

# Mobile Application-Based Interventions to Improve Attention in Stroke Survivors: A Scoping Review

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**Background:** Stroke is a major global cause of disability, and attention deficits are among the most common cognitive impairments in survivors. These deficits limit independence and hinder rehabilitation outcomes. Conventional post-stroke rehabilitation focuses primarily on motor recovery, while targeted cognitive rehabilitation, particularly attention training, remains underrepresented.

**Purpose:** This scoping review aimed to identify mobile application-based interventions developed to improve attention in stroke survivors. The secondary aim was to describe the implementation settings of these interventions.

**Methods:** This review followed the PRISMA-ScR Arksey and O'Malley frameworks. Systematic searches were conducted in PubMed, Scopus, EBSCO-host, and Google Scholar up to January 2025. Eligible studies included randomized controlled trials (RCTs), pilot RCTs, and quasi-experimental designs involving post-stroke patients with attentional deficits using mobile applications via smartphones or tablets. Methodological quality was appraised using the Joanna Briggs Institute (JBI) checklist for RCTs and the National Institutes of Health (NIH) tool for pre-post studies without a control group.

**Results:** Eleven studies were included from 5840 identified records. Two types of mobile applications were identified: cognitive training applications (n = 4) incorporating structured exercises and telehealth support, and game-based rehabilitation applications (n = 7), emphasizing gamification and training tasks. The interventions were implemented in hospital-based and hybrid settings.

**Conclusion:** Mobile applications show promise in post-stroke attentional rehabilitation, with evidence supporting cognitive training and game-based programs via tablets in hospital or hybrid settings and these interventions improve attention. However, methodological variability and heterogeneous protocols limit study comparability. Future research needs standardized frameworks and large clinical trials, supported by digital literacy among healthcare professionals, to strengthen clinical integration within stroke rehabilitation.

**Keywords:** attention, cognitive rehabilitation, mHealth, mobile applications, stroke

## Introduction

Stroke is an acute neurological event caused by a sudden disruption of cerebral blood flow, leading to neuronal injury and potentially resulting in long-term functional impairments.<sup>1</sup> According to the World Health Organization and recent global estimates, the worldwide burden of stroke is projected to increase substantially from 104.2 million cases in 2017 to 113.7 million by 2030, and nearly 150 million by 2045.<sup>2</sup> Although survival rates have improved, particularly for ischemic stroke compared to hemorrhagic stroke a considerable proportion of survivors continue to experience persistent complications.<sup>3</sup> Cognitive impairments, including attention deficits, are particularly debilitating, affecting approximately 46% to 92% of individuals who have experienced a stroke.<sup>4</sup> These impairments hindering recovery, reducing independence, compromising quality of life, and necessitating targeted rehabilitation strategies.<sup>5</sup>

Attentional deficits are widely acknowledged as the primary cognitive impairment following a stroke.<sup>6</sup> Attentional deficits, marked by impairments in sustained, selective, and divided attention, result from disruptions within cortical and subcortical networks that regulate attention.<sup>7,8</sup> Sustained attention refers to the ability to maintain focus over prolonged periods, selective attention involves filtering relevant from irrelevant information, and divided attention encompasses managing multiple tasks or stimuli simultaneously.<sup>9</sup> Deficits in these areas manifest as significant impairments in daily activities, such as the inability to drive safely, complete household tasks (multitasking), or difficulty in following conversations in noisy environments.<sup>10,11</sup> These deficits compromise executive function, memory, language, and daily activities, consistently linked with poorer rehabilitation outcomes and reduced quality of life.<sup>12,13</sup> Although the global prevalence of post-stroke cognitive impairment is well documented, attentional difficulties specifically are common yet often underrecognized, particularly in low- and middle-income countries where disparities in acute care and rehabilitation access are more pronounced.<sup>14</sup>

Conventional rehabilitation approaches frequently fall short of addressing cognitive recovery, particularly attentional impairments.<sup>15</sup> These interventions primarily emphasize physical restoration and often provide limited individualized or engaging cognitive stimulation.<sup>16,17</sup> Challenges such as low patient engagement, restricted accessibility, and limited personalization further reduce their long-term effectiveness and the generalization of cognitive gains to everyday activities.<sup>18</sup> Consequently, targeted and domain-specific attentional rehabilitation is essential for optimizing post-stroke recovery and improving overall quality of life.<sup>9</sup>

