

Effectiveness of dyadic interventions to improve stroke patient–caregiver dyads' outcomes after discharge: A systematic review and meta-analysis study

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Abstract

Background: Because of the importance of a dyadic approach, it is necessary to conduct a systematic review to identify which dyadic intervention could be implemented for stroke survivor–caregiver dyads after discharge from the rehabilitation hospital to improve outcomes.

Aims: The aims were to systematically review the evidence to identify which dyadic interventions have been implemented in stroke survivor–caregiver dyads to improve stroke survivor–caregiver dyads' outcomes and to analyse, through a meta-analysis, which intervention was found to be the most effective.

Methods: A systematic review and meta-analysis were conducted using the following electronic databases: PubMed, CINAHL and PsycInfo. Randomized controlled trials (RCTs) and quasi-RCT studies published within the last 10 years were included. Quantitative data were extracted from papers included in the review using the standardized data extraction tool from JBI-MASARI. Pooled effects were analysed between the experimental and control groups for each outcome.

Results: Sixteen studies involving 2997 stroke survivors (male gender=58%) and 2187 caregivers (male gender=25%) were included in this review. In 16 studies, which were subdivided into three quasi-RCTs and 13 RCTs, the application of dyadic interventions for stroke survivors and caregivers was systematically reviewed, but only a few of these identified a significant improvement in the stroke survivors' and caregivers' outcomes of its intervention group. Dyadic interventions showed a significant effect on stroke survivors' physical functioning ($p=0.05$), memory ($p<0.01$) and quality of life ($p=0.01$) and on caregivers' depression ($p=0.05$).

Conclusions: This study provides moderate support for the use of a dyadic intervention to improve stroke survivors' physical functioning, memory and quality of life and caregiver depression.

Keywords

Dyad, caregiver, patient, survivor, stroke, meta-analysis, review

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Introduction and purpose

The first year post stroke is critical in the recovery process for both stroke survivors^{1,2} and for their caregivers.³ During this period, some authors^{4,5} have observed that stroke survivors have poor quality of life (QOL), particularly during the first three months post discharge; however, improvements in QOL are seen later. Conversely, some authors have reported

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that stroke survivors' QOL decreases significantly during the first year.⁶ For caregivers, the literature⁷ reports high levels of burden, anxiety and depression in stroke caregivers during the first year post stroke, as well as lower QOL.

Due to both physical and psychological disabilities in both stroke survivors^{2,8} and their caregivers^{8,9} after stroke and also owing to low preparedness in stroke caregivers¹⁰ in the recovery process, which both negatively impact QOL, several authors have developed and implemented interventions to improve the stroke survivors' or the stroke caregivers' outcomes (i.e. QOL, anxiety, depression, physical functioning, etc.). However, recent studies have emphasized the importance of a dyadic approach when studying stroke survivors and caregivers.^{11,12} Emerging theory¹¹ states that patients and their unpaid informal caregivers (i.e. family or friends) experience and navigate the illness together. Recent evidences^{7,13,14} have shown that stroke survivors and caregivers are interdependent and may influence each other.

Considering the importance of dyadic perspectives in stroke care, it is vital to understand the effectiveness of the dyadic interventions (i.e. educational, informative and supportive) developed and implemented to improve stroke survivor–caregiver dyads' conditions. Although some previous authors^{7,14,15} have highlighted the importance of studying the dyads in a stroke population, to our knowledge, only two previous systematic reviews^{16,17} have offered evidence for stroke family caregiver and dyadic interventions. In Bakas and colleagues' systematic review¹⁶ conducted from 1990 to 2012 and in their update¹⁸ investigated from 2012 to 2016, the authors analysed the effects of an intervention on both stroke survivors and caregivers but did not conduct a meta-analysis of the interventions. In another review,¹⁷ the authors focused more on studying the effectiveness of an educational intervention mainly on family caregivers' outcomes (i.e. burden, depression, anxiety, social support, etc.), while in stroke survivors they limited themselves to studying the effect of the educational intervention only regarding the use of healthcare resources. Minshall et al.¹⁹ also conducted a systematic review and meta-analysis; however, they analysed only the psychosocial interventions and not the educational intervention, observing the effects on psychological outcomes, such as anxiety, depression, coping, self-efficacy and carer strain. Given that stroke survivors and caregivers are interdependent, it is necessary to implement tailored interventions that may include both elements of the dyad (stroke survivors and caregivers) because each element of the dyad could be either positively or negatively influenced by the interventions. Because of the importance of a dyadic approach, having a systematic review in the

stroke dyadic population is fundamental to synthesize the evidence about the stroke survivor–caregiver dyads' interventions and to provide the foundation for evidence-based recommendations to design dyadic programmes to improve the care of stroke patients and their caregivers after the stroke survivors' discharge from rehabilitation hospitals.

