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Impact of Digital Health on Dementia Caregivers' Knowledge, Attitude and Practice: A systematic review

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Abstract

Informal caregivers of people living with dementia often lack formal training, leading to gaps in knowledge, attitudes, and caregiving practices (KAP). Digital health interventions may help address these gaps. This systematic review, conducted in accordance with PRISMA 2020, searched five major databases up to February 2025 for studies assessing at least one KAP outcome. Study quality was appraised using the EPHPP tool. Seven studies met the inclusion criteria. Digital interventions generally improved caregiver knowledge and attitudes, while effects on practice were less consistent. Overall study quality was moderate. Digital interventions are promising, but more rigorous research is needed.

Keywords: Dementia; caregivers; KAP; systematic review.

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1.0 Introduction

1.1 Research Background

Dementia is a growing global public health challenge, affecting an estimated 55 million people worldwide, with numbers projected to nearly triple by 2050 due to population ageing (WHO, 2017). The progressive cognitive, functional, and behavioural decline associated with dementia leads to increasing dependence on others for daily activities, placing substantial physical, emotional, social and financial burdens on informal caregivers, most often family members (Loh, 2024).

Caregiving for people living with dementia (PLwD) requires not only practical skills but also sound knowledge and a positive, resilient attitude to manage behavioural and psychological symptoms, and maintain quality of life. Deficits in these domains, conceptualised as knowledge, attitude, and practice (KAP), are associated with increased caregiver burden, poorer care outcomes, and reduced well-being for both caregivers and care recipients. Interventions aimed at improving caregiver KAP can empower families, reduce stress, and enhance the quality of care provided (Guilin, 2019). The KAP model, first introduced in the 1950s, emphasises the interrelated dimensions of what individuals know (knowledge), believe (attitude), and do (practice) in relation to a given context (Andrade, 2020).

In recent years, digital interventions have emerged as promising tools to support caregivers of PLwD (Zou, 2024). These technologies offer accessible, flexible platforms for delivering education, skills training, and psychosocial support, overcoming many of the barriers to traditional face-to-face interventions, such as travel distance, time constraints, and limited service availability. Furthermore, digital platforms can facilitate care coordination, centralise information sharing, and provide timely, tailored content that meets caregivers' evolving needs (Fernandez, 2024; Zou, 2024).

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Given the increasing prevalence of dementia, the central role of informal caregivers, and the expanding reach of digital health solutions, there is a critical need to synthesise existing evidence on how digital interventions affect KAP outcomes among informal caregivers of PLwD. This systematic review aims to address this gap by comprehensively mapping and synthesising current evidence on the effectiveness of digital interventions in improving the KAP of informal caregivers of PLwD.

The review will examine various digital interventions, including e-learning programs, virtual programs, web-based information platforms, and mobile applications designed to support caregivers throughout their caregiving journey. By synthesising these findings, this review will provide critical insights into the potential of technology to support informal caregivers of PLwD, offering significant implications for healthcare professionals, researchers, and policymakers in the development and implementation of interventions designed to improve caregivers' KAP and enhance the quality of life for both caregivers and recipients.

2.0 Literature Review

Research applying the KAP framework consistently demonstrates substantial deficiencies among informal caregivers of PLwD. A scoping review identified widespread knowledge gaps in essential domains of elderly caregiving, particularly in technical tasks such as medication management and patient positioning, resulting in suboptimal care practices and the performance of skilled procedures without adequate training (Ab Ghani, 2022). Similarly, a cross-sectional study in Indonesia reported moderate overall dementia knowledge, with the lowest scores in communication and behavioural management (Andrews, 2024).

This knowledge-to-action gap is further compounded by cultural beliefs and conceptual misunderstandings. Qualitative evidence from Vietnam revealed that dementia is often perceived as a normal part of ageing rather than a clinical condition, thereby delaying early intervention and care planning. Caregivers also demonstrated inadequate essential caregiving skills, particularly in managing complex behavioural symptoms (Nguyen, 2025).

Quantitative studies further highlight the discordance between knowledge and practice. In China, caregivers exhibited suboptimal KAP levels (Knowledge = 58.54 ± 7.41; Practice = 56.34 ± 13.39), with knowledge positively correlated with care quality ($r_s = 0.38$, $p < 0.001$) but not necessarily with improved attitudes (Guilin, 2019). Comparable findings were reported in India, where 67.1% of caregivers had above-average knowledge, yet 52.8% demonstrated poor practice and only 4.3% achieved good practice, emphasising that knowledge alone is insufficient to ensure high-quality caregiving (Superior, 2020). These relationships are further influenced by psychological and experiential factors. A study in Greece identified caregiver confidence as the strongest predictor of positive attitudes, with knowledge levels mediating the effect (Teichmann, 2022). In Malaysia, although general knowledge of ageing was associated with more positive attitudes ($b = 0.56$, $p < 0.001$), direct caregiving experience significantly weakened this relationship ($b = -0.87$, $p = 0.002$), suggesting that caregiving burden may attenuate the benefits of knowledge (Subramaniam, 2025).

