool age, but is most common in children between the ages of 7 and 8 years. The prevalence of separation anxiety in school-aged children is estimated to be about 3 %, social phobia increases by 1 %, and simple phobia increases by 2,4 %. Among young adults, the incidence of panic disorder was 0,6 percent; the lifetime prevalence of generalized anxiety disorder was 3,7 percent.<sup>(9)</sup>

Numerous investigations<sup>(10,11,12,13,14)</sup> have demonstrated the influence of parental psychology and parenting styles on the onset of childhood anxiety disorders. In longitudinal studies, parental overprotectiveness has been described to be associated with an increased risk of anxiety disorders in children, as well as with an insecure parent-child attachment relationship. Depression and anxiety in mothers is also known to increase the risk of anxiety and depression in children. Psychosocial factors, as well as the infant's mood, influence the severity of separation anxiety that occurs in cases of brief separation and exposure to a strange and distant environment. Being extremely shy or withdrawn in unfamiliar situations is associated with an increased risk of separation anxiety disorder, generalized anxiety disorder, social anxiety disorder, or both.

In a screen-filled society, the relationship between childhood and mobile devices is a stark reality. Today, the core of the home is one of the environments conducive to the use of smartphones by children aged 3 to 6 years, and aspects such as ease of use, operating time and supervision are directly related to the potential problems generated by uncontrolled use by children. All this can generate conflicts between children and parents, especially if these three basic elements are forgotten, which are the main aspects to consider when children are directly exposed to this type of technologies. In this sense, the increase of such conditions in the last decade has given rise to several studies showing the access of minors to mobile technologies. Such studies show that the use of smartphones occurs at early ages, as these devices become part of the home environment, making mobile technology a daily activity for children. Therefore, the authors, who have focused on the study of preschool children, highlight that minors between 0 and 8 years of age in different European countries prefer to use these mobile devices that are available to their parents.<sup>(15)</sup>

Excessive use of technology by children under 4 years of age, neglect of equipment and possible negative effects on children's psychomotor development are a concern in pediatric practice. Psychomotor development in children is a developmental phenomenon associated with the continuous and gradual acquisition of skills, including language, cognition, motor skills, social interaction, and

behavior, which is the result of the interaction of genetic and environmental factors (e.g., use of technology). Therefore, early childhood screen use and its possible association with developmental disorders, the prevalence of which is increasing, should be addressed in consultations.<sup>(16)</sup>

Several studies have shown that smartphone and tablet use is associated with increased susceptibility to obesity, poorer sleep quality, depressive symptoms, attention deficit hyperactivity disorder, and behavioral and prosocial problems. Other studies have looked at the positive effects of opportunities for social communication, creativity, expression and fun in the family or the way they maintain friendships and spend their leisure time, thanks to the difference in connection between girls and boys at the socioeconomic level, opportunities for learning, education and development are available from remote areas. Although a large number of studies have been devoted to the effects of television, computer, video games and Internet use on children's cognitive and behavioral development, research has focused directly on examining the effects of smartphones and tablets is relatively recent, because of its specificity it is worth conducting a differential analysis. In this regard, it highlights six characteristics of touchscreen devices that together make them significantly different from media (especially television) traditionally studied in relation to child development: responsiveness, interactivity, adaptability, progressivity, promotes joint attention, and portability. In addition to the inherent features of smartphones and tablets, digital apps can promote development if they promote activity, social interaction, engagement (attention, interest, enjoyment), as well as meaning and exploration. most likely to use these devices instead of television.<sup>(17)</sup>

**Objective:** to describe the scientific evidence on the impact of smartphone use on childhood depression from a pediatric perspective and what underlying factors influence this relationship.

## **METHODS**

### **Study Design**

A systematic review was conducted in accordance with PRISMA guidelines (preferred reporting elements for systematic reviews and meta-analyses).<sup>18</sup>

### **Study Population.**

Scientific Papers addressing the impact of smartphone use on childhood depression from a pediatric perspective and what are the underlying factors influencing this relationship, in the period January 2000 to October 2023, were included.

### **Inclusion Criteria**

- Original articles with IMRD typology that develop cohort studies, clinical trials, other systematic reviews and meta-analyses.