Thus, the aims of this systematic review and meta-analysis are as follows:

1. To describe which dyadic interventions are implemented in stroke survivor–caregiver dyads to improve stroke survivors' (QOL, depression, physical functioning, activities of daily living and Stroke Impact Scale (SIS) communication, composite physical, memory, emotional dimensions) and caregivers' outcomes (QOL, depression and burden).
2. To use a meta-analysis to analyse which intervention is the most effective to improve stroke survivors' (QOL, depression, physical functioning, activities of daily living and SIS communication, composite physical, memory, emotional dimensions) and caregivers' outcomes (QOL, depression and burden).

Methods

Search strategy

The Preferred Reporting Items for Systematic Reviews and Meta-analysis checklist was used to present detailed information in this systematic review, and the Joanna Briggs Institute Meta-analysis of Statistics Assessment and Review Instrument (JBI-MASARI) software was employed to assess the methodological validity prior to inclusion in the review. The present systematic review was registered on the PROSPERO register (n° PROSPERO 2019 CRD42019117478, available from: http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42019117478).

A comprehensive search was conducted in May 2019 using the following electronic databases: PubMed, CINAHL and PsycInfo. The keywords were as follows: 'dyad', 'families', 'caregiver', 'carer', 'patient', 'survivor' and 'stroke'. These terms were adapted for each database, and the detailed search strategies are shown in the Supplementary Material Appendix 1 online. Furthermore, reference lists and bibliographies of all relevant articles were also searched for inclusion.

Criteria for considering studies for the review

Studies eligible for the review had to fulfil the following inclusion criteria: (a) randomized controlled trials (RCTs) and quasi-RCTs, (b) published within the last 10 years (from 2009 to May 2019) that (c) examined the

dyadic interventions (informative, educational and supportive) implemented in stroke survivor–caregiver dyads. We decided to include articles published within the last 10 years because another systematic review had analysed articles about the educational intervention in stroke survivor–caregiver dyads published between 1990 and 2012. The exclusion criteria were as follows: (a) articles not written in English, Italian, Spanish, French or German; (b) articles that were reviews, reports, book chapters or observational studies; (c) articles where the intervention was implemented before the rehabilitation programme; (d) duplicate articles; (e) studies not involving human participants (if any); (f) studies in which the diagnostic criteria were unclear or not scientifically acceptable; and (g) articles where the authors did not implement a dyadic educational intervention.

The titles and abstracts of studies identified by our search strategy were screened independently for their eligibility by two members of the research team (GP and ML). Endnote X6, a computer-based reference management software program, was used to indicate whether the citation was assessed as potentially relevant or not. Following Bramer and colleagues' indications,²⁰ it was created in an Endnote two group set: (a) included and (b) excluded. After the groups for inclusion and exclusion criteria had been made, two copies of these files were created (adding the name of the reviewer to the file name) and distributed to the reviewers. Discrepancies were resolved by discussion. The full text of articles deemed eligible were retrieved and assessed for the inclusion criteria by the same investigators. Any disagreement was resolved by discussion and consensus. When the latter was not reached, arbitration was sought from a third member of the team (SS). The inter-rater agreement for the selection of studies was assessed using non-weighted Cohen's kappa statistics.²¹

Population

The review included studies on stroke survivor–caregiver dyads after stroke survivor discharge from the rehabilitation hospital who were without cognitive disabilities and lived in their own homes. Long-term settings in rehabilitative or home-care structures were excluded because the intent of the review was to conduct a meta-analysis of the dyad interventions once discharged from the hospital.