Recent advancements in digital health have introduced mobile application-based cognitive interventions as promising alternatives to traditional rehabilitation.<sup>17</sup> Mobile health tools offer enhanced accessibility, affordability, and scalability, allowing patients to engage in structured cognitive exercises at home with real-time feedback.<sup>19</sup> Gamification features and personalized training modules have been shown to improve adherence and user engagement, supporting their potential role as supplementary digital therapeutics.<sup>20,21</sup> While digital interventions for other cognitive domains, such as memory and executive function, are increasingly available, evidence specifically targeting attentional rehabilitation through mobile applications remains limited.<sup>22</sup>

Previous reviews and meta-analyses have confirmed the general efficacy of digital cognitive rehabilitation for stroke survivors, showing significant improvements in global cognitive function, memory, and executive functions however, the specific impact on attentional domains remains insufficiently defined.<sup>23,24</sup> This uncertainty frequently occurs because current reviews merge broad cognitive outcomes, which hides the effects on specific attentional components, and because they examine diverse digital rehabilitation technologies collectively, which makes it difficult to isolate the benefits of mobile applications alone.<sup>25</sup> Although mobile application-based interventions offer advantages such as accessibility, personalization, and home-based usability, there is limited knowledge on whether these tools specifically target attentional domains that are critical for functional independence.<sup>26</sup> To address this gap, the present scoping review aims to identify mobile applications that target attention in individuals with stroke and to describe their implementation settings, with implications for health service delivery and digital health strategies.

## Materials and Methods

### Design

This study used a scoping review following the PRISMA Extension for Scoping Reviews (PRISMA-ScR) as proposed by Arksey and O'Malley (2005).<sup>27</sup> The broad review question was, What mobile application-based interventions have been explored to improve attention in stroke patients within rehabilitation settings (hospital, home, or community)? The narrow question of this review was which mobile application-based cognitive interventions have been identified, and in which rehabilitation settings (hospital, home, or community) have they been implemented to enhance attention among stroke patients, with implications for clinical practice and digital health strategies?.

## Eligibility Criteria

The search approach adhered to the PRISMA-ScR guidelines. Articles were selected based on the inclusion and exclusion criteria. In this study, the Population, Concept, Context (PCC) framework was used as a guide.

Population: Stroke patients with attention deficits.

Concept: Mobile application-based interventions to improve attention.

Context: Rehabilitation settings (hospital, home, and community).

Additionally, we included primary studies, such as randomized controlled trials and quasi-experiments, which evaluated mobile application-based (smartphone and tablet) interventions, either as the primary delivery or as an adjunct (eg, monitoring, feedback) alongside other platforms, such as virtual reality interventions aimed at improving attention in stroke. Only studies published in English, with publication years up to January 2025, and conducted in various rehabilitation settings were considered. The exclusion criteria were studies focusing exclusively on motor or language rehabilitation, those employing non-mobile technologies such as robotics or personal computers, protocols, reviews, meta-analyses, editorials, commentaries, and studies lacking primary data or available only as abstracts.

## Search Strategy and Study Selection

In this scoping review, articles were obtained from PubMed, Scopus, EBSCO-host, and Google Scholar databases. A keyword-adjusted MeSH term was used, focusing on mobile application-based interventions designed to improve attention in stroke patients with attention deficits (Table 1). Two authors from the research team (C.E. and A.N.) independently screened the titles and abstracts, followed by a full-text review and data extraction by the same team. In cases of disagreement, discussions were conducted to reach a consensus.

The study assessment was performed by two independent reviewers, with additional consultation from another author (I.P. and V.B.). The Joanna Briggs Institute (JBI) critical appraisal tool was used for quality assessment. The quality of the articles was evaluated using the JBI Critical Appraisal Tool for randomized controlled trials (RCTs) and the National Institutes of Health (NIH) quality assessment tool for before–after (pre-post) studies without a control group.<sup>28,29</sup> Articles were considered to meet the quality criteria if they achieved a minimum score of  $\geq 75\%$ , calculated based on the proportion of items rated “yes” across all statements. Further details of this study are presented in Table 2.