The increasing reliance on informal caregivers has driven interest in digital health interventions, including internet-based psychoeducation, telehealth, and mobile applications, as tools to enhance caregivers' KAP and resilience (Lewis, 2010; Rashid, 2022; Zou, 2024). Evidence from interventional studies supports their effectiveness. A randomised controlled trial in Vietnam showed that a culturally adapted smartphone-based psychoeducational intervention significantly improved dementia knowledge and perceived social support, with sustained effects at three months (Nguyen, 2025). A controlled study in Taiwan demonstrated that a blended model combining mobile learning, mentoring, and social networking improved dementia knowledge, attitudes, and caregiving competence (Su, 2021). A quasi-experimental study in rural Thailand reported significant improvements in dementia caregivers' knowledge after using a mobile application (Turnbull, 2024). An internet-based program also improved dementia caregiver knowledge and confidence (Lewis, 2010).

Qualitative evidence highlights broader psychosocial benefits, with mobile applications evolving from "tools" to "partners" that enhance caregiving efficiency, emotional regulation, social connection, and self-care (Shen, 2025). Similarly, digital interventions improved knowledge, emotional support, and continuity of care, while complementing conventional services (Kagwa, 2024). Overall, digital interventions appear to improve caregiver outcomes through pathways that enhance knowledge and attitudes, strengthen competence and self-efficacy, and improve coping, although effectiveness depends on cultural adaptation, usability, personalisation, and ethical design (Wang, 2022; Zou, 2024).

3.0 Materials and Methods

This systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Schiavo, 2019) and is registered with PROSPERO (CRD420251120508).

3.1 Literature Search and Selection of Studies

A systematic review of studies identified in the electronic databases Scopus, PubMed, Cochrane Library, ScienceDirect, and ACM Digital Library was conducted for articles published up to and including February 2025, and limited to English-language articles. The Population, Intervention, Comparison, Outcome and Study Type (PICOS) framework was used to formulate the research questions and guide the search and selection of relevant studies. The search strategy incorporated the following keywords: "dementia," "Alzheimer," "Alzheimer's disease," "caregiver," "carer," "informal care," "digital intervention," "mobile application," "internet-based," "web-based," "knowledge," "attitude," "awareness," "practice," "behaviour," and "competency." Boolean operators AND and OR were used to combine and refine search terms: AND retrieves results that meet all specified conditions, while OR retrieves results that meet at least one of the conditions. The search strategy is presented in Table 1.