Intervention

The interventions of interest must have been informative (i.e. providing information with guides, brochures, booklets, etc.), educational (i.e. training programme,

skill improvement, etc.) and supportive for the stroke survivors and the caregivers. The interventions may or may not have been managed by a multidisciplinary team (this information was obtained by reading the studies) and began during hospitalization and continued after hospital discharge with follow-up at home. In addition, the intervention may or may not have been developed specifically through a dyadic approach. However, studies which had not been designed following a dyadic approach must have developed a treatment that included stroke survivors and caregivers.

Comparison (control group)

The intervention was compared with the usual level of routine care. The control group received informal information, training and support without a systematic procedure during the patient's admission to a rehabilitation hospital. The stroke survivors were rehabilitated with standard programmes (physiotherapy, speech therapy, etc.).

Outcomes

The efficacy of the dyadic interventions was measured as medium-term (between three and six months) outcomes. This choice was necessary because most of the included studies had medium-term outcomes. For stroke survivors, the analysed outcomes were: generic and specific QOL, identified through the SIS, physical functioning, activities of daily living (ADL), anxiety and depression, while for the caregivers, the analysed outcomes were QOL, burden, depression and anxiety.

Study

This review considered both experimental and quasi-experimental study designs,^{22,23} including RCTs, quasi-RCTs, before and after studies and interrupted time-series studies. In addition, analytical observational studies, including prospective and retrospective cohort studies, case–control studies, and analytical cross-sectional studies, were considered for inclusion. This review did not include descriptive observational study designs, such as case series, individual case reports or descriptive cross-sectional studies.

Assessment of the methodological quality and risk of bias

The selected studies were evaluated for methodological quality by two independent investigators using the critical appraisal tools made available by the Joanna Briggs Institute (JBI) to evaluate the RCTs ([https://wiki.joannabriggs.org/display/MANUAL/Appendix + 3.1%3A + JBI + Critical + appraisal + checklist + for](https://wiki.joannabriggs.org/display/MANUAL/Appendix+3.1%3A+JBI+Critical+appraisal+checklist+for)

+ randomized + controlled + trials) and quasi-RCTs (<https://wiki.joannabriggs.org/pages/viewpage.action?pageId=9273720>). The first tool used to evaluate the RCTs is shown in Table 1. The second tool for evaluating quasi-RCTs is described in Table 2. Any disagreement between reviewers was resolved through discussion or consultation with a third reviewer.²⁴ The JBI quality appraisal checklist identifies bias that may exist in the selected studies to determine whether the results are valid. To ensure methodological quality, the checklist criteria included the following: (a) evidence of allocation concealment at randomization, (b) details of study sample withdrawals, (c) inclusion and exclusion criteria for the study sample, and (d) information on the validity of outcome measurements and any potential bias of the study. Studies of low methodological quality as determined by the critical appraisal were excluded from the synthesis. The risk of bias in the included studies was assessed by two reviewers (GP and ML) using the JBI Critical Appraisal Checklist for RCTs and the JBI Critical Appraisal Checklist for Quasi-RCTs. Based on these assessment tools, studies were rated as having a low, high or unclear risk of bias. When the authors had disagreements, a third author (SS) was consulted to resolve the discrepancy and reach a consensus.

A sensitivity analysis based on study design and study quality (i.e. studies that had a low risk of bias compared with studies with a high risk of bias based on the JBI tools) was performed to determine the robustness of the results, and this analysis assessed the impact of the methodological quality, the study design and any missing data as well as the analysis methods on the results of this review. We also used sensitivity analyses to investigate suspected funnel plot asymmetry due to publication bias.

Data extraction

Quantitative data were extracted from studies included in the review using the standardized data extraction tool from JBI-MAStARI. Two reviewers independently extracted the following data for each study: country, setting context, participant characteristics, group description and sample, outcomes measured and description of the main result. Two different investigators (GP, ML) extracted data based on the objectives and form of the study; thereafter, the extracted data were reviewed. Since the size and format of each variable could be different, the size and format of the outcomes could also be different and slight changes could be required when combining the data.²⁵ If there were differences in the size and format of the outcome variables that cause difficulties combining the data, such as the use of different evaluation instruments or

different evaluation timepoints, the analysis would be limited to a systematic review. The investigators resolved differences of opinion by debate, and if they failed to reach a consensus, a third reviewer (SS) would be consulted.

