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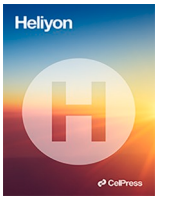

Review article

Telehealth interventions to support self-care of stroke survivors: An integrative review

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ABSTRACT

Background: Self-care is essential for stroke survivors to recover from neurological disorders caused by stroke and to prevent recurrences. Self-care behaviors are activities that individuals undertake to prevent recurrence and complications, and have a positive effect on the quality of life of patients. Telehealth is an emerging technology through which self-care intervention can be provided from a distance. Review-based research is needed to determine the value and development of telehealth-based self-care interventions for stroke survivors.
Objective: Based on the middle range theory of self-care of chronic illness, to provide an effective guide when developing telehealth self-care interventions for stroke survivors by comprehensively understanding telehealth interventions to support self-care of stroke survivors.
Methods: An integrative review, this study was performed in accordance with Whittemore and Knafl's stages of an integrative review (problem identification, literature search, data evaluation, data analysis, and presentation of the results). The key search terms included combinations of concepts related to stroke survivors and self-care, and telehealth. The research year of searched publications was not limited, and five electronic databases (PubMed, Ovid-MEDLINE, Ovid-EMBASE, CINAHL and Cochrane Library) were searched.
Results: Four attributes were identified that represented telehealth's functions that appeared to be associated with a self-care intervention for stroke survivors. These included introducing the concept of interaction, monitoring, education, and store and forward. These self-care interventions were found to influence the behaviors of stroke survivors' self-care maintenance (physical activity and treatment adherence), self-care monitoring (blood pressure, healthy behaviors, health diet, psychological well-being, glucose control, and depression), and self-care management (sense of control, healthcare resource utilization, social integration, and support).
Conclusions: The results of this study can provide a guide for developing effective telehealth self-care intervention by identifying the attributes of telehealth self-care intervention for stroke survivors.

1. Background

Stroke, one of the representative cerebrovascular diseases, is one of the three leading causes of death and long-term disability

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worldwide [1]. In the world, the annual mortality rate from cerebrovascular disease is 44.7 per 100,000 people, which is the fourth-leading cause of death [2]. Stroke is a disease in which brain cells are damaged due to impaired cerebral blood flow, resulting in neurological damage, and it can cause problems such as hemiplegia, speech disorders, dysphagia, sensory disturbances, and urination disorders, depending on the area, extent and location of brain damage [3]. Stroke survivors are affected in their daily life according to the degree of disability after stroke, and the longer the period, the more difficult it is to lead an independent daily life and the lower the quality of life due to the loss of social roles [3]. Self-care behaviors are activities that individuals undertake to maintain their own lives and well-being. It includes all health-related actions for well-being, such as performance and self-development [4]. Self-care behaviors are known to improve the symptoms and functional status of patients with stroke, prevent recurrence and complications, and have a positive effect on the quality of life of patients [5]. However, the daily lives of stroke survivors are affected by the degree of physical function and activity restriction after stroke, and the longer the period, the more difficult it is to live independently. There is also the loss of social role, which lowers the quality of life of stroke survivors [6]. In addition, even if stroke survivors recover after onset, they can be accompanied by problems such as hemiparesis, movement disorders, gait disorders, and lessened daily living activities [7]. Therefore, in order to maintain a high quality of life by minimizing the functional impairment of stroke survivors and preventing the risk of secondary damage, it is necessary to improve self-care behaviors that can actively perform rehabilitation treatment and secondary prevention once the medical condition is stabilized after onset [7,8].

The middle-range theory of self-care of chronic illness developed by Riegel et al. [10] emphasizes the self-care process of chronic illness rather than the care process dependent on the medical system. The main content of the theory is the self-care process of chronic illness, which is divided into self-care maintenance, self-care monitoring, and self-care management. In addition, it was said that the level of self-care of chronic illness patients is determined according to the organic process of these three core linked elements [10]. Specifically, maintenance of self-care is an act performed by chronic illness patients to maintain health or to maintain physical and emotional stability. In previous studies, health promoting behaviors such as diet, weight control and medication intake [11] were identified as self-care maintenance. Self-care monitoring is a process of regularly observing and monitoring one's own health, which means checking one's own blood pressure (or measuring one's blood sugar levels) [12–14]. Self-care management is the behaviors associated with the ability to evaluate whether symptoms have changed requiring action and then evaluate whether the action was successful or not, so that it can be performed again in the future [15,16].

In line with the recent COVID-19 pandemic, telehealth-based healthcare that uses digital technology to promote health is spreading further to the healthcare field [17]. In addition, the World Health Organization (WHO) Global Strategy on Digital Health (2020–2025) in Geneva in 2019 demonstrated that telehealth has been escalating because of technology advances and increasing use of mobile phones [18].Telehealth is defined as the delivery and facilitation of health and health-related services including medical care, providers, and patients' education, health information services, and self-care via telecommunications and digital communication technologies [19,20]. As telerehabilitation applied to stroke patients with disabilities significantly improves their physical function, telerehabilitation could be a useful supplement to traditional poststroke rehabilitation given the limited resources available for in-home rehabilitation for stroke survivors [21]. As such, programs using telehealth are applied to subjects with chronic conditions or comorbidities, such as cardiovascular disease [22], diabetes, and hypertension [23], who need continuous management. Among them, stroke patient management systems using digital healthcare technology are attracting attention as being very useful for self-care of chronic disease patients who require constant management because they are easy to access anytime and anywhere without restrictions of time and space and can allow smooth communication with medical staff [24]. Thus, it is possible to effectively manage chronic diseases and diseases of stroke survivors through self-care education and support using telehealth, and to remotely exchange important clinical information for continuous self-care management and support between subjects and medical professionals [25].