Table 1. Search Strategy for the Databases

Database	Search strategy	Filters
PubMed	(("dementia"[MeSH Terms] OR "Alzheimer Disease"[MeSH Terms] OR dementia[tiab] OR "Alzheimer*"[tiab]) AND ("Caregivers"[MeSH Terms] OR caregiver*[tiab] OR carer*[tiab] OR "informal care*"[tiab]) AND ("Mobile Applications"[MeSH Terms] OR "Internet"[MeSH Terms] OR "Telemedicine"[MeSH Terms] OR "eHealth"[tiab] OR "mHealth"[tiab] OR "mobile app*"[tiab] OR "web-based"[tiab] OR "internet-based"[tiab] OR "digital intervention*"[tiab]) AND ("Knowledge"[MeSH Terms] OR "Attitude"[MeSH Terms] OR "Practice"[MeSH Terms] OR knowledge[tiab] OR attitude[tiab] OR practice[tiab] OR behavior[tiab] OR behaviour[tiab] OR awareness[tiab] OR competency[tiab] OR KAP[tiab]) AND ("Randomized Controlled Trial"[pt] OR "Intervention Study"[tiab] OR "Trial"[tiab] OR "pre-post"[tiab] OR "evaluation"[tiab]))	English, Humans, Last 15 years, Open access
Scopus	(TITLE-ABS-KEY(dementia OR "Alzheimer*") AND TITLE-ABS-KEY(caregiver* OR carer* OR "informal care*") AND TITLE-ABS-KEY("mobile health" OR mHealth OR "mobile app*" OR "internet-based" OR "web-based" OR eHealth OR "digital intervention*") AND TITLE-ABS-KEY(knowledge OR attitude OR practice OR behavior OR behaviour OR awareness OR competency OR KAP) AND (TITLE-ABS-KEY("randomized controlled trial" OR intervention OR trial OR "pre-post" OR evaluation)))	English, Humans, Last 15 years, Open access
Cochrane	("dementia":ti,ab,kw OR "Alzheimer*":ti,ab,kw) AND ("caregiver*":ti,ab,kw OR "carer*":ti,ab,kw OR "informal care*":ti,ab,kw) AND ("mobile app*":ti,ab,kw OR "internet-based":ti,ab,kw OR "web-based":ti,ab,kw OR "digital intervention*":ti,ab,kw OR mHealth:ti,ab,kw OR eHealth:ti,ab,kw OR telemedicine:ti,ab,kw) AND (knowledge:ti,ab,kw OR attitude:ti,ab,kw OR practice:ti,ab,kw OR behavior:ti,ab,kw OR behaviour:ti,ab,kw OR awareness:ti,ab,kw OR competency:ti,ab,kw OR KAP:ti,ab,kw OR competence:ti,ab,kw OR skills:ti,ab,kw) AND ("randomized controlled trial":ti,ab,kw OR intervention:ti,ab,kw OR trial:ti,ab,kw OR "pre-post":ti,ab,kw OR evaluation:ti,ab,kw OR qualitative:ti,ab,kw)	English, Humans, Last 15 years, Open access
Science Direct	(TITLE-ABSTR-KEY(dementia OR "Alzheimer*")) AND (TITLE-ABSTR-KEY(caregiver* OR carer* OR "informal care*")) AND (TITLE-ABSTR-KEY("mobile health" OR mHealth OR "mobile app*" OR "internet-based" OR "web-based" OR eHealth OR "digital intervention*" OR “telemedicine”)) AND (TITLE-ABSTR-KEY(“knowledge” OR “attitude” OR “practice” OR “behavior” OR “behaviour” OR “awareness” OR “KAP” OR “competency” OR “skills”)) AND (TITLE-ABSTR-KEY("randomized controlled trial" OR “intervention” OR “trial” OR "pre-post" OR “evaluation” OR “qualitative”))	English, Humans, Last 15 years, Open access
ACM Digital Library	("dementia" OR "Alzheimer*") AND (caregiver* OR carer* OR "informal care*") AND ("mobile app*" OR "internet-based" OR "web-based" OR "digital intervention*" OR “mHealth” OR “eHealth” OR “telemedicine”) AND (“knowledge” OR “attitude” OR “practice” OR “behavior” OR “behaviour” OR “awareness” OR “KAP” OR “competence” OR “skills”) AND ("randomized controlled trial" OR “intervention” OR “trial” OR "pre-post" OR “evaluation” OR “qualitative”)	English, Humans, Last 15 years, Open access

3.2 Eligibility Criteria

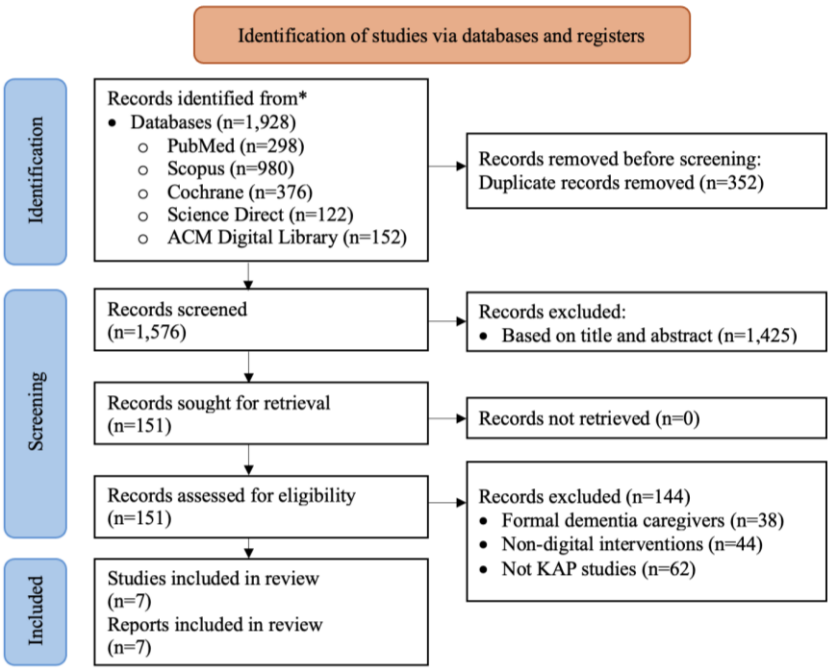
Studies were eligible for inclusion in this systematic review if they met the following criteria, structured according to the PICOS (Population, Interventions, Comparators, Outcomes, and Study Type) framework: (1) Population**:** informal (unpaid) caregivers aged 18 years or older providing care to people diagnosed with any type of dementia; (2**)** Interventions: any digital intervention delivered fully or partially via a mobile application, website, or other internet-based platform, including educational modules, psycho-emotional support programs, and other technology-enabled supports; (3) Comparators**:** usual care, no intervention, face-to-face or non-digital interventions, or pre–post comparisons; (4) Outcomes: at least one outcome related to the KAP of dementia caregiving, assessed using validated tools, structured instruments, or well-described qualitative approaches. Outcomes could be reported quantitatively or qualitatively; (5) Study types: randomised controlled trials (RCTs), quasi-experimental studies, pre-post studies, mixed-methods studies, and qualitative studies.