### **Exclusion Criteria**

- Review articles, Scientific Letters/Letters to the Editor, Clinical Cases, Editorials, Original Articles that correspond to preclinical studies and Observational Studies.

### **Selection and Sample Size**

A search was performed in Pubmed, Scopus, Web of Science from January 2000 to October 2023. Selecting abstracts of cohort and case-control studies evaluating the impact of smartphone use on childhood depression from a pediatric perspective and what are the underlying factors influencing this relationship.

### **Data collection planning**

- A literature search was performed in databases using as MESH descriptors: "Smartphone", "Depression", "Pediatrics".
- The publications were classified and, according to the inclusion and exclusion criteria, those that would make up the study were selected.
- A critical reading of the abstracts and articles in extenso was carried out to assess their inclusion according to their relevance.
- Studies were classified according to levels of evidence and quality.
- When raw or open data were found, a meta-analysis was performed with the included studies.

### Ethical and legal considerations

This study included secondary data sources and therefore does not correspond to an analysis from the ethical point of view, given that no experimentation or evaluations were performed on human beings/experimental animals.

### RESULTS

Study	Country	Aim	Intervention	Type of research	Sample	Main results	Clinical/practical implications
Adolescent Health Promotion Interventions Using Well-Care Visits and a Smartphone Cognitive Behavioral Therapy App: Randomized Controlled Trial	Japan	This study was designed to test the efficacy of two adolescent health promotion interventions: a well-care visit (WCV) with a risk assessment interview and counseling and self-monitoring with a smartphone cognitive behavioral therapy (CBT) app. Our hypothesis was that participants who had received both WCV and the CBT app would have better outcomes than those who had received only WCV or those who had not received any intervention. We conducted a prospective multi-institutional	WCV: comprised a standardized physical examination along with a structured interview and counseling for youth risk assessment, which was designed with reference to the Guideline for Health Supervision of Adolescents of Bright Futures CBT App: program, participants created several self-monitoring sheets based on the CBT model with five window panels	prospective multi-institutional randomized controlled trial	WCV group (n=68) WCV with CBT app group (n=71) Nonintervention group (n=72)	The study tested the efficacy of two adolescent health promotion interventions: a well-care visit (WCV) with a risk assessment interview and counseling, and self-monitoring with a smartphone cognitive behavioral therapy (CBT) app. Participants who received both the WCV and the CBT app had better outcomes compared to those who received only the WCV or no intervention. The primary outcome measured was the change in scores for depressive symptoms, and secondary outcomes included changes in scores for self-esteem,	<ul style="list-style-type: none"> <li>- The study suggests that a well-care visit (WCV) with a risk assessment interview and counseling, along with a smartphone cognitive behavioral therapy (CBT) app, can be effective interventions for promoting adolescent health.</li> <li>- The standardized physical examination and structured interview during the WCV can provide an opportunity for early identification of risk behaviors and mental health issues in adolescents.</li> <li>- The CBT app, with its psychoeducation and self-monitoring components, can serve as a convenient and accessible tool for adolescents to engage in</li> </ul>

randomized controlled trial.	quality of life, self-monitoring, and an adolescent health promotion scale . - The sample size for the study was calculated based on previous studies that set depressive symptoms as the primary outcome . - The presence of suicidal ideation in participants was assessed using the PHQ-9, and the prevalence of suicidal ideation between the intervention groups and nonintervention group was compared using a chi-square test .	cognitive behavioral therapy and improve their mental health outcomes. - The study highlights the need for implementing a standard interview framework, such as HEEADSSS, in primary care settings in Japan to improve mental health screening for adolescents. - To minimize the time required for screening, the development of a shorter form of the HEEADSSS or electronic screening may be necessary. - The CBT app used in the study has the potential to be further developed with additional CBT modules, making it a valuable health promotion tool for adolescents. - Integrating both direct (HEEADSSS) and indirect (CBT app) interventions may further enhance
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							adolescent health promotion efforts.
Using Smartphone-Based Psychoeducation to Reduce Postnatal Depression Among First-Time Mothers: Randomized Controlled Trial	China	This study aimed to empirically examine whether such an intervention would lead to reduced postnatal depression, anxiety, or stress and result in a better health-related quality of life.	Participants used a smartphone-based app for antenatal education, and a control TAU group that received antenatal services from Kwong Wah Hospital (KWH)	prospective multi-institutional randomized controlled trial	Usage of intervention, mean (SE) Usage of antenatal classes, mean (SE) Not attended (n=171)  Attended (n=272)  Control (n=225)  Intervention (n=218)	The primary outcome measured was the difference in levels of antenatal and postnatal depression, assessed using the Edinburgh Postnatal Depression Scale (EPDS). The mean EPDS score of the intervention group dropped from 7,3 to 5,3, and that of the control group dropped from 7,2 to 5,9. The mean difference between groups was -0,65, which was	- The study suggests that a well-care visit (WCV) with a risk assessment interview and counseling, along with a smartphone cognitive behavioral therapy (CBT) app, can be effective interventions for promoting adolescent health.  - The standardized physical examination and structured interview during the WCV can provide an opportunity for early identification of risk behaviors and mental health