Looking at the telehealth-based education programs implemented for stroke survivors so far, a rehabilitation education program for motor function recovery [26], a communication training program for aphasia patients [27], and a virtual reality cognitive rehabilitation program for improving cognitive function [28,29], it was confirmed that there were few intervention studies concerning improving the self-care of stroke survivors based on telehealth. Hence, it is judged that it is meaningful to comprehensively review studies that apply telehealth intervention to promote self-care, which is a core competency required for stroke survivors, and to identify their properties.

The integrative review proposed by Whittemore and Knafl is a research method that analyzes research results by comprehensively reviewing different qualitative and quantitative studies, including interventions, without limiting the research papers to be analyzed to a specific research design [30]. This is an expanded literature review research method that can systematically analyze the research topic to be considered and can identify different factors in an integrated manner. In addition, it provides a comprehensive understanding of the contents to be considered based on the findings and can play an important role in implementing evidence-based nursing practices and nursing policies most effectively. The integrated review clearly identifies the research problem, searches the literature using a search strategy, compares and analyzes the literature, and draws a comprehensive conclusion that synthesizes the meaning of each research result. A deep understanding of the desired phenomenon can be obtained [30].

Thus, a comprehensive review of research results applying telehealth self-care to stroke survivors is considered very important to help understand future telehealth self-care interventions and to establish nursing interventions and practical strategies. Thus, one purpose of this study to investigate or explore stroke survivors understanding of self-care and telehealth interventions based on the middle-range theory of self-care of chronic illness presented by Riegel et al. [10]. Another purpose of this study is to present the evidence for the development and practical application of telehealth self-care interventions for stroke survivors by deriving the properties of the functions of telehealth intervention.

2. Methods

2.1. Study design

This study is a literature review study that analyzed research papers on telehealth self-care intervention for stroke survivors at home and abroad through an integrated review method. The study was performed sequentially according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guideline, and the PRISMA checklist is provided.

2.2. Procedure

This study was performed in accordance with Whittemore and Knafl's stages of an integrative review in five steps: 1) problem identification; 2) literature search; 3) data evaluation; 4) data analysis; and 5) presentation [30]. The weight of evidence (WOE) of Gough [31] was used to evaluate the quality of the paper. The three researchers strictly followed the procedures suggested in the entire