Studies were excluded if they were protocols, reviews, editorials, or opinion papers; did not report KAP-related outcomes; involved non-dementia caregivers; or evaluated non-digital interventions.

3.3 Study Selection

Two independent reviewers (NM and DR) screened titles and abstracts for eligibility, with a third and fourth reviewer (NNA and MSD) resolving any disagreements. The remaining full-text studies were then assessed against the inclusion criteria, a process detailed in the PRISMA flowchart (Figure 1).

Figure 1. PRISMA Flow Diagram for Study Selection Procedure



3.4 Data extraction

The data extraction process included the following key details: study information (author name, year of publication, and country), sample characteristics (sample size and participants), study design, intervention details (description and duration), control group, outcome measures (knowledge, attitude, and practice), and main findings.

3.5 Quality Assessment

Methodological rigour was evaluated using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool (Thomas, 1999). Four reviewers (NM, NNA, DR, and MSD) independently assessed each study across six critical domains: selection bias, study design, confounders, blinding, data collection methods, and withdrawals. According to the EPHPP criteria, studies were assigned a global quality rating of Strong (no "weak" ratings), Moderate (one "weak" rating), or Weak (two or more "weak" ratings). Any discrepancies between reviewers were resolved through consensus to ensure inter-rater reliability.

4.0 Results

4.1 Search Strategy and Description of Studies

A total of 1,928 records were identified through database searches: PubMed (n = 298), Scopus (n = 980), Cochrane (n = 376), Science Direct (n = 122), and ACM Digital Library (n = 152). After removing 352 duplicate records, 1,576 records remained for screening. Following title and abstract screening, 1,425 records were excluded as irrelevant. The full texts of 151 records were sought and successfully retrieved. After eligibility assessment, 144 studies were excluded: 38 involved formal dementia caregivers, 44 applied non-digital interventions, and 62 were not KAP-related studies. Ultimately, 7 studies met the inclusion criteria and were included in this systematic review.

4.2 Quality Assessment of the Included Studies Using the EPHPP Tool

Based on the quality assessment of the included studies using the EPHPP tool, the methodological rigour of the seven reviewed studies varies. While a significant proportion of the studies demonstrated strengths in data collection methods (100% rated strong) and low dropout rates (85.7% rated strong), major weaknesses were identified in other areas. A notable finding is that all seven studies (100%) received a weak rating for blinding, which suggests a high risk of performance or detection bias across the board. Furthermore, a large number of studies were rated as having weak study designs (42.9%) and weak control of confounders (42.9%). As a result of these pervasive weaknesses, particularly in blinding, no study achieved a "strong" global rating. The majority of the studies (57.1%) were categorised as having a "moderate" global rating, while a substantial number (42.9%) were deemed "weak" overall. The detailed quality assessment results are presented in Table 2.

Table 2. The EPHPP Quality Assessment

Component	A. Selection Bias	B. Study Design	C. Confounders	D. Blinding	E.	F.	Global Rating

					Data Collection Methods	Withdrawals and Dropouts	
Hattink B et al., 2015	Moderate	Strong	Strong	Weak	Strong	Moderate	Moderate
Salehinejad S et al., 2024	Moderate	Strong	Strong	Weak	Strong	Strong	Moderate
Turnbull N et al., 2024	Moderate	Moderate	Weak	Weak	Strong	Strong	Weak
Noel MA et al., 2022	Moderate	Moderate	Strong	Weak	Strong	Strong	Moderate
Ashida S et al., 2024	Weak	Weak	Weak	Weak	Strong	Strong	Weak
Kagwa AS et al., 2024	Moderate	Weak (quantitative EPHPP), Strong (qualitative rigour)	Not applicable	Weak	Strong	Strong	Weak
Lewis MA et al., 2010	Moderate	Weak	Weak	Weak	Strong	Strong	Moderate
Sum of weak (%)	1 (14.3%)	3 (42.9%)	3 (42.9%)	7 (100%)	0	0	3 (42.9%)
Sum of moderate (%)	6 (85.7%)	2 (28.6%)	0	0	0	1 (14.3%)	4 (57.1%)
Sum of strong (%)	0	2 (28.6%)	3 (42.9%)	0	7 (100%)	6 (85.7%)	0
Sum of not applicable (%)	0	0	1 (14.3%)	0	0	0	0

4.3 Characteristics of the Included Studies

Table 3 illustrates the Characteristics of the Included Studies. The seven studies reviewed employed a range of research designs and were conducted across various geographic locations, with varying sample sizes.