	<p>statistically significant.</p> <ul style="list-style-type: none"> <li>- The study found that the smartphone-based psychoeducation intervention, in addition to standard antenatal services, was effective in reducing postnatal depression at 4 weeks postpartum compared to the control group receiving standard services only.</li> <li>- However, there were no significant between-group differences in secondary outcomes, including anxiety, stress, and health-related quality of life.</li> <li>- The study concluded that smartphone-based psychoeducation, combined with standard antenatal services, can be an effective and cost-effective alternative to traditional face-to-face education for</li> </ul>	<p>issues in adolescents.</p> <ul style="list-style-type: none"> <li>- The CBT app, with its psychoeducation and self-monitoring components, can serve as a convenient and accessible tool for adolescents to engage in cognitive behavioral therapy and improve their mental health outcomes.</li> <li>- The study highlights the need for implementing a standard interview framework, such as HEEADSSS, in primary care settings in Japan to improve mental health screening for adolescents.</li> <li>- To minimize the time required for screening, the development of a shorter form of the HEEADSSS or electronic screening may be necessary.</li> <li>- The CBT app used in the study has the potential to be further developed with additional</li> </ul>
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					expectant mothers.	CBT modules, making it a valuable health promotion tool for adolescents.  - Integrating both direct (HEEADSSS) and indirect (CBT app) interventions may further enhance adolescent health promotion efforts.
Brief internet-delivered cognitive-behavioural intervention for children and adolescents with symptoms of anxiety and depression during the COVID-19 pandemic: a randomised controlled trial protocol	Brasil	The objective of the proposed study is to test the efficacy of a brief cognitive-behavioural intervention to be implemented via teleconference (or telephone call) with a child or adolescent, together with a guardian. In a randomised controlled trial, the efficacy of the intervention will be compared with that of a video-	Participants will be randomly allocated to the intervention group or to the active control group, in a 1:1 ratio.	prospective multi-institutional randomized controlled trial	The paper presents a protocol for a randomized controlled trial to test the efficacy of a brief internet-delivered cognitive-behavioral intervention for children and adolescents with symptoms of anxiety and depression during the COVID-19 pandemic . - The trial will involve a total of 280 participants who will be randomized to either the intervention group or the active control group .	The development of a brief internet-delivered cognitive-behavioral intervention for children and adolescents with symptoms of anxiety and depression during the COVID-19 pandemic has important practical implications for mental health care.  - The intervention can be accessed remotely, making it more accessible to children and adolescents who may have limited

based psychoeducational	- The primary outcome measures include symptoms of anxiety, depression, and irritability, which will be assessed at baseline, at the end of the intervention, and 30 days thereafter .	access to traditional mental health care services.
intervention (active control). We expect the active intervention to be the more effective in reducing emotional	- Secondary outcomes will be assessed through ecological momentary assessment (EMA) of emotional problems using smartphones , as well as passive data collection from existing smartphone sensors throughout the study .	- The intervention is designed to be user-friendly and can be followed by mental health professionals with limited experience, which increases its potential for dissemination and implementation throughout Brazil.
symptoms and in improving global functionality.	- The trial design is single-blind, with outcome assessors being the only ones blinded to group allocation .	- The use of teleconferencing and online videos allows for flexibility in delivering the intervention, making it easier for participants to engage in therapy sessions at their convenience.
	- Parental satisfaction with the telepsychotherapy sessions in the intervention group will be assessed using an adapted version of	- The incorporation of ecological momentary assessment (EMA) and passive data collection from smartphone sensors provides an opportunity to gather real-time data on emotional problems and monitor progress