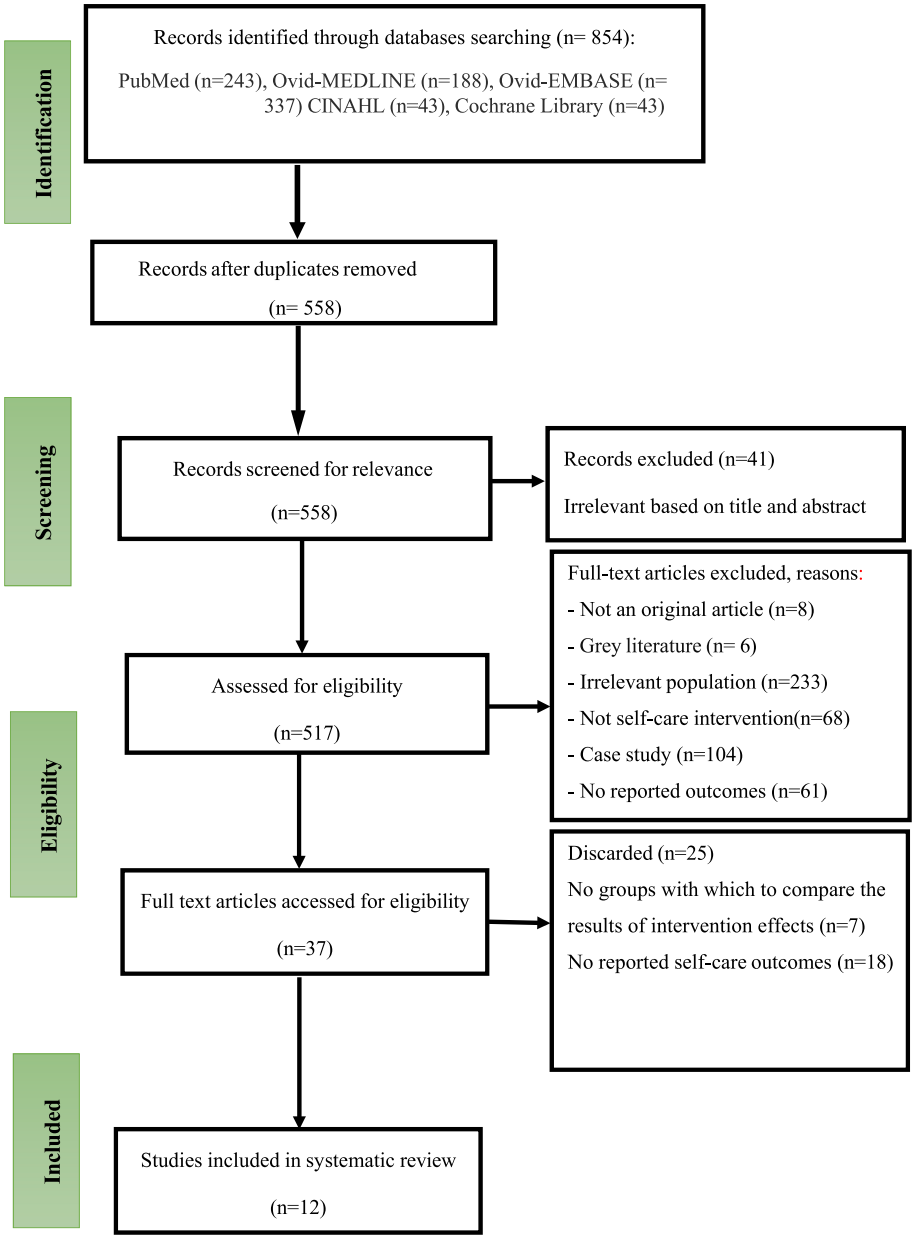

Fig. 1. Flow chart of the articles retrieved and selection process.

process of the integrative review and analyzed in detail.

2.2.1. Problem identification

The first step in an integrative review is to clarify the research question and make the purpose of the research clear. The research question of this study is "what are the defining characteristics of telehealth self-care intervention for stroke survivors?"

2.2.2. Literature search

The second stage of the integrative review is the process of finding all literature with meaningful and appropriate data relevant to the research topic. Studies covered self-care intervention provided to stroke survivors. The key search terms included combinations of concepts related to stroke survivors and self-care and telehealth. The following key words and MeSH terms were used using a variety of combinations: "cerebral stroke," "transient ischemic attack," "cerebrovascular stroke," "self-care," "self-management," "self-monitoring," "self-control," "mobile applications," "smartphone," "mobile health," and "telemedicine." The year of publication of the searched research was not limited. Referred databases selected were PubMed, Ovid-MEDLINE, Ovid-EMBASE, CINAHL and Cochrane Library in consultation with a librarian on October 22, 2022. The exclusion criteria were as follows: 1) non-original studies, animal and clinical trial studies, and literature that did not undergo peer review; and 2) articles published in a language other than Korean or English.

Focusing on the primarily searched papers, 296 duplicate papers were removed through a literature management program (EndNote X9) and manual work. As a result of reviewing the abstracts of 558 papers excluding redundant papers according to the selection and exclusion criteria, 37 papers were selected. Of these, 25 papers were discarded, 7 papers had no groups with which to compare the results of intervention effects and 18 papers did not report self-care outcomes. At the end, 12 papers were selected (Fig. 1).

2.2.3. Data evaluation

The third stage is the data evaluation stage. For this purpose, the 12 finally selected studies were reviewed by the first author, publication year, study design, number of samples, subject characteristics (Table 1), characteristics of self-care intervention, and main

Table 1
Characteristics of the included studies ($N = 12$).

1sAuthors	Country	Design	Sample size (n)	Gender of Participants	Age of participants (mean ± SD)
Wang et al. [32]	China	RCT[a]	Intervention group (100) Control Group (100)	Intervention group: M(58), F (42) Control Group: M(63), F(37)	Intervention group: 41.32 ± 2.16 Control Group: 42.75(±0.16)
Kamoen et al. [33]	Belgium	Non-RCT[b]	Intervention group (145) Control group (69)	Intervention group: M(104), F (41) Control group M(40), F(29)	Intervention group: 69.7 (±10.6) Control group: 66.6(±11)
Sarfo et al. [34]	Ghana	RCT	Intervention group (30) Control group (30)	Intervention group: M(18), F (12) Control group: M(21),F(9)	Intervention group: 54.3 (±11.9) Control group: 55.9(±13.7)
Spassova et al. [35]	Germany	RCT	Intervention group (46) Control group (48)	Intervention group: M(29), F (17) Control group: M(34), F(18)	Intervention group: 59.6 (±12.1) Control group: 60.7(±11.3)
Cadilhac et al. [36]	Australia	RCT	Intervention group (25) Control group (29)	Intervention group: M(15), F (10) Control group: M(18), F(11)	Intervention group: 69(±10) Control group: 68(±11)
Kamal et al. [37]	Pakistan	RCT	Intervention group (100) Control group (100)	Intervention group: M(64), F (36) Control group: M(71), F(29)	Intervention group: 56.07 (±1.5) Control group: 57.62(±1.3)
Kim et al. [38]	Korea	RCT	Intervention group (18) Control group (18)	Intervention group: M(13), F (5) Control group: M(10), F(8)	Intervention group: 67.4 (±7.3) Control group: 63.9(±7.4)
Sakakibara et al. [39]	Canada	RCT	Intervention (64) Control group (62)	Intervention group: M(38),F (26); Control Group: M(49), F(13)	Intervention group: 67.2 (±9.2) Control Group: 49.1(±10.2)
Skolarus et al. [40]	USA	Non-RCT (1 group pre-post test)	Intervention group (56)	Intervention group: M(50), F (6)	Intervention group: 62(±7.0).
Huijbregts et al. [41]	Canada	RCT	Intervention group (10) Control group (8)	Intervention group: M(5), F(5) Control group: M(3), F(5)	Intervention group: 61.8 (±9.8) Control group: 65.6(±4.7)
Requena et al. [42]	Spain	Non-RCT	Intervention group (107) Control group (52)	Intervention group: M(66), F (41) Control group: M(39), F(13)	Intervention group: 57(±12) Control group: 59(±10)
Paul et al. [43]	England	RCT	Intervention group (15) Control group (8)	Intervention group: M(7), F(8) Control group: M(4), F(4)	Intervention group: 56.3 (±8.7) Control group: 55.3(±12.6)

[a] RCTs: randomized controlled trial.
[b] Non-RCT: non randomized controlled trial.