The included studies used a mix of quantitative, qualitative, and mixed-methods approaches. Two of the studies were randomised controlled trials (RCTs): the study by Hattink et al. (2015) was a traditional RCT, while the one by Salehinejad et al. (2024) was an unblinded RCT. Other quantitative designs included a quasi-experimental one-group pre-post-test design used by Turnbull et al. (2024), a pre-post comparison design used by Noel et al. (2022), a pre-post survey used by Ashida et al. (2024), and a formative evaluation with both quantitative and qualitative data used by Lewis et al. (2010). In contrast, the study by Kagwa et al. (2024) used a qualitative descriptive design to explore participants' experiences.

The geographical settings of the studies were diverse, covering multiple continents. Studies were conducted in Europe, North America, and Asia. Specifically, the studies were conducted in the Netherlands, the United Kingdom, Iran, Thailand, the United States, and Sweden. The variety of locations, from a rural province in Thailand to two municipalities in Sweden and a specific region in the United States, reflects the global interest in and use of digital tools by caregivers of PLwD.

The sample sizes across the studies varied considerably. The largest sample size was in the study by Turnbull et al. (2024), which included 402 caregivers. In contrast, the smallest sample was in the Ashida et al. (2024) pilot study, with only 31 participants. Other studies had sample sizes ranging from 30 participants in the qualitative study by Kagwa et al. (2024) to 142 participants in the study by Hattink et al. (2015). The Lewis et al. (2010) study had 47 participants who completed the program, while the Salehinejad et al. (2024) and Noel et al. (2022) studies had 50 and 134 participants, respectively.

Table 3. Characteristics of the Included Studies

First author, year	Study design, country	Participants	Intervention	Outcomes	Main findings
Hattink B et al., 2015	A randomized Controlled Trial (RCT) conducted in the Netherlands and the United Kingdom.	The study had a total of 142 participants, including informal caregivers, volunteers, and professional caregivers. Participants were randomly assigned to one of two groups: • Intervention Group: This group had access to the STAR	The intervention is the STAR (Skills Training and Reskilling) e-learning course, was a web-based training portal designed to provide training to informal and professional caregivers of people with dementia. It	Improved Attitudes: The training was effective in improving caregivers' attitudes toward dementia and their approach to providing person-centered care.	While the program didn't boost caregivers' factual knowledge about dementia, it did improve their attitude by teaching them how to be more empathetic and focus on person-centered care.