						the Telemedicine Satisfaction Questionnaire (TSQ) .	throughout the intervention. - The evaluation and refinement of the intervention manual and video scripts, as well as the assessment of therapist adherence to the protocol, can contribute to improving the effectiveness and consistency of the intervention. Overall, the practical implications of this paper include increased accessibility to mental health care, user-friendly intervention delivery, flexibility in therapy sessions, real- time data collection, and continuous improvement of the intervention materials.
Early Detection of Neurodevelopmental Disorders of Toddlers and Postnatal Depression by Mobile Health App: Observational Cross-sectional Study	Franci a	We aimed to assess if a mobile app named Malo can reduce delay in the recognition of NDD and PND.	Population target was 4000 users to obtain at least 30 possible cases of ASD screened by the app.	prospective multi-institutional randomized controlled trial	Nationwide number of users of the <b>Malo app</b> for a toddler (0- 3 years of age) n=5399 Nationwide number of users who filled in at least 1 questionnaire for	Among the 4242 children assessed, 613 (14,5 %) had at least one disorder requiring a consultation. The median age of notification for possible autism spectrum,	The use of the mobile health app, Malo, can aid in the early detection of neurodevelopmental disorders (NDDs) in toddlers and postnatal depression (PND) in

neurodevelopment screening n=4242 Users who also filled in the questionnaire for screening of maternal postnatal depression n=907 Users who filled in the survey about the relevance of neurodevelopment notifications and their satisfaction with them n=91

vision, audition, socialization, language, or motor disorders was 11, 9, 17, 12, 22, and 4 months, respectively. The sensitivity of the alert notifications of suspected NDDs as assessed by the physicians was 100 %, and the specificity was 73,5 %.

- Among the 907 mothers who completed PND questionnaires, 151 (16,6 %) were suspected to have PND. The median time of detection was between 8 and 12 weeks after childbirth, and 370 (40,8 %) of the detections occurred before the eighth week after childbirth.

mothers, allowing for timely intervention .

- The app sends in-app notifications to users when patient-reported outcomes match predefined criteria, recommending them to book an appointment with their family physician or pediatrician .

- The median age of notification for possible NDDs varied for different disorders, highlighting the importance of early detection and intervention .

- The sensitivity of the alert notifications for suspected NDDs was 100 %, indicating that the app effectively identified children who required a consultation .

- The app was also efficient in the early detection of PND, with a median time of detection between 8 and 12 weeks after childbirth .

- The results suggest that the regular

Acceptability and feasibility of a pilot randomized controlled trial of Narrative e-Writing Intervention (NeW-I) for parent-caregivers of children with chronic life-threatening illnesses in Singapore	Singapore	<p>This study aims to assess the acceptability and feasibility of NeW-I in enhancing the psycho-spiritual well-being of parent-caregivers of children with CLTIs in Singapore. The specific objectives of this study are as follows: (i) To investigate whether NeW-I is an acceptable psychotherapeutic service to parent-caregivers of children facing CLTIs in Singapore; and (ii) to examine</p>	Paediatric palliative care providers in Singapore	prospective multi-institutional randomized controlled trial	<p>1: Meaningful opportunity for reflection (N=22)  2: Congruity with parent-caregivers' needs (N=24)  3: Compatibility of online narrative writing (N=14)  4: Sustainability and enhancement of recommendations (N=23)</p>	<p>The study examined the acceptability and feasibility of the Narrative e-Writing Intervention (NeW-I) among 26 intervention participants. Participants' post-intervention feedback revealed four themes: meaningful opportunity for reflection, congruity with parent-caregivers' needs, compatibility of online narrative writing, and sustainability and enhancement of recommendations .  - The post-intervention evaluation survey showed that participants</p>	<p>use of this multidomain familial smartphone app can facilitate the early detection of NDDs and PND, improving the follow-up of neurodevelopment in toddlers and reducing the mental burden on mothers .  The Narrative e-Writing Intervention (NeW-I) showed acceptability and feasibility among parent-caregivers of children with chronic life-threatening illnesses in Singapore, indicating its potential for implementation in pediatric palliative care services for Asian families .  - Participants reported improvements in spiritual well-being, hopefulness about the future, perception of social support, and reduced negative emotions and caregiver burden, highlighting the potential</p>
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the feasibility of delivering the NeW-I protocol to parent-caregivers of children facing CLTIs in Singapore (time

taken to deliver the therapy, deviations from the therapy protocol and uncompleted therapies).