Table 2
Description of the self-care intervention and outcomes ($N = 12$).

Study	Telehealth Category	Intervention (weeks)	Functionality	Follow- up	Self-care outcomes	WOE[j] (a-b-c-d)
Wang et al. [32]	Individual digital assist (web platform)	Provided monitoring service and healthy information (BP, LDL) and remote guidance and online consultation and recording service. (48)	recording display feedback	Baseline, and 3, 6, 9, 12 months	BHHM[a]-led mHealth[b] follow-up is an effective method for managing blood pressure and improving self-care ability (treatment adherence, healthy behaviors)	H–H–H–H
Kamoen et al. [33]	Individual digital assist (web platform)	Provided video consultations with the stroke coach 4 times and education using digital platform. (24)	education consultation	Baseline, and 6 months	Individualized digital platform shows promising results in improving self-monitoring rates (blood pressure, diet), therapeutic adherence and quality of life in patients after stroke	H–H–H–H
Sarfo et al. [34]	Individual mobile assisted (Bluetooth device, SMS[c] message)	Provided regular SMS message, BP, self-care device and smartphone for monitoring and reporting (12)	recording display monitoring	Baseline, and 3 months	No effect on systolic BP[d] Increased in medication adherence ($p = 0.03$) Increased autonomous self-regulation improved ($p < 0.0001$) Increased perceived confidence improved ($p = 0.005$)	H–H–H–H
Spassova et al. [35]	Individual digital assist (automated phone message)	Provided Computer aided Prevention System for guide, record and self-care management. (24)	training management	Baseline, and 6 months	Positive change in intervention group for systolic BP, LDL[e], and triglycerides ($p = 0.03$, $p = 0.04$, $p = 0.04$) with no corresponding change in control group. No effect for HDL[f], glycaemia or BMI[g]. Positive change in intervention group for fruit and vegetable, sweet and wholegrain food consumption ($p = 0.04$, $p = 0.04$, $p = 0.04$) with no corresponding change in control.	H–H–H–H
Cadilhac et al. [36]	Individual mobile assisted (SMS message, phone call)	Provided programming of electronic support and education massage for behavior change (5).	education monitoring consultation	Baseline, and 5 weeks	Increased the self-management domains (e.g. social integration and support: β coefficient 0.34; 95% CI −0.14 to 0.83) and several quality-of-life domains in favor of the intervention group	H–H–H–H
Kamal et al. [37]	Individual mobile assisted (SMS message)	Provided designed message for reminder, and self-monitoring for medication adherence regular blood pressure management, health information. (8)	education monitoring	Baseline, and 2 months	After 2 months, the mean medication adherence score was 7.4 (95% CI: 7.2–7.6) in the intervention group while 6.7 (95% CI: 6.4–7.02) in the control group. The mean diastolic blood pressure in the intervention group was 2.6 mmHg (95% CI; −5.5 to 0.15) lower compared to the usual care group.	H–H–H–H
Kim et al. [38]	Individual internet assisted (computer program)	Provided education program for healthy behaviors. (24)	education training feedback	Baseline, and 12 months	Improved physical activity, healthy diet, healthy behaviors. -Blood lipids- no effect -Positive physical exercise ($p = 0.005$); 44.4% intervention vs 27.8% control -Reduced salt intake: intervention 10% vs 2.4% control -Increased fruit and vegetable consumption in ($p = 0.037$), -Medication adherence: No effect, Sense of control: Greater increase in intervention than control (3.8 vs 1.1, $p = 0.003$) Health motivation: Greater increase in intervention than control (9.8 vs 1.0, $p < 0.001$)	H–H–H–H
Sakakibara et al. [39]	Individual mobile assisted (check in calls)	Provided 5- to 10-min 'check-in' calls with a trained lifestyle coach. (24)	management monitoring report	Baseline, and 6, 12 weeks	There were no significant differences in health promoting lifestyle (95% CI; 8.03 to 2.29, $p = 0.28$). Glucose control, as measured by HbA1c (95% CI; 0.17 to 0.32, $p = 0.03$). HRQoL[h], measured using SF-36[i]	H–H–H–H

(*continued on next page*)

Table 2 (*continued*)