First author, year	Study design, country	Participants	Intervention	Outcomes	Main findings
		training portal for 2 to 4 months. • Control Group: This group received free access to the STAR training portal after the study had ended.	consisted of 8 modules covering various topics related to dementia and dementia care.	Factual Knowledge: The training did not increase participants' factual knowledge about Alzheimer's disease.	
Salehinejad S et al., 2024	An unblinded randomized controlled trial (RCT) conducted in Kerman, Iran.	50 family caregivers of patients with moderate to severe dementia. Participants were randomly allocated to one of groups: • Intervention Group: 25 caregivers who received access to a password-protected, web-based health information platform for two months. • Control Group: 25 caregivers who received "information as usual," which consisted of a neurologist's semi-annual follow-up appointment.	The intervention was a free, password-protected, web-based platform in the Persian language accessible via any device (smartphone, tablet, or desktop). It provides written guides on dementia and self-care, along with training videos for practical techniques and relaxation. Users can stay up-to-date with the latest news and events and connect with others in a private forum.	Knowledge: The intervention group showed a significant increase in their knowledge score after the intervention, while the control group's score remained unchanged. Attitudes: The intervention group showed an approximately 11-unit improvement in their attitudes towards dementia, while no significant change was observed in the control group.	The web-based intervention was effective in significantly improving the knowledge, and attitudes, of family caregivers of PLwD. The findings suggest that web-based interventions are a potential platform for delivering support to caregivers due to their accessibility and ability to overcome geographic and time barriers.
Turnbull N et al., 2024	A quasi-experimental design with a one-group pre-post-test, conducted in the rural areas of Maha Sarakham province, Thailand.	There were no separate intervention and control groups in the traditional sense, as it was a one-group pre-post-test design. The study involved 402 caregivers: The main group of participants who participated in all five phases of the ADDIE model. Of these, 340 caregivers were part of the quasi-experimental pre-post-test for effectiveness.	The intervention was the "SmartCaregivers" 1.0 mobile application, developed to enhance caregiver support and resource management for long-term dependent individuals in rural areas. The app's purpose was to provide tools for managing care routines, accessing local resources, and improving communication with healthcare providers.	The application significantly improved caregivers' knowledge scores. The mean knowledge score increased from 10.49±2.53 to 12.18±2.76 after using the app ($p<0.001$).	The study concluded that the "SmartCaregivers" mobile application was effective in supporting caregivers in rural areas. The app demonstrated significant improvements in caregivers' knowledge.
Noel MA et al., 2022	A pre-post comparison design, conducted in the Western North Carolina region of the United States.	The study had a total of 134 participants among dementia family caregivers: • Intervention Group: 90 caregivers who enrolled in and completed a five-week, synchronous, virtual education program delivered via Zoom. • Control Group: 44 caregivers who had participated in a different caregiver education event and were surveyed at two time points, six weeks apart.	The intervention was a five-week, interactive Virtual Caregiver Education Program for family caregivers of PLwD. The course covered key topics on dementia, including its nature, progression, treatment options, and risk reduction, alongside caregiver roles in safety, behavior management, communication, self-care, and accessing community support.	Participants' self-reported perceptions of the program's impact were highly positive, with nearly all reporting increased knowledge, and ability to manage dementia-related behaviors.	The findings suggest that the Virtual Education Program effectively enhanced perceived knowledge in managing dementia, with outcomes comparable to or surpassing those of the traditional in-person format, , and ability to manage dementia-related behaviors.
Ashida S et al., 2024	A pre-post survey in the United States.	This was a one-group pre-post study, so there were no distinct intervention and control groups. The pilot test (Phase 2) involved a total of 31 participants: • Family caregivers (n=16) of PLwD. • Paid care providers (n=15) of PLwD.	The intervention was a web-based mobile application Dental.Aging.Tips (https://dental.aging.tips), designed to provide on-demand, evidence-based guidance on oral healthcare for frail older adults, particularly those with dementia. The app can be accessed on personal devices or desktop computers without installation.	Attitudes: Both family and paid caregivers reported a significant increase in positive attitudes toward providing oral hygiene care ($p=0.05$ for family and $p=0.02$ for paid caregivers). Knowledge: Both family and paid caregivers reported a significant increase in knowledge about oral health and care ($p=0.001$ for family and $p=0.02$ for paid caregivers).	The study showed the app improved caregivers' knowledge, attitudes, and skills in oral care. It has potential to enhance oral health literacy and support caregivers by addressing gaps in educational resources.
Kagwa AS et al., 2024	A qualitative descriptive design to explore the experiences of	This study involved 30 participants: • 19 family caregivers, consisting of 16 women and 3 men.	The intervention was an 8-week program where social care professionals provided tailored support to family caregivers through a mobile	Caregivers' experiences with the app fell into three themes: • Accessibility: It provided flexible, private, and	The study highlighted the need for family caregivers to receive support that is tailored to their individual needs.

First author, year	Study design, country	Participants	Intervention	Outcomes	Main findings
	participants. It was conducted in two municipalities in Sweden, Stockholm County and Västerbotten County.	• 11 social care professionals (all women) who worked in municipalities or senior day care centers.	app named STAV (STöd till AnhörigVårdare: Support to family caregivers). The features included mindfulness sessions, a digital diary, and a collection of web links with relevant information about dementia and caregiving.	convenient support, with chat lowering barriers compared to calls or groups. • Engagement: Features like the diary and mindfulness supported reflection and relaxation, while professionals reported improved efficiency and continuity.	The findings support the use of a mobile app as a complement to traditional support methods, which can facilitate caregivers' knowledge, awareness, and self-care management.
Lewis MA et al., 2010	A formative evaluation process with both quantitative and qualitative data collection, conducted in the United States.	A total of 47 dementia family caregivers completed the Internet-Based Savvy Caregiver (IBSC) program and a follow-up questionnaire, representing a 74% response rate.	The intervention was a prototype of the IBSC program, adapted from the face-to-face Savvy Caregiver Program. It consisted of four modules covering the effects of dementia on thinking, balancing control and independence, providing practical help, and managing daily care and challenging behaviors.	The program was designed to provide caregivers with the knowledge, skills, and outlook they need to succeed in their role. The theoretical framework for the program, the stress and coping model, postulates that positive and negative caregiving outcomes can be mediated by strengthening a caregiver's personal resources, including their knowledge and attitude.	The formative evaluation showed that participants felt more confident in their caregiving skills and communication with family members. Participants reported increased knowledge, and understanding, in dementia caregiving. Participants' qualitative responses also reflected an increase in knowledge, with some commenting on learning useful strategies and techniques for dealing with the behaviors associated with dementia.

