BMC Pediatrics

RESEARCH Open Access

Evaluating the effectiveness of the complementary therapy web application based on Kiddo game therapy on children with attention deficit hyperactivity disorder: a before and after study

Atefeh Arkani[1], Narges Norouzkhani[2], Azam Kheirdoust[3], Kosar Ghaddaripouri[1,4] and Mohammad Reza Mazaheri Habibi[1*]

Abstract

Attention deficit hyperactivity disorder (ADHD) is one of the most common neurological disorders, especially in childhood. Children with ADHD may have symptoms such as an inability to maintain concentration and attention, inappropriate developmental performance, and impulsivity. Play therapy helps to improve such symptoms by making the treatment process attractive. Therefore, the purpose of this study was to investigate the effectiveness of the Kiddo game-based complementary therapy web application in this disorder. This study was conducted in 2022 on 40 children aged 4 to 12 years in 2 psychotherapy clinics located in two cities. The available sampling method was used to select participants. At first, the Conners questionnaire was completed by the children's parents, and then the Kiddo web application was made available for two months. At the end, the Conners questionnaire was again completed by the parents. Nearly 31 children with ADHD were evaluated. The average age was 6.48 ± 1.89. The highest percentage of children was in preschool. A significant difference was observed between the average Conners scores before and after the intervention ($P < 0.001$). The results showed that complementary treatment based on play therapy improves the quality of life in ADHD children and reduce the amount and severity of the disorder. Intervention based on remote play therapy can be used as an effective, accessible, and low-cost intervention for children with ADHD.

Keywords Attention deficit hyperactivity disorder, Mobile health, Play therapy, Child

*Correspondence:
Mohammad Reza Mazaheri Habibi
MazaheriM@varastegan.ac.ir
[1]Department of Health Information Technology, Varastegan Institute for Medical Sciences, Mashhad, Iran
[2]Department of Medical Informatics, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
[3]Department of Medical Informatics, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran
[4]Department of Health Information Management, School of Health Management and Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran

Introduction

Today, one of the public health concerns is mental health among children and young people [1]. Mental health problems negatively affect the growth process of these people [2]. The most common neurodevelopmental disorder in childhood is attention deficit hyperactivity disorder (ADHD), with a prevalence of 2–7% in the world [3, 4]. This disorder is often diagnosed in the childhood [5]. The symptoms include the inability to maintain focus and attention, inappropriate growth performance, and impulsivity [6]. Moreover, this disorder leads to a range of negative consequences such as reduced quality of life, academic problems, and disruption in social relationships [7]. However, international treatment guidelines do not recommend drug therapy for children with ADHD [8, 9]. ADHD treatment includes pharmacological and non-pharmacological interventions [10, 11]. Non-pharmacological methods include cognitive behavioral therapy (CBT), psychological training programs, and behavioral interventions [12].

The World Health Organization has defined telemedicine as the provision of health care using various methods embedded in the field of information and communication technology [13]. Telemedicine uses a variety of platforms such as web applications to improve education, improve accessibility, and cost-effectiveness of health care [14]. Today, smartphones have provided an opportunity to increase access to mental health care, and in recent years, the design of mobile applications has enhanced the field of mental health [15, 16]. Considering the growing interest in technology in the population of children and adolescents, there is growing hope to use technology-based interventions, especially mobile phone applications, to address the mental health needs of such patients [17–20].

According to the studies, the use of mobile phone-based games leads to an increase in interest and motivation in the child resulting in faster recovery [21]. Play therapy is a child psychotherapy approach in which a trained therapist uses the therapeutic power of play to help children prevent or solve psychosocial problems [22]. A review of studies has shown that ADHD treatment lead to the improvement in the long term [23]. In addition, early diagnosis increases self-esteem and improves quality of life [23, 24]. Given the increasing interest in technology among children and adolescents, there is a compelling rationale for utilizing technology-based interventions, particularly mobile applications, to effectively address the mental health needs of this population. Research indicates that mobile phone-based games enhance interest and motivation among children, causing faster recovery. By integrating play therapy principles into a mobile application, this study aims to create a novel intervention that combines accessibility with evidence-based therapeutic techniques.