Study	Telehealth Category	Intervention (weeks)	Functionality	Follow- up	Self-care outcomes	WOE[j] (a-b-c-d)
					Physical Component Summary (95% CI 5.88 to 0.21, $p = 0.04$)	
Skolarus et al. [40]	Individual mobile assisted (automatic phone calls)	Weekly IVR (automated interactive voice response) assessments of depressive symptom, medication adherence and side effects and provided feedback to support depressive symptoms (12)	management monitoring	Baseline, and 3, 6, months	There were no significant differences in baseline depressive symptoms. $p = 0.11$) Other results: Stroke patients with depressive symptoms were able to engage in an IVR call system. This subjects were contacted by the study team immediately and followed up shortly thereafter by the PCP where this subject's antidepressant regimen was changed and outpatient mental health counseling was initiated.	H–H–H–H
Huijbregts et al. [41]	Individual mobile assisted (text messages and phone calls)	Discussion and exercise, participants learn about goal-setting, problem-solving, exercise, and community-reintegration skills. (9)	management	Baseline, and 6,8 weeks	There was a significant difference in Mobility scores between the intervention group and the control group (mean difference 4.27, 95%CI: 6.66 to 1.87). Other result: Reported additional benefits, including increased motivation and awareness of partners' needs.	H–H–H–H
Requena et al. [42]	Individual mobile assisted (web program)	Provided education program for self-care maintenance and management. (3)	education consultation	Baseline, and 3 months	Improved risk factor management - Greater percentage of intervention compared to control group achieved total control [diabetes mellitus (83.2% versus 63.5%, P < 0.01) and hypercholesterolemia (80.3% versus 63.5%, P = 0.03)]. -Greater percentage of intervention compared to control group could knowledge of vascular risk factors (86% vs 69%, p = 0.02). No effect for treatment compliance.	H–H–H–H
Paul et al. [43]	Individual mobile assisted (web program, ActivPAL™ activity monitor)	Provided education program for self-care monitoring. (6)	education consultation feedback	Baseline, and 2 months	Improved physical activity, physical function -Increase of mean number of steps/day by 39.3% (1633 steps/day) in intervention group compared to reduction in control group (p = 0.005) -Increase in walking time by 20 min per day in intervention group versus reduction in control group (p = 0.002) - Improved Fatigue (p = 0.003) level in intervention group versus in control group - Heart rate, blood pressure, body mass index were no significant.	H–H–H–H

[a] BHHM: brain and heart health manager.
[b] mHealth: mobile health.
[c] SMS: short message service.
[d] BP: blood pressure.
[e] LDL: low-density lipoprotein.
[f] HDL: high–density lipoprotein.
[g] BMI: body mass index.
[h] HRQoL: *health-related quality of life*.
[i] SF-36: 36-item short form survey.
[j] WOE: Weight of Evidence.

results. After being organized, the data quality was evaluated using Weight of Evidence (WoE) suggested by Gough [31]. The Weight of Evidence (WoE) is evaluated in four stages, and the evaluation criteria include the research purpose, research method, subject selection and rationale, and derivation of results appropriate to the research problem. Weight of Evidence (WoE) an evaluates the consistency and integrity of the evidence for the research question, focusing on the context and evidence of the study, and Weight of Evidence (WoE) b assesses whether the form of evidence for the research question is consistent with the research purpose. As a result, it was evaluated whether the study selected an appropriate study design for the study purpose. Weight of Evidence (WoE) c focuses on the

research question to determine whether a research method or research analysis was selected based on appropriate evidence. It was evaluated in terms of subject selection, data collection process, research ethics, and data analysis. Finally, Weight of Evidence (WoE) d is a comprehensive judgment based on Weight of Evidence (WoE) a, b, and c. Three grades of high, medium, and low were used as analysis criteria. This means that among the items a, b, and c of Weight of Evidence (WoE), two or more items were evaluated as "high" and if more than two items were evaluated as "high" or "medium" they were classified as 'medium" and "medium." The quality evaluation should be satisfied [31]. As a result, all 12 pieces of literature selected in this study were analyzed as "medium" grade or higher and satisfied the quality evaluation criteria.

2.2.4. Data analysis

The fourth step is an analysis process that interprets the final selected data through quality evaluation without bias and synthesizes its meaning. In order to extract all data, one researcher filled out the basic form, and three researchers independently performed the analysis to analyze the data. Items for data extraction include basic research (first authors, publication year, publication country, study design, and sample size), subject characteristics (gender and age of participants; mean ± SD), intervention-related data (telehealth category, intervention period, functionality, follow up, and outcomes), and the contents of each matrix were compared and reviewed through regular meetings between researchers. In case of data disagreement, a consensus data analysis matrix was completed through the process of reconciling opinions after sufficiently discussing the differences.

Presentation. The fifth step is to present data from what type of the attributes of the topic finally agreed upon among researchers were derived. To this end, a conceptualized attribute derivation matrix was analyzed, and the final attributes were confirmed by checking whether the attributes of stroke survivors' self-care intervention were integrated with the main coded data. In addition, the meaning of the derived attributes was interpreted and schematized so that they could be expressed visually.

3. Results

3.1. Study characteristics

Twelve telehealth-based self-care intervention studies for stroke survivors were selected for this study, and the results of analyzing the characteristics of the studies are shown in Table 1. The studies were published between 2009 and 2021, and 3 studies were Non-Randomized Controlled Trials (RCTs) [33,40,42], and the remaining 9 studies were Randomized Controlled Trials (RCTs) [32,34–39,41,43]. The studies were conducted in China [32], Belgium [33], Ghana [34], Germany [35], Australia [36], Pakistan [37], Korea [38], USA [40], Spain [42], England [43], and two were done in Canada [39,41]. No studies included how long stroke survivors survived after having a stroke. The number of participants varied from 8 to 145 and the average age of the participants of collected studies was 41 years or older.