**Table 1** Searching Strategy

No	Database	Keyword
1	PubMed	(Stroke[MeSH Terms] OR stroke[All Fields] OR poststroke[All Fields]) AND (Mobile Applications[MeSH Terms] OR mobile[All Fields] OR smartphone[All Fields] OR tablet[All Fields] OR mHealth[All Fields] OR app[All Fields] OR Video Games[MeSH Terms] OR serious game*[All Fields]) AND (Attention[MeSH Terms] OR attention[All Fields] OR attentional[All Fields] OR attention deficit*[All Fields] OR neglect[All Fields]) AND (Rehabilitation[MeSH Terms] OR Cognitive Rehabilitation[MeSH Terms] OR Cognitive Therapy[MeSH Terms] OR rehabilitation[All Fields] OR cognitive [All Fields] OR training[All Fields])
2	Scopus	TITLE-ABS-KEY (stroke OR poststroke) AND TITLE-ABS-KEY (“mobile application*” OR “mobile app*” OR smartphone* OR tablet* OR mhealth OR app* OR “serious game*” OR “video game*”) AND TITLE-ABS-KEY (attention OR attentional OR “attention deficit*” OR neglect*) AND TITLE-ABS-KEY (rehabilitation OR “cognitive rehabilitation” OR “cognitive therapy” OR cognitive OR training)
3	EBSCO-host	(MH “Stroke+” OR TX stroke OR TX poststroke) AND (MH “Mobile Applications+” OR TX mobile OR TX smartphone OR TX tablet OR TX mhealth OR TX app OR MH “Video Games+” OR TX serious game*) AND (MH “Attention+” OR TX attention OR TX attentional OR TX “attention deficit*” OR TX neglect*) AND (MH “Rehabilitation+” OR MH “Cognitive Rehabilitation+” OR MH “Cognitive Therapy+” OR TX rehabilitation OR TX cognitive OR TX training)
4	Google Scholar	(stroke OR post-stroke) AND (“mobile application” OR mobile OR smartphone OR tablet OR mHealth OR app OR “video games” OR “serious games”) AND (attention OR attentional OR “attention deficit” OR neglect) AND (rehabilitation OR “cognitive rehabilitation” OR “cognitive therapy” OR cognitive OR training)

**Table 2** Quality Appraisal

No	Study Design	Study Design	Critical Appraisal Tool	Quality Appraisal Scores of Included Studies
1	Des Roches et al (2015) <sup>30</sup>	Quasi-experimental	JBI	75%
2	Torrise et al (2019) <sup>31</sup>	Pilot RCT	JBI	77%
3	Jung H.-T. et al (2020) <sup>32</sup>	Pilot RCT	JBI	77%
4	Thaivon T & Munkhetvit P (2020) <sup>33</sup>	Quasi-experimental	NIH quality assessment tool	83%
5	Abou-Shady et al (2023) <sup>34</sup>	RCT	JBI	77%
6	Liu et al (2022) <sup>35</sup>	Pilot RCT	JBI	85%
7	Oliveri et al (2023) <sup>22</sup>	RCT	JBI	77%
8	Contrada et al, (2025) <sup>36</sup>	RCT	JBI	77%
9	Abdou F.A. et al (2023) <sup>37</sup>	Quasi-experimental	NIH quality assessment tool	75%
10	Kim et al (2025) <sup>38</sup>	RCT	JBI	85%
11	Specht J. (2023) <sup>39</sup>	Pilot RCT	JBI	77%

**Notes:** NIH quality assessment tool: The National Institutes of Health (NIH) quality assessment tool for before-after (pre-post) studies with no control group.

**Abbreviation:** JBI, Joanna Briggs Institute.

## Data Extraction and Analysis

Data extraction was conducted by the first author (A.N) and subsequently verified by other authors (C.E. and I.P). Essential information was gathered from the articles reviewed in the subsequent sections. The outcomes of this review are shown in Table 3, including the author, year of publication, country, study design, sample size and characteristics (age), application type, platform, key features, outcomes, setting, and main findings. All discrepancies were resolved through discussion until a consensus was reached.

A descriptive analysis was conducted to summarize the characteristics of the included studies. Study attributes, such as intervention type, delivery platform, features, and outcome categories, were organized into tables and synthesized narratively. Frequency counts and categorical mapping were used to identify patterns in the study designs, implementation settings, and intervention components. To complement the descriptive summaries, the research team performed a qualitative thematic analysis to identify recurring themes related to the intervention features, implementation contexts, and reported outcomes. This integrated approach allowed the findings to be synthesized comprehensively and presented under structured thematic categories.

## Results

### Study Selection Results

A total of 5840 records were initially identified from Scopus (n = 572), PubMed (n = 981), EBSCO-host (n = 1117), and Google Scholar (n = 3170) databases. After removing 378 duplicates, 5462 records were screened by title and abstract based on predetermined inclusion and exclusion criteria. This process yielded 30 full-text articles for eligibility assessment. Following a detailed evaluation, 19 articles were excluded (eg, not related to digital health interventions, not randomized controlled trials, or not stroke populations), resulting in the inclusion of 11 studies in the final review. The details of the selection process are presented in Figure 1 and Table 1, respectively.