Materials and methods

Study design

This before-and-after study was conducted on 40 children in two separate psychiatric clinics in two cities of Mashhad and Neishabur, Iran during 2022. All ethical principles in research have been considered according to the Declaration of Helinisky. The study was approved by the Varastegan Institute for Medical Science.

Participants

Inclusion and exclusion criteria

Children aged 4 to 12 years with a documented clinical diagnosis of ADHD and currently receiving treatment at psychiatric clinics were included in the study. Inclusion criteria specified participants with no additional psychiatric or developmental disorders that confound the assessment of ADHD symptoms. Exclusion criteria were parental refusal to consent, significant cognitive impairments precluding assessment, and non-adherence to the Kiddo application protocol.

Verification of ADHD diagnosis

ADHD diagnoses were initially established by licensed psychiatrists in accordance with the DSM-5 criteria during routine clinical evaluations. For further verification, the Conners' Parent Rating Scale (CPRS-R) was administered to caregivers at baseline. Only those participants meeting or exceeding the clinical threshold for ADHD on the CPRS-R were included in the final analysis.

Evaluation tool

In the current study, the Conners questionnaire for parents was used [25]. This questionnaire contains 26 items that are used to identify the presence of ADHD in children or measure the severity of the disorder. To complete this questionnaire, parents were required to rate their child's behavior within a month. That is, they should ask themselves to what extent this problem has existed in the past month and then, choose the best answer based on the following rating. For instance, they circled the number one if the problem did not exist at all or was very rare.

- Not true at all (never) = 1.
- It is only slightly true (sometimes) = 2.
- Relatively true (often) = 3.
- It is completely true (very much) = 4.

If the child's total scores are higher than 34, it indicates that he/she has ADHD.

Kiddo application

Development of the Kiddo application

The Kiddo web application was developed as an interactive intervention based on play therapy to assist children with ADHD in improving cognitive, emotional, and behavioral skills. The development process involved collaboration among psychologists, child health experts, and software engineers to create activities specifically designed to address the challenges of ADHD, such as attention deficits, impulsivity, and emotional regulation. Each of the 11 sessions was informed by evidence-based play therapy techniques, and designed to be easily accessible for home use with minimal resources.

Intervention components

The Kiddo app included 11 structured educational videos that demonstrated play therapy games aimed at improving attention, memory, emotional control, and motor coordination in children with ADHD. Each video was supplemented with text instructions detailing game mechanics, alternative materials, and explanations of the therapeutic benefits of each game. Parents were instructed to use the application with their child for 30–40 min daily over a two-month period, focusing each day on different cognitive or emotional functions. In addition to the therapy sessions, the app included a "Kiddo Library" with resources for parents on ADHD management, a music section with calming music to aid sleep, and a gallery with visually engaging, child-friendly images to maintain interest in the application. While the application initially included a consultation and messaging section for professional support, these were inactive due to technical limitations.

Play therapy session descriptions

Play therapy consists of different sessions including:

Session 1: A game to enhance visual memory and concentration, where children guess hidden shapes. Parents substitute shapes with household items for home play.

Session 2: A drawing game for accuracy and focus, allowing parent-child interaction by completing each other's drawings.

Session 3: A memory-based game where children identify missing images in a sequence, enhancing visual memory and recall.

Session 4: A color-recognition and motor-control game using homemade bowling pins, designed to improve auditory discrimination and restraint.

Session 5: A game focusing on attention and reaction time, requiring children to match hand and foot movements to paper patterns on the ground.

Session 6: A puzzle game to boost processing speed and accuracy, involving color matching and shape replacement in a picture.

Session 7: Techniques for anger management, including breathing exercises to help children learn calming strategies.

Session 8: A coordination game using balls or Legos, where children respond to cues, building auditory memory and control.

Session 9: An exercise combining speech and movement to engage memory and coordination, involving play dough and word recall.

Session 10: A fine-motor game involving line coloring and cutting, designed to strengthen visual memory, concentration, and hand-eye coordination.

Session 11: A number-recognition game to improve visual memory and concentration, using age-appropriate number sequences.

Assessment of intervention implementation

Implementation of the Kiddo intervention was monitored through activity tracking within the application beside weekly follow-up contact with the parents. Parents were provided instructions on session frequency, duration, and expected outcomes. Weekly check-ins served to evaluate adherence, address technical issues, and provide guidance on game facilitation. Engagement was assessed based on parent-reported usage frequency and qualitative feedback during these check-ins. Participants with insufficient session completion or minimal engagement with the application were excluded from the final analysis to maintain data consistency. Lack of regular accomplishment of the games and/or absence of responds by the parents to follow-ups raised by the investigators for more than three times were defined as minimal engagement, which meet the criteria for excluding the participants.