3.2. Features and utilization of the telehealth intervention

Comparative subjects were included in 11 studies, and one did not have comparative subjects [40]. The characteristics and outcomes of telehealth interventions for self-care were presented (Table 2). Eleven of the studies applied individual mHealth strategies [32–37,39–43], and one study applied computer Internet health strategies [38]. The total study duration was 1 study at 3 weeks [42], 1 study at 5 weeks [36], 1 study at 6 weeks [43], 1 study at 8 weeks [37], 1 study at 9 weeks [41], 2 studies at 12 weeks [34,40], 4 studies at 24 weeks [33,35,38,39], and 1 study at 48 weeks [32].

All studies performed an intervention for the intervention group based on telehealth, and usual treatment was performed for the control group. All studies used an individual's mobile phone or individual's computer. Three studies had a store and forward function for actions such as which patients directly recorded clinical score (blood pressure, diet, etc.) and medication taking through a mobile web program, and delivered them to healthcare administrators [32,34,39], and in 5 studies, medical care interaction functions such as consulting and feedback were provided to providers [32,33,36,38,43]. For self-monitoring interventions, one study provided a mobile Bluetooth device [34] and an activity monitor machine [43]. In 4 studies, self-care guides and text messages for measuring blood pressure were regularly provided [34–37], and in 2 studies, self-care monitoring and education were provided through regular phone calls [36,40]. Two studies provided education and counseling on healthy living for stroke survivors using a web platform [32,33]. One study provided education and training on health behaviors for stroke survivors through an Internet program [38].

Blood pressure was measured as an outcome variable in five studies [32–35,37], and medication adherence and treatment adherence were measured in five studies [32–34,36,37]. In three studies, health behaviors and diet health were measured [32,33,35,38], and disease-related risk factors were measured in three studies [35,39,42]. In five studies, physical activity was measured by improving the physical functional state [36,38,39,41,43], and in two studies, psychological states such as depression and anxiety were measured [40,41]. Four studies measured the degree of healthcare resource utilization for interventions provided through text message and web platform [32,34,35,37] (Table 2).

3.3. Characteristics of self-care intervention for stroke survivors

The results of analysis of self-care interventions for stroke survivors identified through this study based on self-care theory are as

follows: 1) self-care maintenance; 2) self-care monitoring; and 3) self-care management.

3.3.1. Self-care maintenance

Interventions for self-care maintenance of stroke survivors shown in the results of this study include physical activity and treatment adherence (Table 3). Five of the 12 studies were related to physical activity [36,38,39,41,43]. All of these 5 studies were randomized controlled trials (RCTs), and 4 of them were mobile assisted studies, using text messages and phone calls to coach physical activity or to perform self-care maintenance through a mobile program provided [36,39,41,43]. In another study [38], healthy physical activity was educated through a computer and a gait and arm and leg exercise training program was provided. Four studies were collected using self-report questionnaires to measure changes in physical activity in measuring outcomes as a result of interventions and assessed the feasibility of intervention programs [36,38,39,41]. In one study, a commercialized activity monitor was provided prior to intervention to measure and transmit activity for steps and walking, which results were [43].

In 7 studies, text messages for treatment adherence for stroke survivors, regular phone calls, and mobile app push alarms were provided as reminders to promote adherence to treatment according to the time of pre-set medication treatment execution (medication, regular treatment, etc.) [32–34,36,37,40,42]. A study using web push notifications [32,34] recorded treatment adherence tracking through responses to treatment adherence notifications. Another study did not specifically include a recording function and assessed treatment adherence as a result of interventions using self-report questionnaires in follow-up outcome measures [33,36–38,42].

3.3.2. Self-care monitoring

All 12 studies covered self-care monitoring. Self-care monitoring included blood pressure, healthy behaviors, diet health, psychological well-being, glucose control, and depression. Five of these studies involved blood pressure measurements (Table 3). The most frequently monitored blood pressure was systolic BP in all five studies [32–35,37,43]. Among them, two studies [32,34,43] included a recording function through a mobile program to input daily blood pressure monitoring results or to automatically input blood pressure through a Bluetooth device [34]. Three other studies compared changes in blood pressure during regular follow-up [33,35,37].

Healthy behavior monitoring was included in three studies [32,33,35], and one study [32] recorded healthy behavior through a

Table 3
Self-care characteristics of in the Telehealth ($N = 12$).

Authors (year)	Self-care Maintenance		Self-care Monitoring						Self-care Management		
Study	PA[a]	TA[b]	BP[c]	HB[d]	HD[e]	PW[f]	GC[g]	DP[h]	SC[i]	HRU[j]	SIS[k]
Wang et al. [32]		√ (+)	√ (+)	√ (+)			√(+)			√ (+)	
Kamoen et al. [33]		√ (+)	√ (+)	√ (+)	√ (+)						
Sarfo et al. [34]		√ (+)	√ (+)							√ (+)	
Spassova et al. [35]			√ (+)	(+)	√ (+)					√ (+)	
Cadilhac et al. [36]	√ (+)	√ (+)				√ (+)					√ (+)
Kamal et al. [37]		√ (+)	√ (+)							√ (+)	
Kim et al. [38]	√ (+)	√ (−)			√ (+)				√ (+)		
Sakakibara et al. [39]	√ (−)				√ (−)	√ (+)	√ (+)				
Skolarus et al. [40]		√(+)						√ (−)			
Huijbregts et al. [41]	√ (+)					√ (+)					√ (+)
Requena et al. [42]		√ (−)			√ (−)		√ (+)				
Paul et al. [43]	√ (+)		√ (−)				√ (+)				