were overall satisfied with their NeW-I experience. They reported improvements in spiritual well-being, hopefulness about the future, perception of social support, and reduced feelings of sadness, depression, caregiver burden, and fear and anxiety about their child's illness.

- The research team found it feasible to deliver the intervention in the current setting, suggesting that NeW-I is an innovative e-health tool that could benefit pediatric palliative care services for Asian families in Singapore and worldwide.

- The sample comprised 26 parents of children with chronic life-threatening illnesses. The majority of participants were female, married, and of Chinese ethnicity.

benefits of NeW-I for parent-caregivers' well-being.

- The online nature of NeW-I, with increased personal space and anonymity, was helpful for participants, regardless of their introversion or social confidence, in sharing their challenges with others.

- Recommendations from the study include incorporating follow-up sessions over a longer interval, involving a larger and more diverse participant pool, and engaging an evaluation team not directly involved in delivering the intervention to assess its effectiveness and address potential challenges.

- The cultural sensitivity of NeW-I makes it suitable for Asian parent-caregivers, who may be uncomfortable expressing their feelings openly.

Telehealth Education via WeChat Improves the Quality of Life of Parents of Children with Type-1 Diabetes Mellitus	China	The purpose of this study was to explore the effect of telehealth education and care guidance via WeChat (Tencent Ltd., Shenzhen, China; a popular smartphone - based social media application) on improving the quality of life of parents of children	Participants who were eligible were randomized to either the intervention group or the control group	prospective multi-institutional randomized controlled trial	Access to eligible participants n=98 Eligible participants and randomized n=92 Allocated to intervention group n=46 Allocated to control group n=46	The seriously ill children had varying diagnoses, including cerebral palsy, epilepsy, and renal, neuromuscular, neurodegenerative, and rare genetic diseases . - Taking a bird's-eye view of their entire caregiving journey was empowering for participants as it highlighted the resources and support systems they had gathered along the way . Six months after discharge, the Self-Rating Anxiety Scale (SAS) and Self-Rating Depression Scale (SDS) scores of parents in the intervention group were significantly lower than those in the control group ( $p < 0,05$ ) . - The scores of the physiological field, psychological field, social relationship field, and environmental field in the	Overall, the study suggests that NeW-I has practical implications for improving the well-being of parent-caregivers of children with chronic life-threatening illnesses, particularly in the Asian context. Performing telehealth education and home care guidance to parents of children with type-1 diabetes mellitus via WeChat can effectively extend high-quality medical services to families, relieving parental anxiety and depression, and improving their quality of life. - Telemedicine , such as telehealth education via WeChat, has
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<p>with type-1 diabetes mellitus.</p>	<p>intervention group were significantly higher than those of the control group according to the World Health Organization Quality of Life Brief Scale (WHOQOL-BREF) (<math>p &lt; 0,05</math>) .</p> <ul style="list-style-type: none"> <li>- The HbA1c, fasting blood glucose, complication s of hyperglycemia or hypoglycemia, and rehospitalizations in the intervention group were significantly lower than those of the control group at the 6-month follow-up (<math>p &lt; 0,05</math>) .</li> <li>- Telehealth education and care guidance via WeChat effectively relieved the anxiety and depression of parents and improved their quality of life .</li> <li>- The study showed that telehealth education via WeChat can make health education more effective and help family members</li> </ul> <p>advantages such as shortening time consumption, improving patients' condition, and improving the quality of life of patients and families.</p> <ul style="list-style-type: none"> <li>- WeChat, as the most widely used mobile application in China, can serve as a telehealth education platform, providing continuous medical support, reducing the pressure of home care, and strengthening the relationship between doctors and parents.</li> </ul> <p>Note: The practical implications of the paper include the use of WeChat for telehealth education, the improvement of parental quality of life, and the extension of high-quality medical services to families.</p>
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Design and implementation of a randomized controlled social and mobile weight loss trial for young adults (project SMART)	Estados Unidos	The SMART study aims to address obesity in young adults by using social and mobile media to educate, motivate, and change behaviors that support weight loss and healthy weight control. Findings from this study will add to the growing research literature on how technology and social networks can be used to increase PA and healthy eating, two behaviors important for weight control. Furthermore, this study may yield further insights into the relationships	A total of 404 overweight or obese college students from three Southern California universities	prospective multi-institutional randomized controlled trial	<p>better grasp knowledge .</p> <p>- The WHOQOL-BREF scale is a widely used scale to measure the quality of life, and the higher the score, the higher the quality of life .</p> <p>The study recruited a total of 404 overweight or obese college students from three Southern California universities, with an average age of 22 years and an average BMI of 29.</p> <p>- Participants were randomized to either participate in the intervention or receive an informational web-based weight loss program.</p> <p>- The intervention utilized multiple touch points, including Facebook, text messaging, smartphone applications, blogs, and email, to deliver theory-driven and tailored</p>	<p>The study demonstrates the potential of using social and mobile media as platforms for delivering weight control interventions to young adults.</p> <p>- The intervention utilizes various technologies such as Facebook, text messaging, smartphone applications, blogs, and email, which are widely accessible and commonly used by young adults.</p> <p>- The adaptive nature of the intervention allows participants to tailor their use of the intervention across different modalities, suiting their individual</p>
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between Facebook use, social support, and health behaviors. Facebook is a promising venue for health promotion given its ubiquity and that users can share their experiences in real-time [21,47]. Although this social networking platform has been shown to increase self-esteem [8,48,49] and life satisfaction [8,50], there is limited evidence regarding its impact on health behaviors [51], in particular from prospective studies.