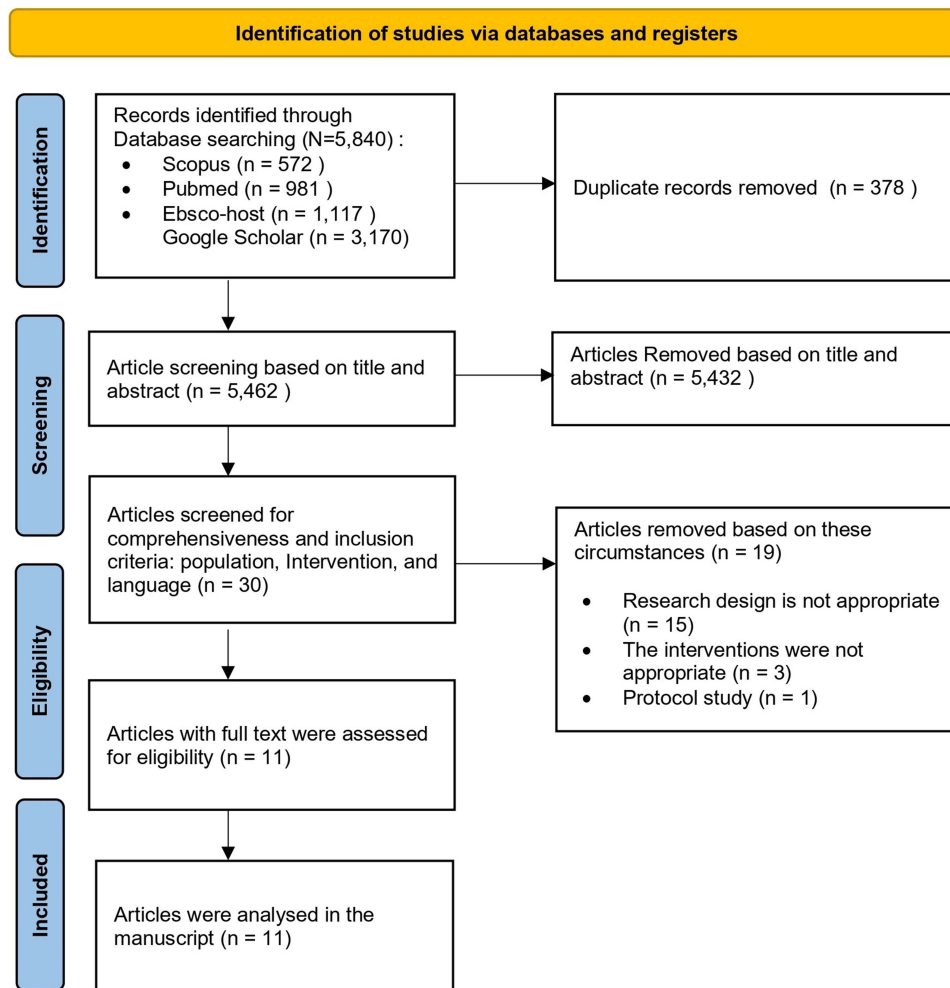
### Characteristic of Included Studies

Eleven studies were included in this review. The study designs included randomized controlled trials (n = 4),<sup>22,34,36,38</sup> pilot randomized controlled trials (n = 4),<sup>31,32,35,39</sup> and quasi-experimental studies (n = 3).<sup>30,33,37</sup> Across all studies, the combined sample size was 412 post-stroke participants. The studies were geographically diverse, with contributions from the United