Statistical analysis

First, the parents were given the necessary explanations under the supervision of the psychiatrists of both centers about how to answer the Conners questionnaire, and then the questionnaire file was sent to each of the parents on the WhatsApp social network, and they were asked to answer the questionnaire before the intervention (pre-test). After that, the Kiddo web application was available to the parents for 2 months from June 15 to August 16, 2022. Then, to evaluate the level and severity of the disorder after the intervention (post-test), the parents' Conners questionnaire was completed again.

Findings

During the follow-up, 9 people who did not have acceptable activity in using Kiddo were excluded from the study, and 31 eligible children were evaluated. Of these, 17 were boys and 14 were girls. The average age

Table 1 Demographic information

Variable	*N* (%)/ Mean ± SD
Age	6.48 ± 1.89
Sex	
-Boy	17 (54.83)
-Girl	14 (45.17)
City	
- Mashhad	16 (51.61)
- Neishabur	15 (48.39)
Grade	
Pre school	12 (38.70)
First grade	7 (22.58)
Second grade	6 (19.35)
Third grade	4 (12.90)
Fourth grade	2 (6.47)

was 6.48 ± 1.89. In total, 51.6% lived in Mashhad city and 48.4% in Neishabur city. The highest percentage of the studied people (38.7%) were in preschool (Table 1). The Conners scores were measured before and after the implementation of the kiddo web application. According to Table 2, a significant difference was observed between the average Conners scores of people before and after the play therapy ($P < 0.001$). Moreover, the effect size of 0.855 shows meaningful difference between Conners scores before and after Kiddo therapy. In Table 3, Conners scores were compared in subgroups before and after play therapy.

Table 3 Average Conners scores of children stratified by different variables before and after the entry

Variable	Mean	*N*	Std. Deviation	Std. Error Mean	*P*-value
Boy					
-before	69.82	17	12.59	3.05	< 0.05
-after	60.06	17	11.37	2.75	
Girl					< 0.05
-before	69.93	14	9.95	2.66	
-after	61.57	14	8.41	2.25	
Mashhad					
-before	68.38	16	8.08	2.02	< 0.05
-after	60.69	16	8.68	2.17	
Neyshabor					< 0.05
-before	71.47	15	14.07	3.63	
-after	60.8	15	11.58	2.99	
Preschool					
-before	71.42	12	10.98	3.17	= 0.5
-after	63.25	12	11.62	3.35	
First grade					< 0.05
-before	71.43	7	11.54	4.36	
-after	57.68	7	11.03	4.17	
Second grade					= 0.21
-before	62.33	6	13.61	5.56	
-after	57	6	9.12	3.72	
Third grade					< 0.05
-before	68.25	4	4.34	2.17	
-after	62.25	4	5.12	2.56	
Fourth grade					= 0.36
-before	81	2	8.48	6	
-after	64	2	7.07	5	

Discussion

Nowadays, telemedicine by the aid of smart mobile phone technology has created many opportunities to increase access and reduce the cost, especially in the field of mental health. Also, early treatment or recovery of this disorder in children is very effective and has promising impact for their future. Therefore, the present study was conducted to investigate the effect of Kiddo game therapy application in children with ADHD. The results showed the positive impact of the Kiddo application on the recovery process of 31 children with ADHD. Also, in a study conducted by Baghaei et al. on children with ADHD using computer games, they concluded that children enjoy using these games, and it increases self-esteem in such people [26]. In addition, Peijnenborgh and colleagues investigated the effect of a computer game on the specific cognitive functions of understanding time and reward mechanisms in children, and as a result, computer games have become a useful tool for children with ADHD [27].

Oord et al. also conducted a study to investigate the effectiveness of executive function correction training with play therapy on 40 children with ADHD, and concluded that people had a significant improvement after this course of play therapy [28]. The results of these three studies are consistent with the findings of our research. In addition, the findings of the present study show that complementary treatment based on play therapy improves the level and severity of ADHD in children under pharmacotherapy. In this regard, in a study conducted by Bul et al. on 170 children with ADHD to investigate the effects of playing a serious game based on the Internet for 20 weeks, they concluded that the use of this game was very effective in the treatment process along with traditional treatment approaches [29].