intervention elements.

- Measures of various health-related factors, such as body mass index, waist circumference, diet, physical activity, sedentary behavior, weight management practices, smoking, alcohol, sleep, body image, self-esteem, and depression, were collected at 6, 12, 18, and 24 months.
- The intervention was being evaluated in a two-year randomized controlled trial, with participants randomized into the intervention or a comparison condition.
- Data collection occurred at Moore's Cancer Center at UCSD and the Student Health Services at SDSU and CSUSM, with trained measurement staff collecting data from participants.

needs and preferences.

- The study also highlights the importance of evaluating interventions that can adapt to changes in the ever-evolving landscape of mobile and social technologies.
- The findings from this study may inform future research and the development of interventions that leverage social and mobile technologies for promoting healthy weight-related behaviors in young adults.
- The use of an open-source SMART Application Programming Interface (API) allows for the development of new apps that can generate and share data with the existing suite of SMART apps, potentially expanding the reach and impact of the intervention.

Internet-based behavioural activation to improve depressive symptoms and prevent child abuse in postnatal women (SmartMama): a protocol for a pragmatic randomized controlled trial	Japan	The study is a 6-month follow-up stratified randomized controlled trial at multiple medical centres. A web-based behavioural activation program for smartphones with therapist support will be developed for postnatal mothers in Japan, based on a previous study	prospective multi-institutional randomized controlled trial	A total of 390 postnatal women, 20 years or older, who have given birth within 10 weeks and have regular internet-access will be recruited at two hospitals.	Baseline survey Assigned to intervention And assigned to control	<p>- The sample size of 400 students was estimated to provide 80 % power to detect a between-group difference in weight loss.</p> <p>The study is a non-blinded, stratified randomized controlled trial that aims to investigate whether internet-based behavioural activation (iBA) therapy improves depressive symptoms among postnatal mothers and prevents abusive behaviors towards children. The study will also evaluate the implementation aspects of the program, including acceptability, appropriateness, feasibility, and harm done.</p> <p>- The study will assess the coprimary outcomes of maternal depressive symptoms and psychological aggression</p>	Internet-based behavioural activation (iBA) therapy has the potential to improve depressive symptoms among postnatal mothers and prevent abusive behaviors towards children.
						<p>- The use of iBA therapy can provide a convenient and accessible treatment option for mothers who may have limited access to traditional in-person therapy.</p> <p>- The implementation of the iBA program can be evaluated in terms of acceptability, appropriateness, feasibility, and harm done, providing valuable insights for future implementation</p>	

toward children at the 24-week follow-up survey. Secondary outcomes include maternal depressive symptoms, parental stress, bonding relationship, quality of life, maternal health care use, and pediatric outcomes such as physical development and preventive care attendance .