Table 3 Extraction Data

No	Author Year (s)	Country	Design	Sample (n), Age (Mean ± SD) (Year)	Application Type	Platform	Key Features	Prescription (X) Minutes/Day, (Y) Days/Week	Outcome	Setting	Finding
1	Des Roches et al (2015) <sup>30</sup>	USA	Quasi-experimental	N = 51 (EG: 42, CG: 9); (EG: 63.6 ± 10.8 years, CG: 67.1 ± 10 years)	Cognitive Training App	tablet	Training, Monitoring, Assessment, Telehealth Support	1 hour/week in clinic and 6 hours/week at home	Attention	Hospital and home - based	Significant improvement in attention (p < 0.05)
2	Torrissi et al (2019) <sup>31</sup>	Italy	Pilot RCT	N = 40 (EG: 20, CG: 20); (EG: 57.1 ± 15.9 years, CG: 53.2 ± 20.8 years)	Cognitive Training App	Tablet	Training, Monitoring, Assessment, Telehealth Support	<ul style="list-style-type: none"> <li>● Phase 1: 50 minutes/day, 5 days/week</li> <li>● Phase 2: 50 minutes/day, 3 days/week</li> </ul>	Attention (Sustained and Selective attention)	Hospital and home-based	Significant improvement in AM (p < 0.001), TMT-B (p < 0.01)
3	Jung H.-T. et al (2020) <sup>32</sup>	South Korea	Pilot RCT	N = 29 (EG: 14, CG: 15) (EG: 72.71 ± 9.86 years, CG: 72.67 ± 12.64 years)	Game-Based Therapy App	Smartphones and Tablet	Gamification and Training	30 minutes/day, 2 days/week /12-week	Attention	Hospital-based	Significant improvement in attention (p < 0.05)
4	Thaivon T & Munkhetvit P (2020) <sup>33</sup>	Thailand	Quasi-experimental	N = 15, (58.73 ± 11.39 years)	Game-Based Therapy Apps	Tablet	Training and Gamification	45 min/session, 3 sessions/week for 6 weeks	Attention	Hospital-based	Significant improvement in attention (p = 0.001)
5	Abou-Shady et al (2023) <sup>34</sup>	Egypt	RCT	N = 40 (EG: 20, CG: 20); (45–60 years)	Game-Based Therapy Apps	Smartphones	Gamification and Training	30 min/session, 3 sessions/week for 6 weeks	Attention	hospital-based	Significant improvement in attention (p = 0.001)
6	Liu et al (2022) <sup>35</sup>	China	Pilot RCT	N = 30 (EG = 15, CG = 15); (EG: 74.93 ± 6.81 years, CG: 73.40 ± 7.5)	Game-Based Therapy Apps	Tablet	Gamification and Training	15 min/day, 6 days/week for 6 weeks	Attention (Visual-spatial Attention)	hospital-based	Significant improvement in visual-spatial attention (p = 0.028)
7	Oliveri et al (2023) <sup>32</sup>	Italy	RCT	N = 30 (EG = 15, CG = 15); (EG: 65.1 ± 14.6 Years, CG: 56.9 ± 12.4 Years)	Game-Based Therapy Apps	Tablet	Gamification and Training	40 minutes/day, daily sessions for 10 days	Attention	hospital-based	Significant improvement in attention (p < 0.01)
8	Contrada et al. (2025) <sup>36</sup>	Italy	RCT	N = 30 (EG = 15, CG = 15); (EG: 63 (50–69) years, CG: 70 (65–74) Years)	Cognitive Training App	Tablet	Training, Monitoring, and Telehealth Support	60 minutes/day, 5 days/week, for 4 weeks	Attention	Hospital and home-based	No significant improvement in attention (p > 0.05)
9	Abdou F.A. et al (2023) <sup>37</sup>	Egypt	Quasi-experimental	N = 50; 18–60 years	Game-Based Therapy Apps	Tablet	Gamification and Training	30 minutes/day, 3 days/week, for 3 months	Attention	hospital-based	Significant improvement in attention (p = 0.001)
10	Kim et al (2025) <sup>38</sup>	South Korea	RCT	N = 55 (EG = 27, CG = 28), (EG: 68.0 ± 12.5 Years, CG: 65.6 ± 10.6 Years)	Cognitive Training App	Tablet	Training, Monitoring, Assessment, and Telehealth Support	30 minutes/day, 24 sessions over 6 weeks	Attention	Hospital and home-based	No significant improvement in attention (p > 0.05).
11	Specht J. (2023) <sup>39</sup>	Germany	Pilot RCT	N = 42 (EG = 21, CG = 21) (EG: 68.3 ± 14.5 ± 36 Years, CG: 67.3 ± 4.6 Years)	Game-Based Therapy Apps	Tablet	Gamification, and Training,	30 minutes/session, 3–5 days/week	Attention	hospital-based	No significant improvement in attention (p > 0.05).

**Abbreviations:** AM, Attention Matrix; CG, Control Group; EG, Experimental Group; RCT, Randomized Controlled Trial; SD, Standard Deviation; TMT-B, Trail Making Test Part B.

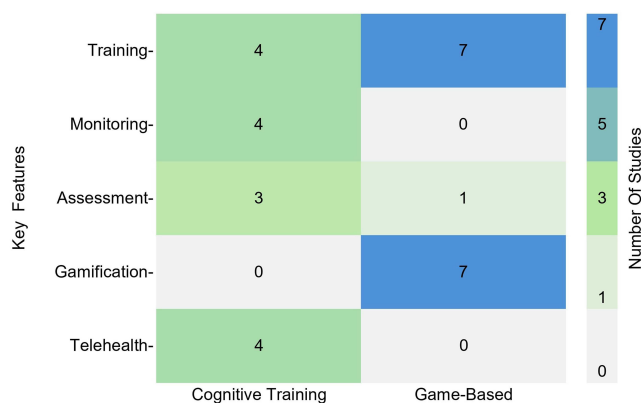


**Figure 1** PRISMA Flowchart of Study Selection Process. Adapted from the study by Page et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews.<sup>41</sup>