4.4 E-Learning and Web-Based Platforms

The interventions by Hattink et al. (2015) and Salehinejad et al. (2024) used web-based platforms to deliver training. The STAR (Skills Training and Reskilling) e-learning course by Hattink et al. was a web-based training portal with eight modules covering various dementia topics. Similarly, Salehinejad et al. used a free, password-protected, web-based health information platform accessible via any device. These platforms provided written guides, training videos, and forums for users to connect. Lewis et al. (2010) also employed an internet-based program, a prototype of the Savvy Caregiver Program, which consisted of four modules. Noel et al. (2022) used a five-week, interactive virtual education program delivered via Zoom.

4.5 Mobile Applications

Several studies focused on mobile applications. Turnbull et al. (2024) developed the "SmartCaregivers" 1.0 mobile application to assist caregivers in rural areas with managing care routines and accessing resources. Ashida et al. (2024) tested a web-based mobile app, Dental.Aging.Tips, which was designed to provide on-demand guidance on oral healthcare for older adults with dementia. Kagwa et al. (2024) explored an 8-week program using a mobile app named STAV (STöd till AnhörigVårdare), which featured mindfulness sessions, a digital diary, and a collection of web links.

4.6 Outcomes of Knowledge, Attitude, and Practice (KAP)

The outcomes across the seven included studies demonstrate that mobile applications and internet-based interventions can meaningfully influence caregivers' KAP, although the magnitude and consistency of these effects vary.

Most interventions significantly improved caregivers' dementia-related knowledge. Salehinejad et al. (2024) reported a marked increase in knowledge scores following a two-month web-based intervention, while Turnbull et al. (2024) demonstrated significant pre–post knowledge gains with the SmartCaregivers mobile application in rural Thailand. Similarly, Ashida et al. (2024) demonstrated improvements in oral health knowledge among both family and paid caregivers after using a mobile app. Virtual education programs also yielded knowledge benefits, as reported by Noel et al. (2022). Lewis et al. (2010) further highlighted enhanced knowledge and understanding through the Internet-Based Savvy Caregiver program, with qualitative feedback highlighting practical applicability. Kagwa et al. (2024) echoed these findings, showing that tailored mobile app support complemented conventional services to expand caregivers' knowledge base. However, not all interventions were effective. Hattink et al. (2015) found that their STAR e-learning course improved empathy and understanding but did not significantly increase factual knowledge of Alzheimer's disease. This discrepancy suggests that intervention design and content delivery format critically influence knowledge outcomes.

Attitudinal shifts were consistently reported, particularly with interventions incorporating interactive or person-centred approaches. The STAR training portal by Hattink et al. (2015) improved caregivers' attitudes toward dementia care, despite limited effects on factual knowledge. Salehinejad et al. (2024) demonstrated an approximate 11-unit improvement in caregivers' attitudes toward dementia following the use of a web-based health information platform. Likewise, Ashida et al. (2024) found that both family and paid caregivers exhibited significantly more positive attitudes toward the provision of oral health care. These findings suggest that digital interventions

may be particularly effective at fostering empathy, acceptance, and more person-centred approaches to caregiving, especially when combined with interactive or experiential learning features.

Across the included studies, improvements in caregiving practice following digital interventions were generally promising but domain-specific. Ashida et al. (2024) demonstrated enhanced practical skills in oral hygiene care, while Kagwa et al. (2024) reported improved self-care management among caregivers through supportive app features such as mindfulness and reflection. Similarly, Lewis et al. (2010) and Noel et al. (2022) found that caregivers improved their ability to manage dementia-related behaviours, indicating better application of practical caregiving strategies. However, these improvements were not consistently observed across all domains of caregiving, suggesting that while digital interventions can enhance specific skills, they may not comprehensively improve overall dementia caregiving practice.

The seven included studies collectively demonstrate that digital interventions can positively influence caregivers' knowledge and attitude, although the magnitude and consistency of these effects vary. On the other hand, while digital interventions demonstrate potential in improving specific components of dementia caregiving, their impact on comprehensive dementia caregiving practice remains limited, emphasising the need for more integrated and standardised intervention designs.

5.0 Discussion

This systematic review synthesises digital interventions across diverse platforms, highlighting differential effects on knowledge, attitude, and practice domains that have not been examined collectively before. However, the magnitude and consistency of these effects vary across domains, reflecting both the strengths and inherent limitations of current digital intervention designs.

The findings of this review indicate that most digital interventions effectively improve caregivers' dementia-related knowledge. This is consistent with the theoretical foundation of psychoeducational interventions, which aim to enhance caregivers' understanding of disease processes, symptom management, and care strategies. Yu et al. (2023) conceptualise internet-based psychoeducation as programs designed to improve caregivers' capabilities to provide care and cope with stress. However, evidence from this review and prior studies suggests that the effectiveness of knowledge acquisition is highly dependent on intervention design, particularly the use of structured, multimodal, and interactive content. Interventions that rely primarily on passive information delivery may improve conceptual understanding but may not sufficiently enhance factual knowledge, as demonstrated in studies such as Hattink et al. (2015). This emphasises the importance of instructional design and user engagement in determining knowledge outcomes.