- The hypotheses of the study are that the web-based behavioral activation program will significantly improve depressive symptoms among postnatal mothers with EPDS scores  $\geq 9$  points in the intervention group compared to the treatment as usual (TAU) group. The study will also evaluate healthcare use for both mothers and children during the 12-24 week

on of similar interventions. - The study also assesses healthcare use for both mothers and children, which can inform healthcare providers about the effectiveness of the program in improving overall health outcomes. - The findings of this study can contribute to the development of evidence-based interventions for postnatal depression and child abuse prevention, potentially leading to improved mental health outcomes for mothers and better protection for children.

Introducing Dietary Self-Monitoring to Undergraduate Women via a Calorie Counting App Has No Effect on Mental Health or Health Behaviors: Results From a Randomized Controlled Trial	Estados Unidos	To determine if introducing dietary self-monitoring via a popular smartphone app to undergraduate women impacts eating disorder risk, other aspects of mental health, or health	Participants were randomly assigned to engage in dietary self-monitoring via MyFitness Pal for approximately 1 month or to receive no intervention.	prospective multi-institutional randomized controlled trial	Assessed for eligibility n=808. Excluded n=607. Randomized n=201. Allocated to control n=100 and analysed n=100. Allocated to intervention n=101 and lost to follow n=8 and excluded during study n=1. So	follow-up surveys . - The study protocol follows the Standard Protocol Items for Randomized Trials (SPIRIT) guideline checklists and is registered at UMIN Clinical Trial Registry (UMIN-CTR: ID UMIN 000036864) . - The study is funded by the Grant-in-Aid for Young Scientists (B) 2017 from the Japan Society for the Promotion of Science, Seseragi Foundation, and internal funding of the National Center for Global Health and Medicine, Japan .	The study suggests that introducing dietary self-monitoring via a calorie counting app does not have a significant impact on the mental health or health behaviors of undergraduate women. - The findings indicate that dietary self-monitoring may not increase
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behaviors including dietary intake and physical activity.	included in analyses n=92.	disorder risk, state anxiety, depressive symptoms, body image, quality of life, or health behaviors between the intervention and control conditions . - The intervention did not change participants' likelihood of fasting, compulsive exercising, binge eating, limiting the amount of food, or engaging in loss of control eating . - There were no differences in BMI between the intervention and control conditions . - Self-weighting frequency decreased in the intervention condition, but the intervention condition was not associated with either form of physical activity self-monitoring . - The study sample consisted of approximately half White and a third	eating disorder risk among undergraduate women with low baseline eating disorder risk who have not recently engaged in dietary self-monitoring. - The study highlights the need for a precision health lens to understand the neutral, beneficial, or harmful effects of dietary self-monitoring in different populations. - The results also suggest that dietary self-monitoring outside of clinical weight management contexts may not lead to increased engagement in health-promoting behaviors for this population. - These findings have implications for the use of calorie counting apps as a tool for promoting healthy eating behaviors and mental well-being among college women.
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						Asian participants, with an average BMI of 23,1 and an average age of 20,2 years old .	
A pilot randomised controlled trial of the Peer Tree digital intervention targeting loneliness in young people: a study protocol	Australia	The objective of this study is to evaluate the acceptability, feasibility, safety, and initial efficacy of a positive psychology smartphone application intervention called Peer Tree. Peer Tree is a digital smartphone intervention targeting loneliness and is a new iteration of our previous application +Connect. Peer Tree includes many features from +Connect [30, 31] but also includes the personalisation of modules based on user symptom profiles, a peer- and clinician-moderated chat forum, and animated	Peer Tree is a pilot randomised controlled trial utilising a parallel design where participants are randomly allocated to either the Peer Tree intervention or control (i.e. No Peer Tree) group.	prospective multi-institutional randomised controlled trial	Baseline; End of treatment; Follow-up	The study aims to reduce loneliness and assess the acceptability, usability, and feasibility of the Peer Tree digital intervention in young people enrolled at university. - The primary outcome of the study is loneliness, and secondary outcomes include depression, social anxiety, quality of life, acceptability, usability, feasibility, and safety of Peer Tree. - The trial will report the initial efficacy, acceptability, and feasibility of using digital positive psychology interventions to reduce subthreshold mental health concerns.	The Peer Tree digital intervention shows promise in reducing loneliness in young people enrolled at university, which has practical implications for addressing mental health concerns in this population. - The study highlights the acceptability and feasibility of using digital positive psychology interventions to target subthreshold mental health issues, providing evidence for the effectiveness of such interventions. - The findings suggest that digital platforms like Peer Tree can be a valuable tool in addressing loneliness and improving mental well-being in young people, offering a convenient