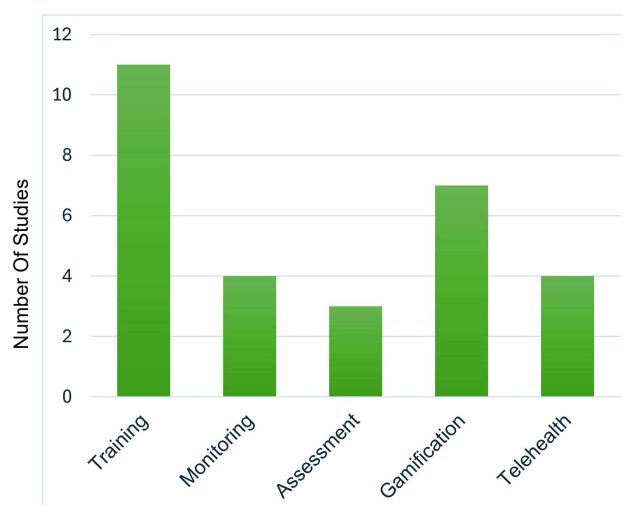
States (n = 1),<sup>30</sup> Italy (n = 3),<sup>22,31</sup> South Korea (n = 2),<sup>32,38</sup> Thailand (n = 1),<sup>33</sup> Egypt (n = 2),<sup>34,37</sup> China (n = 1),<sup>35</sup> and Germany (n = 1).<sup>39</sup> Regarding patient characteristics, the reported mean age of participants ranged from 18 to approximately 75 years, with the majority of the studies involving participants in the 60–70 year age group. The detailed characteristics of the included studies are summarized in [Table 3](#).

## Mobile Applications Identified

This review identified 11 mobile application–based interventions targeting post-stroke attentional rehabilitation ([Table 3](#), [Figures 2](#) and [3](#)). Two primary categories of applications were used: cognitive training applications (n = 4)<sup>30,31,36,38</sup> and game-based rehabilitation applications (n = 7).<sup>22,32–35,37,39</sup> As illustrated in [Figures 2](#) and [3](#), cognitive training interventions typically incorporated multiple functional components, including monitoring, assessment, and telehealth support. In contrast, game-based interventions were characterized primarily by training-intensive tasks and robust gamification features, with limited use of monitoring or clinician-facing capabilities. Overall, [Figures 2](#) and [3](#) show that training and gamification were the most frequently reported components, followed by monitoring, telehealth, and assessment. Cognitive training applications were predominantly tablet-based and featured structured attention-focused exercises supported by clinician monitoring and feedback. Game-based applications emphasized engagement through gamification mechanics combined with cognitive training tasks to support attentional rehabilitation. A synthesis of application types and intervention characteristics is presented in [Table 3](#), with methodological quality summarized in [Table 2](#).



**Figure 2** Key features of mobile application-based interventions for post-stroke attentional rehabilitation, categorized by cognitive training and game-based applications.



**Figure 3** Distribution of key features in mobile application-based interventions for post-stroke attentional rehabilitation, showing training, gamification, monitoring, assessment, and telehealth support.

## Cognitive Training Applications

The cognitive training applications identified in this review were consistently designed for tablet-based delivery and emphasized structured training protocols tailored to attentional rehabilitation (Table 3, Figures 2 and 3).<sup>30,31,36,38</sup> As reflected in Figures 2 and 3, cognitive training applications demonstrate a broader range of functional components than game-based applications, particularly through the inclusion of assessment and telehealth features. This functional diversity highlights the emphasis on structured therapeutic delivery and clinician-guided monitoring. These applications incorporated multiple functionalities, including task-based cognitive exercises, continuous monitoring of user performance, integrated assessment tools, and telehealth support features to facilitate remote clinician supervision.<sup>36</sup> Despite similarities in platform and core functions, the studies demonstrated heterogeneous outcomes. A quasi-experiment study<sup>30</sup> and a pilot RCT<sup>31</sup> both reported significant improvements in attention, particularly in sustained and selective domains, highlighting their potential efficacy in clinical and home-based settings.<sup>30,31</sup> In contrast, two randomized controlled trials found no measurable benefits, indicating variability in the intervention protocols, dosage, and study design.<sup>36,38</sup> Across the included trials, outcome measures differed considerably in terms of the attentional domains assessed, the instruments used, and the scoring criteria applied. This variability likely influenced the comparability of the findings across studies and contributed to the differences in the reported effectiveness.