Table 2 Average Conners scores of children before and after the therapy

Variable	Mean	*N*	Std. Deviation	Std. Error Mean	*P*-value	Effect size
Conners scores of people before using Kiddo	60.74	31	10.01	1.79	$P < 0.001$	0.85
Conners scores of people after using Kiddo	69.87	31	11.29	2.02		

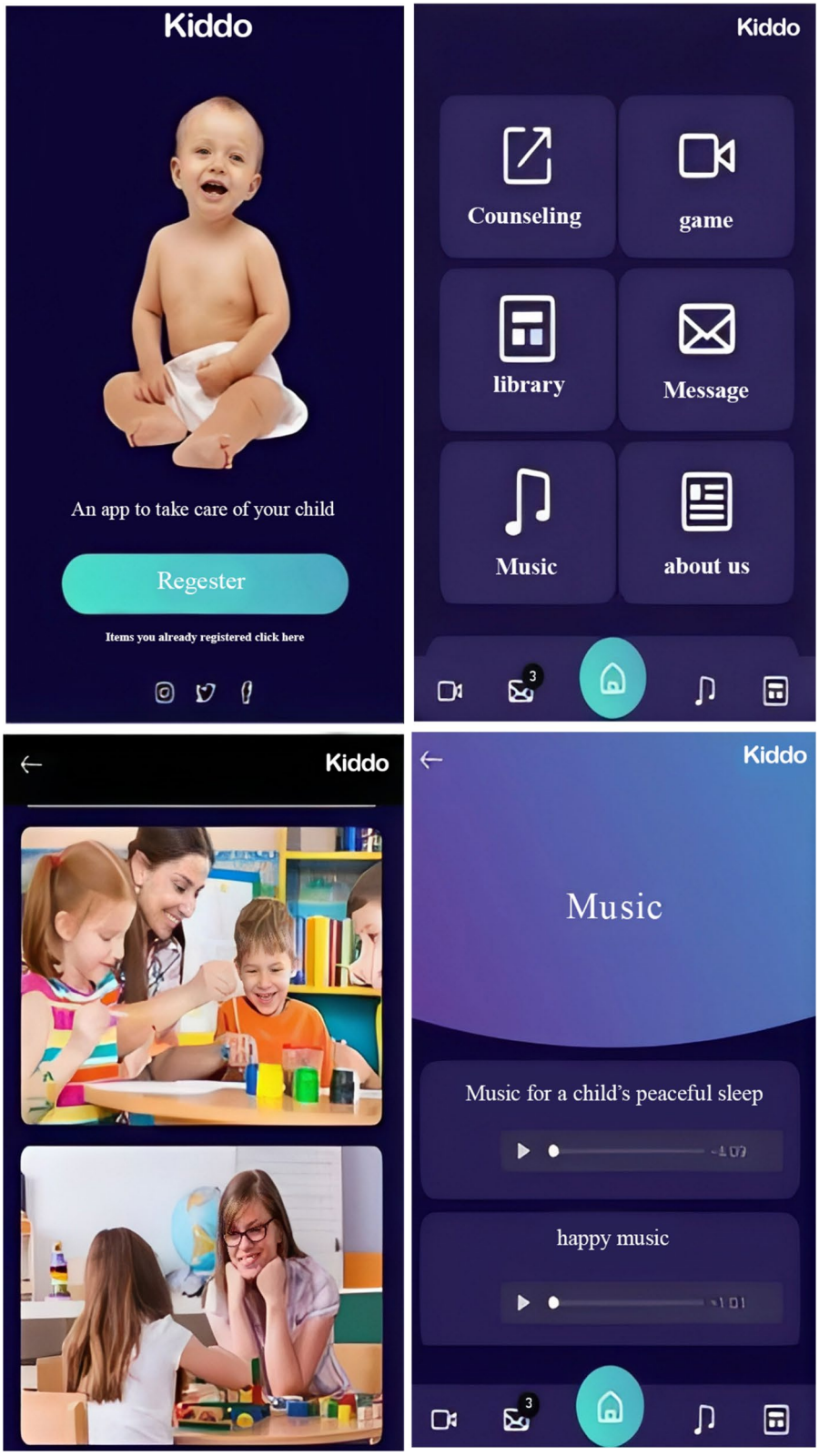

Fig. 1 Different interfaces of the Kiddo web-application. Up: registry form (left), and main menu containing diverse items including play therapy educational videos, message to the physician, library for redaing play therapy-relevant books, and an "about us" item (right). Down: a photo showing a part of play therapy in order to promote application use by children and their parents (left), and musical item containing relaxing audios to be played for children before sleep (right)