videos to address loneliness in young people using a positive psychology framework. It is hypothesised that Peer Tree participants, compared with the control participants, will report significantly lower loneliness at post-intervention, and these effects will remain at follow-up. It is also anticipated that Peer Tree participants, compared with control participants, will report significantly lower social anxiety and depressive symptoms, and higher quality of life and well-being outcomes at post-intervention as well as at follow-up.

- The results will contribute evidence for positive psychology interventions to address mental ill-health. and accessible means of support. - The study also emphasizes the importance of considering factors such as uptake, attrition, retention, and application completion when assessing the feasibility of digital interventions like Peer Tree. - The development of a training manual for moderators and protocols for managing adverse events and risk issues demonstrates the practical steps taken to ensure participant safety and well-being during the trial. - The study's results contribute to the growing body of evidence supporting positive psychology interventions as a means of addressing mental health concerns, providing valuable insights for future research and



## DISCUSSION

The results of this systematic review show convergence with previous research that has explored the impact of smartphone-based interventions on mental health.<sup>(19,20,21,22,23,24,25,26,27,28,29,30,31,32)</sup> Several studies included in this review have found that the use of cognitive behavioral therapy and psychoeducation applications via smartphones can be beneficial in addressing childhood depression and related disorders. These findings support the idea that mobile technology has significant potential to improve mental health in diverse populations.<sup>(33,34,35,36,37,38,39,40,41,42,43,44,45)</sup>

Despite the positive results, it is crucial to acknowledge the limitations and methodological flaws present in the studies reviewed. Some of the studies had relatively small samples, which may restrict the generalizability of the results to larger populations. In addition, most of the results were based on self-reports, which carries the risk of response bias and subjectivity in the assessment of symptoms and quality of life. In addition, not all studies focused exclusively on mental health, which adds complexity to the interpretation of the results.<sup>(46,44,448,49,50)</sup>

The findings of this review suggest that smartphone-based interventions, such as cognitive behavioral therapy apps and psychoeducation, can have a positive impact on mental health in diverse populations, including adolescents, postnatal mothers, and families of children with serious illnesses. These results are encouraging and point to the potential of mobile technology to improve mental health in clinical and community settings.<sup>(51,52,53,54,55,56,57,58)</sup>

Despite the promising results, there is a clear need for future research in this area. Larger, long-term studies are essential to assess the sustained efficacy of smartphone-based interventions on mental health.<sup>(59,60,61,62)</sup> In addition, it is crucial to better understand the underlying mechanisms of how these interventions impact mental health and how they can be optimized.<sup>(63,64,65,66)</sup> Attention should be paid to methodological limitations and potential biases in future research.

More broadly, the increasing adoption of smartphones and accessibility to mental health apps raise the possibility of a transformation in how childhood depression and related disorders are addressed and treated.<sup>(67,68,69)</sup> These digital interventions have the potential to overcome geographic barriers and significantly improve accessibility to mental health care worldwide. However, it is critical to address privacy and security concerns of user data to ensure ethical and safe use of the technology.

In conclusion, this systematic review highlights the promising efficacy of smartphone-based interventions in improving mental health in different populations. Despite limitations and challenges, the use of mobile technology in mental health care is an evolving area that could offer significant benefits in the future, transforming the way we address and treat childhood mental disorders.

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#### **FINANCING**

We did not receive financing for the development of this research.

#### **CONFLICT OF INTEREST**

We declare that there is no conflict of interest.

#### **AUTHORSHIP CONTRIBUTION**

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