(+): effect.
(−): no effect.
[a] PA: physical activity.
[b] TA: treatment adherence.
[c] BP.: blood pressure.
[d] HB.: healthy behaviors.
[e] HD: health diet.
[f] PW: phychological well-being.
[g] GC: glucose control.
[h] DP: depression.
[i] SC: sense of control.
[j] HRU: healthcare resource utilization.
[k] SIS: social integration and support.
- Not an original article (n = 8)
- Grey literature (n = 6)
- Irrelevant population (n = 233)
- Not self-care intervention(n = 68)
- Case study (n = 104)
- No reported outcomes (n = 61)

mobile web platform, and asked researchers about their health behavior during the intervention period. The remaining two studies [33,35] evaluated healthy behaviors through self-report questionnaires as an item of intervention program evaluation. In one study [33], the type of health behavior and the importance of implementation were included in the program to be provided to the subjects, and in one study [35], an alarm message about health behavior implementation was regularly provided through an automated message.

Five studies included differentiated interventions and monitoring for a healthy diet [33,35,38,39,42]. Four of them provided a mobile program [33,35,39,42], and one study conducted education on healthy eating through a personal computer [38]. None of the four studies [33,35,38,39] had an immediate recording function for a healthy diet, thus monitoring and intervention programs were conducted through self-report questionnaires.

Three studies included monitoring interventions for psychological well-being [36,39,42]. A mobile assisted remote program was used to monitor the emotional state through structured text messages and phone calls, but no specific evaluation was made. In addition, monitoring interventions for glucose control were included as interventions for risk factors in four studies [32,39,42,43]. In one of these studies, specific coaching was provided through cell phone [39], and in three studies, researchers' feedback on education and risk factor-related health behaviors was provided through a mobile program [32,42,43]. One study included self-care monitoring interventions for assessments of depressive symptoms, medication adherence, and side effects and provided feedback to support depressive symptoms by text messages and phone calls [40].

3.3.3. *Self-care management*

Seven studies addressed self-care management [32,34–38,41] (Table 3). Specific contents include sense of control, healthcare resource utilization, and social integration and support. In one study [38], the results were confirmed through education through a computer program and a self-report questionnaire containing emotional management criteria such as sense of control. In four studies [32,34,35,37], there were self-care management studies related to healthcare resource utilization. In the study design and contents, a communication channel between the researcher and the subject was provided [32] and consultation was conducted within the intervention period, which recorded the utilization of appropriate healthcare resources. In three other studies [34,35,37], it was possible to indirectly check the level of healthcare resource utilization, such as performing the information in the provided text message and recording and transmitting blood pressure and health status. But, it was not done specifically as an evaluation item. Only two studies [36,41] included management evaluation of social integration and support. Medical consultation was conducted through mobile messages and regular phone calls, and the evaluation of this program was done through the social support scale.

3.4. *Emerging framework from the review*

As a result of an integrated review of the 12 studies included in this study, the attributes of the telehealth intervention presented in each study were derived (Fig. 2). These attributes corresponded to the digital medical service function of the technical characteristics of telehealth as being interaction, monitoring, education, and store and forward. It was confirmed that the properties of remote intervention, self-care maintenance, self-care monitoring, and self-care management do not function separately, but rather interact

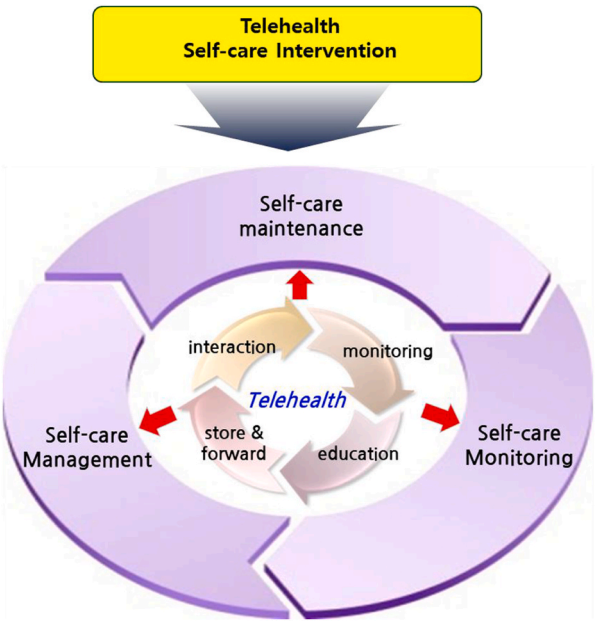

Fig. 2. Framework of telehealth self-care intervention for stroke survivor.

with each other like cogs and influence each other.

4. Discussion

As a result of an integrated review of the 12 studies, the digital health service functions of interaction, monitoring, education, and store and forward are the technical characteristics of telehealth intervention. It was confirmed that the attributes of remote intervention, self-care maintenance, self-care monitoring, and self-care management interact and influence each other like a cogs in a wheel. Self-care can prevent recurrence and complications and improve health by allowing chronic disease patients and subjects with cerebrovascular disease to act as individualized patients after treatment. It is also one of the most important factors that can solve problems such as anxiety, frustration, restriction of physical activity, and return to work according to the course of the disease [31]. Hence, it will be important for stroke survivors to continuously manage their disease by themselves through self-care such as regular exercise, correct medication, and basic lifestyle changes.

