

## Digital health interventions for children with ADHD



Attention deficit hyperactivity disorder (ADHD) is a childhood-onset disorder characterised by a persistent pattern of symptoms of inappropriate and impaired inattention, hyperactivity, or impulsivity, with difficulties often continuing into adulthood.<sup>1</sup> It is estimated to affect 37.1 million children and young people (aged  $\leq 20$  years) worldwide.<sup>2</sup> Although multiple ADHD treatments are available and widely used (eg, evidence-based behaviour therapy, medications, or a combination of both),<sup>3,4</sup> their effectiveness has been questioned because they might not fully address the needs of many children with ADHD. Barriers to evidence-based treatment for ADHD include misconceptions and stigma, time, and complexity of interventions, among others.<sup>5</sup> Digital health interventions, such as those delivered via mobile-based, tablet-based, and web-based platforms, offer diverse possibilities of treatment to address many of the barriers because these interventions can be accessed from everywhere, might support integration across multiple settings (eg, home, education, and health services), and can empower the individuals (and families) to take care of themselves. The evidence base for digital mental health interventions is rapidly accumulating.<sup>6,7</sup> For example, a 2017 overview with an updated systematic review of randomised trials<sup>7</sup> identified 21 reviews and 30 randomised controlled trials of digital health interventions for children and young people with mental health problems. Of these, 10 (33%) trials in 853 participants evaluated digital health interventions (including video game programs or computer programs) aimed at improving ADHD outcomes. The review concluded that the effects of digital mental health interventions in managing children with ADHD were uncertain.<sup>7</sup>

In *The Lancet Digital Health*, Scott Kollins and colleagues<sup>8</sup> sought to provide evidence for the effectiveness of a digital health intervention on attentional functioning and symptoms in children diagnosed with ADHD. The authors did a randomised, double-blind, parallel-group, controlled trial, comprising 348 children with ADHD (aged 8–12 years). Participants were randomised to a video game-like digital health intervention accessed via a tablet-platform (n=180) or a control intervention (n=168). The primary outcome was the mean change in the Attention Performance Index (API), an overall composite score from the Test of Variables of Attention

(TOVA). Secondary outcomes included mean changes in non-composite scores on TOVA, spatial working memory (ie, Cambridge Neuropsychological Test Automated Battery), clinician-rated ADHD symptoms (ie, ADHD-Rating Scale [ADHD-RS] subscale and total scale), executive function (ie, parent-completed Behaviour Rating Inventory of Executive Function subscale), impairment (ie, Impairment Rating Scale [IRS]), and global functioning (ie, Clinical Global Impression-Improvement [CGI-I] score). Moreover, treatment response (ie, proportion of responders at appropriate cutoff points on the same rating scales) and safety (ie, any adverse event) were examined. Overall, the authors found that a video game-like digital health intervention resulted in a small but significant effect in improving attention after 4 weeks of treatment (mean change [SD] from baseline on the composite score from the TOVA API was 0.93 [3.15] in the intervention group and 0.03 [3.16] in the control group, adjusted p value 0.0060). However, an effect was not observed in any of the prespecified secondary outcomes, which included some of the most prominent symptom rating scales. As acknowledged by the authors, there were no significant between-group differences in secondary measures (eg, ADHD-RS, CGI-I score, IRS, working memory). Thus, the study was unable to address a major challenge in treatment of children with ADHD, which ultimately should target not only the severity of impairment but also functional outcomes (school performance–social functioning) at that age.

The study has several strengths. The research design, which incorporated a randomisation schedule to intervention allocation, masking (of parents, children, and investigators), and its size, which was considerably larger than any of the previous studies in digital mental health.<sup>7</sup> The use of standardised measurement tools, which were applied in two different ways (ie, difference between baseline and post-treatment score, and the proportion of responders as an estimate of clinical relevance). The study is also associated with certain limitations. 4 weeks of treatment exposure (with 25-min daily sessions, approximately) is relatively short. Some difficulties were observed in completing intention-to-treat analysis because of invalid tests or missing data. Thus, the authors excluded participants after the random assignment in their main analyses,

Published Online  
February 24, 2020  
[https://doi.org/10.1016/S2589-7500\(20\)30058-3](https://doi.org/10.1016/S2589-7500(20)30058-3)  
See [Articles](#) page e168  
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<https://vizhub.healthdata.org/gbd-compare/>

which is referred to as modified intention-to-treat.<sup>9</sup> The study also excluded patients with comorbidities and patients receiving concomitant treatments, as have previous studies, and thus there are no data on the efficacy (and safety profile) of the digital health intervention in these populations.

However, Kollins and colleagues did give a preliminary indication of the efficacy of a video game-like digital health intervention to improve inattention in a paediatric population with ADHD. What are the implications of these findings for clinical practice? Specifically, how confident should we be about the benefits of this digital health intervention for ADHD, and what do the data tell us about the use of the intervention in the target population? The results of Kollins and colleagues' study are interesting and highlight the way for further development of digital health interventions for children with ADHD. Some might argue that efficacy of digital health interventions should be shown on patients with all subtypes of ADHD, and analyses of effects on subtypes (eg, predominantly inattentive ADHD) might be considered secondary. Because of the chronic course of ADHD, in addition to short-term trials, long-term efficacy should be established in future studies.<sup>10</sup> Thus, further research is needed to examine ways of sustaining treatment effects over the long-term, in the broader population of children with ADHD including those who have comorbidities and receive evidence-based therapies.

We declare no competing interests.

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