## Game-Based Rehabilitation Applications

Game-based rehabilitation applications represent the most frequently reported category of intervention for post-stroke attentional rehabilitation (Table 3, Figures 2 and 3).<sup>22,32–35,37,39</sup> Consistent with the distribution patterns shown in Figures 2 and 3, game-based interventions relied heavily on training and gamification features, with minimal integration of monitoring, assessment, or telehealth capabilities. This concentration of features reflects a design approach focused on engagement and task repetition rather than on comprehensive clinical oversight. These applications were primarily delivered via tablets or smartphones and consistently incorporated gamification elements such as levels, scoring systems, and feedback mechanisms, along with structured training tasks to sustain user motivation and engagement. Six studies reported significant improvements in various domains of attention, including sustained, selective, and visual–spatial attention.<sup>22,32–35,37</sup> In contrast, one pilot randomized controlled trial found no significant effects, underscoring the methodological variability in study designs, intervention protocols, and sample characteristics.<sup>39</sup> These mixed findings underscore the variability in study design, intervention intensity, and sample characteristics. A summary of the outcomes of game-based applications is presented in Table 3.

## Implementation Settings

This scoping review identified two primary implementation settings for mobile application-based interventions in post-stroke attentional rehabilitation: clinical settings and hybrid hospital-based approaches (Table 3). Clinical settings (n = 7)<sup>22,32–35,37,39</sup> were the most frequently reported, with studies conducted exclusively in hospitals. These interventions often demonstrate improvements in attentional performance. However, some randomized controlled trials (RCTs) have yielded non-significant results, underscoring the variability in study design, intervention protocols, and dosage.<sup>22,32–35,37,39</sup> While some studies have reported significant improvements in attention, others have found no measurable benefits, highlighting the heterogeneity of intervention delivery and outcome measures in this field.<sup>22,32–35,37,39</sup> Summaries of implementation contexts and associated outcomes are presented in Table 3.

## Discussion

Compared with previously published reviews on technology-assisted or digital cognitive rehabilitation after stroke, this review provides a more focused and methodologically distinct contribution by examining mobile application-based interventions specifically targeting attentional rehabilitation. Prior reviews have generally encompassed broad cognitive domains, computer-based training, virtual reality systems, or generalized telerehabilitation models without isolating mobile platforms as an independent modality.<sup>23</sup> No previous synthesis has evaluated evidence exclusively on mobile-delivered attentional interventions or investigated how clinical contexts, such as hospital-based, hybrid hospital-to-home, or remotely supervised models, influence therapeutic outcomes.<sup>24</sup> It also identifies critical evidence gaps that earlier studies did not address, including the complete absence of community-based programs and the lack of personalized or AI-driven adaptive mechanisms within current mobile interventions.

Although many studies reported statistically significant improvements in attentional outcomes,<sup>22,30–35,37</sup> several did not show measurable benefits.<sup>36,38,39</sup> These mixed findings extend the variability highlighted earlier and illustrate the heterogeneity of outcomes across studies and can be linked to methodological variability, including differences in intervention duration, frequency, therapeutic intensity, targeted attentional domains such as sustained (the ability to maintain focus over time), selective (the ability to focus on relevant stimuli while ignoring distractions), or visuospatial attention (the ability to direct attention to specific locations in the visual field), and the sensitivity of outcome measures.<sup>31,35</sup> Cognitive training applications typically focused on structured tasks designed to enhance specific attentional processes,<sup>30,31,36,38</sup> whereas game-based applications emphasized motivation and engagement through reward systems and adaptive difficulty.<sup>22,32–35,37,39</sup> Studies with higher therapeutic dosages, clearer alignment between app tasks and attentional domains, and structured supervision tended to report more positive outcomes,<sup>22,31,37</sup> while shorter or nonspecific interventions more frequently showed null results.<sup>36,38,39</sup> Collectively, these findings underscore the need for standardized intervention protocols and theoretically grounded task designs to reduce heterogeneity.

Mobile applications were consistently designed to deliver structured cognitive training, often incorporating gamified elements to enhance user engagement as seen in several trials of tablet- and smartphone-based interventions.<sup>22,32–35,37,39</sup> In some studies, remote monitoring or telehealth support was also included to extend care beyond the clinic.<sup>30,31,36,38</sup> These studies were conducted across diverse regions, including the United States, Italy, South Korea, China, Egypt, Thailand, and Germany, indicating that mobile-based interventions are adaptable across various healthcare contexts.<sup>22,30–39</sup> However, descriptions of personalization, adaptive feedback, or AI-driven mechanisms were notably absent, and none of the included studies detailed cultural tailoring or local development, limiting conclusions about contextual fit or cultural relevance. This gap mirrors the broader inconsistencies in intervention design and highlights the need for clearer reporting standards.