4.1. Self-care maintenance

As a result of this study, self-care maintenance was analyzed as an action performed by stroke survivors to maintain health through physical activity and treatment adherence. It was most important for stroke survivors to minimize events such as falling and maximize physical activity through regular exercise suitable for their current physical condition. Still, stroke survivors were experiencing difficulties in receiving sufficient rehabilitation services because they have difficulties in mobility due to disability and require additional time from their guardians to move to a facility where rehabilitation services are available [20]. In addition, stroke survivors often have underlying diseases such as high blood pressure, diabetes, and atrial fibrillation, and in order to prevent recurrence and exacerbation, they often take drugs such as antihypertensives, hypoglycemic agents, and thrombolytics [33]. , since this is also often accompanied by cognitive decline after a stroke, it is often not possible to take the prescribed medication at the correct time, and when the side effects of the drug are not recognized due to lack of knowledge about interactions between the medication and certain food items [34].

So, in order to maintain self-care maintenance in stroke survivors, an intervention program that can work at any time and place, continuously assess the patient's condition, prescribe, and provide knowledge for self-care maintenance will be important. In this respect, telehealth technology is not affected by time and place, and education, monitoring, and feedback on exercise methods and drug administration are possible. The researchers believe the problem can be resolved.

4.2. Self-care monitoring

Self-care monitoring is a process of regularly observing and monitoring one's own health status, and it includes self-checking blood pressure and glucose or monitoring one's own behavior, diet, and emotional state. It is difficult to change and maintain a lifestyle that has been maintained for a long time, but maintenance and management of self-care such as diet, smoking cessation, and abstinence from alcohol can reduce systolic and diastolic blood pressure and reduce the occurrence of complications such as hyperlipidemia and diabetes to keep the disease stable [34]. In particular, stroke survivors in Korea had the highest demand for knowledge about what to eat among the self-care monitor items [33]. This is because most of the stroke survivors have high blood pressure or hyperlipidemia, diabetes, and heart disease, which may cause drug interactions [35].

Consequently, for self-care monitoring for stroke patients, it is judged that individual customized interventions that sufficiently reflect not only cultural characteristics but also individual underlying diseases and needs for self-care are necessary.

4.3. Self-care management

As a result of this study, self-care management was analyzed as an act of continuously monitoring the subject's emotions, blood pressure, and health status, and responding to and solving the subject's problems through an appropriate communication route. In self-care management, clinical symptoms of stroke survivors were continuously monitored and recorded through interaction with medical staff including nurses. In addition, self-care management behaviors were revised in a more positive direction by transmitting the results to the patient, and medical interviews or consultations were made in case of problems. In self-care management, efforts were made to maximize self-efficacy, which is the most influential factor in performing self-care for subjects through interaction with medical staff [33]. In previous studies, self-efficacy was the most influential factor in the self-care process of adults with severe hypertension. Low self-efficacy led to avoidance of the task and high self-efficacy led to active performance [34]. Thus, for self-care management, social support is provided through close collaboration between patients and their caregivers, medical staff, and patients can set achievable goals together and provide positive feedback to sustain the successful experience of self-care by providing positive feedback.

Self-care intervention for stroke survivors as derived from the integrated review of these 12 studies can be said to improve self-care outcomes through interactions between self-care maintenance, self-care monitoring, and self-care management. Henceforth, when developing a self-care intervention for stroke survivors, it will be necessary to develop an intervention program that can include self-care maintenance, self-care monitoring, and self-care management together without separating them. Also, as in this study, self-care intervention for stroke survivors should not be carried out within a short period of time, but should be carried out regularly for 3–6 months, and medical staff monitoring, education, interaction, and store and forward should be carried out continuously according to the individual's disease state. Consequently, rather than the traditional intervention method, the intervention program of a new

approach using telehealth that reflects the changes of the times should be fully considered.

4.4. Implications

The limitation of this study is that the amount of literature on self-care intervention for stroke survivors using telehealth technology in Korea and abroad was small, and a relatively small number of publications were analyzed, with 12 papers included in this study. In addition, quantitative analysis could not be conducted because the tools for measuring self-care outcomes were different in all of the 12 selected studies. In addition, in the 12 papers analyzed, it is judged that the effect of telehealth intervention can vary depending on the individual's engagement and level of expertise in self-care. So, caution should be exercised in interpreting the results of the literature. Nevertheless, this study will be meaningful in that it identified the attributes of stroke survivors' self-care telehealth intervention and provide a guide for developing an effective program in the future.

5. Conclusion

In this study, an integrated review method was used and systematically reviewed to provide a comprehensive understanding of telehealth-based self-care interventions for stroke survivors. As a result, as a function of telehealth intervention, interaction, monitoring, education, and store and forward were derived, and these did not function separately as self-care maintenance, self-care monitoring, and self-care management, but rather as cogs in the wheel that interlock and influence each other. Consequently, the results of this study can provide a guide for developing effective telehealth self-care intervention in the future by identifying the attributes of telehealth self-care intervention for stroke survivors.

Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article.

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Data availability statement

Data will be made available on request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Abbreviations

WoE	weight of evidence
mHealth	mobile health.
RCTs	randomized controlled trials
SMS	short message service

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2023.e16430.

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