To use play as a therapeutic strategy for change, a therapist must have a thorough understanding of the changing mechanism or the intrinsic characteristics of play behavior. Numerous elements of play that are therapeutic in nature were identified by various theoretically oriented approaches to play therapy [30]. Play therapy practitioners can use Schaefer's list containing 25 therapeutic elements found in play as a guide including, but not limited to, self-expression, access to the unconscious, abreaction, catharsis, sublimation, competence and self-control, creative problem solving, fantasy compensation, behavioral rehearsal, and reality testing [31, 32]. Based on its interventional features, play therapy has established itself as a well-known approach to treating kids with a variety of presenting problems [33] (Fig. 1).

In addition to fostering more adaptive attachments and fruitful social interactions, play therapy interventions that are both child-directed and adult-supportive give kids the chance to learn new information and extend developing neural pathways [34]. Old dysfunctional pathways are reduced and overridden, and dysregulated behaviors are decreased, when play experiences that promote relationally safe attachments and healthy self-regulation are repeated [34]. Further research in neuroscience has shown that play therapy creates new neural pathways, enhancing neuroplasticity [35]. According to more research, oxytocin is essential for social behavior and social understanding, and its release is generally associated with better emotional recognition, less fear, and more trust. By monitoring a child's verbal, nonverbal, and emotional states, a therapist can observe resonance, which boosts oxytocin levels and fosters social bonding [35].

Among the strengths of this study, it can be mentioned that it was conducted before and after play therapy for two months in two different cities. Another strong point of this research was the use of the reliable Conners questionnaire to evaluate the extent and severity of this disorder before and after using Kiddo. A key limitation is the reliance on a single measure, the Conners' Parent Rating Scale, to assess the impact of the intervention. While the Conners scale is a validated tool for evaluating ADHD symptoms, the use of additional measures, such as teacher ratings or direct observational assessments, could have provided a more comprehensive view of the intervention's effect. Future studies should incorporate multiple assessment methods to validate and expand upon these findings. Additionally, the lack of a comparison or control group limits the ability to attribute observed improvements solely to the Kiddo intervention, as changes in ADHD symptoms could be influenced by other factors as well. Conducting a randomized controlled trial with a larger sample size and a control group receiving standard care or an alternative intervention would strengthen the evidence for Kiddo's effectiveness. Future research should also explore long-term outcomes to assess the sustainability of symptom improvement over time.

Conclusion

The results of this study showed that complementary therapy based on remote play therapy reduces the amount and severity of attention-deficit/hyperactivity disorder in affected children and improves the health and quality of life of these patients. Remote play therapy intervention can be used as an effective, accessible, and low-cost intervention for such children.

Acknowledgements
This study was supported by Varastegan Institute for Medical Sciences. We thank all patients for the collaboration in this study.

Author contributions
N.N., and M.R.M.H. designed the study. M.R.M.H. supervised the project. A.A., A.KH., and K.GH. contributed to the app's design. K.GH., A.KH. and A.A. analyzed and interpreted the data. K.GH., M.R.M.H., and N.N. wrote the final manuscript. All authors read and approved the final manuscript.

Funding
No funding was received for conducting this study.

Data availability
The datasets supporting the conclusions of this article are included within the article and its additional files.

Declarations

Ethics approval and consent to participate
This study was approved by the ethical committee of Mashhad University of Medical Sciences (approval number IR.MUMS.REC.1402.147). All methods were carried out in accordance with relevant guidelines and regulations or Declaration of Helsinki. Informed consent to participate was obtained from the parents or legal guardians of any participant under the age of 16. All participant's information was used confidentiality and without revealing names.

Consent for publication
Not applicable.

Clinical trial number
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 8 December 2024 / Accepted: 18 March 2025
Published online: 28 March 2025

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