The crucial role of healthcare professionals further shapes the effectiveness of mobile-based attention rehabilitation. Evidence shows that mobile applications, serious games, and telerehabilitation can support improvements in attention, but their success depends on clinicians' ability to tailor tasks, monitor progress, and adapt interventions to individual needs as demonstrated in studies that incorporated clinician-supported features such as monitoring, assessment, and telehealth support.<sup>30,31,36,38</sup> Occupational therapists adjust tablet-based tasks for motor limitations, while nurses help maintain motivation and adherence in subacute settings, reflecting the supervised nature of most interventions, particularly those conducted in hospital-based environments.<sup>22,32–35</sup> As remote rehabilitation models expand and digital platforms incorporate more advanced features, clinicians require stronger competencies in digital literacy, ethical considerations, and technology-enabled care consistent with the hybrid hospital to home designs reported in multiple trials.<sup>30,31,36,38</sup> These demands underscore the importance of interprofessional training that integrates digital health skills with evidence-based rehabilitation strategies.

Focusing specifically on attentional rehabilitation, trials of mobile-based cognitive training and serious-game interventions have frequently reported improvements in attentional performance, as shown in multiple quasi-experimental and randomized controlled studies.<sup>22,30–35,37</sup> These gains were demonstrated across tablet and smartphone platforms employing multimodal digital features designed to structure training, enhance engagement, and support remote clinician oversight when available.<sup>30,31,36,38</sup> However, several studies reported no significant improvements, indicating variability in effectiveness.<sup>36,38,39</sup> The convergence of findings from earlier paragraphs suggests that these inconsistencies arise not only from study design and intervention intensity but also from supervision levels, application features, adherence, and accessibility, all of which varied considerably across the included trials. To maximize therapeutic benefits, mobile-based interventions should incorporate clinically meaningful tasks, user-centered designs, and structured oversight and standardized outcome measures, rigorous methodologies, and clear reporting are essential for strengthening the evidence base.<sup>40</sup> While mobile applications provide valuable opportunities for home-based practice, current evidence suggests that they complement rather than replace clinician-guided therapy.<sup>41</sup> Consistent with trends in the broader rehabilitation literature, focused evidence on attentional outcomes remains limited, indicating the need for higher-quality studies with clearer intervention frameworks.<sup>42</sup>

## Implications for Clinical Practice

Mobile applications have the potential to improve attention in stroke survivors through gamification and telehealth cognitive training. Most interventions occurred in hospitals or hybrid hospital-to-home settings, extending rehabilitation beyond supervision. These tools can complement conventional rehabilitation by supporting continuity and enhancing patient engagement. However, multidisciplinary oversight remains essential to ensure safety. The findings were mixed, with varying results across different designs and protocols. The success of digital health depends on cultural adaptation, accessibility, and patient adherence. Policymakers should consider integrating validated mobile applications into rehabilitation pathways while supporting additional trials to strengthen the evidence.

## Strengths and Limitations

This review demonstrates the value of a comprehensive search across diverse settings to provide an overview of mobile applications for post-stroke attentional rehabilitation in adults. The methodological quality of the included studies was acceptable, enhancing the reliability of the findings. However, this study has several limitations. Variations in protocols and outcome measures complicate comparisons and limit their generalizability. The findings were heterogeneous, with mixed effectiveness, suggesting that study design, patient characteristics, and intervention features may influence outcomes. The evidence base is limited by small-scale, short-term studies, and few telehealth approaches are compared with

hospital-based programs. Moreover, no studies were identified in community-based settings, which restricts generalizability and highlights an important research gap. Addressing these limitations through standardized methods, larger samples, and extended follow-up will be critical to strengthen the evidence and guide future practice and policy.

## Conclusion

Mobile application interventions show promise in post-stroke attentional rehabilitation. The strongest and most consistent evidence emerged from structured cognitive training applications and game-based attentional training programs, particularly when delivered via tablets or smartphones in hospital or hybrid hospital-to-home settings. These interventions reliably improved attention performance and added value through increased engagement and remote monitoring capabilities. However, methodological variability and heterogeneous intervention protocols continue to limit the comparability of studies. Future progress will require standardized frameworks and large-scale clinical trials supported by adequate digital literacy and training among healthcare professionals. Overall, mobile applications can effectively complement conventional rehabilitation methods. These findings advance current practice by identifying the most evidence-supported app-based approaches and clarifying future research priorities centered on standardization, scalability, and clinical integration.

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## Disclosure

The authors report no conflicts of interest in this work.

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