Attitudinal improvements were among the most consistent findings across the included studies. This aligns strongly with existing evidence demonstrating that digital interventions are particularly effective in influencing caregivers' psychological and emotional domains. Ferrero et al. (2025) reported that technology-based interventions improve psychoemotional outcomes, including stress, anxiety, and emotional burden, among caregivers. Similarly, Leng et al. (2020) found significant reductions in depressive symptoms, perceived stress, and anxiety, alongside improvements in self-efficacy. These findings suggest that digital platforms are well-suited to delivering interventions that foster empathy, acceptance, and person-centred caregiving perspectives, particularly through interactive and reflective components. The accessibility and flexibility of digital tools may also facilitate continuous engagement and reduce caregiver isolation, further contributing to positive attitudinal shifts.

In contrast, improvements in caregiving practice were less consistent and generally domain-specific. While several studies reported improvements in specific areas such as behavioural management, oral care, and caregiver self-care, these gains did not extend uniformly across all aspects of caregiving practice. This finding is consistent with prior evidence. Yu et al. (2023) reported that despite improvements in psychological outcomes, internet-based psychoeducational interventions did not have significant effects on self-efficacy, quality of life, or caregiver burden. Similarly, Leng et al. (2020) found no significant improvement in caregiver burden or overall quality of life, despite reductions in stress and depression.

Together, these findings suggest that improvements in knowledge and emotional coping do not necessarily translate into sustained behavioural change or comprehensive caregiving competence. Caregiving practice is inherently complex and influenced by multiple contextual factors, including the caregiver's environment, the patient's condition, available support systems, and caregiving intensity. Digital interventions alone may be insufficient to address these multifactorial determinants. The discrepancy between improvements in knowledge and attitudes versus practice highlights a persistent knowledge–practice gap in dementia caregiving. While digital interventions effectively deliver information and emotional support, they may lack critical components required for behavioural change, such as hands-on training, real-time feedback, and environmental reinforcement.

5.1 Limitations of the Study

The heterogeneity in KAP measurement instruments limits synthesis across studies. Furthermore, the lack of standardised outcome frameworks is a major barrier to advancing the field. A notable gap is the absence of systematic integration of digital interventions into formal healthcare pathways. None of the included studies embedded digital tools within existing health or social care services, thereby limiting their scalability and long-term sustainability. Another limitation lies in the geographical and cultural diversity of studies. Although

a strength in demonstrating global relevance, it also introduces heterogeneity in intervention design, caregiver populations, and outcome measures. Moreover, sample sizes varied widely, from small pilot studies to large quasi-experiments, limiting comparability.

6.0 Conclusion and Recommendations

Digital interventions demonstrate promise in improving the knowledge and attitudes of informal caregivers of PLwD. Across the included studies, web-based platforms and mobile applications consistently enhanced caregivers' understanding of dementia and fostered more positive, person-centred caregiving perspectives. However, improvements in caregiving practice were less consistent, indicating that gains in knowledge and attitudes do not necessarily translate into sustained behavioural change.

The findings of this review highlight that digital interventions should not be regarded as replacements for formal caregiving services but rather as promising and cost-effective complements. These tools are particularly valuable in low-resource or rural settings, where access to conventional support is often limited. As such, healthcare systems and policymakers should consider embedding digital interventions within national dementia care strategies, ensuring that they are culturally adapted and equitably accessible.

Future research should prioritise several key areas to strengthen the evidence base and maximise the potential of digital interventions. First, there is a pressing need for robust study designs, including adequately powered randomised controlled trials with longer-term follow-up. Second, the development and adoption of standardised KAP measures would allow for greater comparability across studies and facilitate meta-analytic synthesis. Finally, equity-driven approaches are essential, particularly by involving caregivers with low digital literacy, limited access to technology, and diverse cultural contexts who are often underrepresented in current research.

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Finally, we express our appreciation to all researchers whose studies were included in this review. Their work forms the foundation of the evidence synthesised here and continues to advance the field of digital health interventions in dementia caregiving.

Paper Contribution to the Related Field of Study

This paper contributes to the field of environment–behaviour studies by synthesising evidence on how digitally mediated environments influence caregiving behaviour among informal dementia caregivers. By examining mobile applications and internet-based interventions through a KAP framework, this review highlights the role of digital environments in shaping behavioural outcomes, empathy, and caregiving competencies. The findings extend environment–behaviour discourse beyond physical settings to include digital care ecosystems, demonstrating how technology-enabled platforms function as behavioural support environments.

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