Statistical analysis

Data synthesis. To synthesize the data and calculate the overall estimates of treatment effects with 95% confidence intervals (CIs), we used RevMan (version 5.3) software. Standardized mean differences (SMDs) were used to determine standardized effect sizes²⁶ due to the heterogeneity of the measures used. The effects were weighted using the inverse of variance. In addition, we used random effects models to calculate composite effects. This method considers the probability of variability in population parameters among studies and thus allows more robust conclusions to be drawn. Given the likelihood of heterogeneity of behavioural, social and health science data, this approach also allows generalization of meta-analytic findings. A random-effects model was used in the analysis of all outcomes as it incorporated the assumption that the different studies estimated distinct but related effects; in this review, differences in the measurement tools and interventions were anticipated.²⁷

All results were subject to double data entry. For each study, we included the experimental and control group mean, the experimental and control group standard deviation and the total experimental and control sample. This approach allows the software to generate the plot using the data entered. Where statistical pooling was not possible because the interventions were heterogeneous, the findings have been presented in a narrative form, including tables and figures, to aid in the best presentation where appropriate.

Assessment of heterogeneity. Visual inspection of a forest plot was carried out to examine the magnitude of the variation between studies; we also quantified the heterogeneity using Cochrane's Q (χ^2 test) and I^2 statistics.²⁸ To assess the degree of heterogeneity, the following I^2 cut-offs for low, moderate and high heterogeneity were used: (a) <25% indicated no heterogeneity; (b) 25–50% indicated low heterogeneity; (c) 50–75% represented moderate heterogeneity; and (d) \geq 75% suggested high heterogeneity.²⁸ The significance was determined by a χ^2 test for Q , so a p -value <0.05 was considered significant. In these cases, the reasons for heterogeneity were explored qualitatively. These reasons included clinical diversity, such as differences in participants and interventions, and methodological diversity, including outcome measures and risk of bias. Where substantial heterogeneity was present,

Table 1. Methodological quality of the 13 randomized controlled trials.

Criterion	Forster et al., 2009	Marsden et al., 2010	Perrin et al., 2010	Shyu et al., 2010	Galvin et al., 2011	Smith et al., 2012	Eames et al., 2013	Forster et al., 2013	Nayeri et al., 2014	Ostwald et al., 2014	Forster et al., 2015	Wang et al., 2015	Duncan et al., 2017	%
1. Was true randomization used for assignment of participants to treatment groups?	?	+	+	+	+	+	+	+	+	+	+	+	+	92.3
2. Was allocation to treatment groups concealed?	+	?	+	+	+	+	+	+	+	+	+	+	+	92.3
3. Were treatment groups similar at the baseline?	+	+	+	+	+	+	+	+	+	+	+	+	?	92.3
4. Were participants blind to treatment assignment?	+	?	+	+	+	+	+	+	+	+	+	+	+	92.3
5. Were those delivering treatment blind to treatment assignment?	+	-	+	?	+	+	+	+	+	+	?	?	+	69.23
6. Were outcomes assessors blind to treatment assignment?	-	-	?	?	+	+	+	?	?	+	?	?	+	38.46
7. Were treatment groups treated identically other than the intervention of interest?	+	+	+	+	+	+	+	+	+	+	+	+	+	100.0
8. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?	+	+	+	+	+	+	+	+	+	+	+	+	?	92.3
9. Were participants analysed in the groups to which they were randomized?	+	N/A	N/A	N/A	N/A	N/A	?	N/A	+	+	+	N/A	+	38.46
10. Were outcomes measured in the same way for treatment groups?	+	+	+	+	+	+	+	+	+	+	+	+	+	100.0
11. Were outcomes measured in a reliable way?	+	+	+	+	+	+	+	+	+	+	+	+	+	100.0
12. Was appropriate statistical analysis used?	+	+	+	+	+	+	+	+	+	+	+	+	+	100.0
13. Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	+	+	+	+	+	+	+	+	+	+	+	+	+	100.0
Quality assessment	84.6	61.5	84.6	76.9	92.3	92.3	92.3	84.6	92.3	100	84.6	76.9	84.6	

+ = Yes; - = No; ? = 'Unclear'.

N/A: not applicable; RCT: randomized controlled trial

Table 2. Methodological quality of the three quasi-randomized controlled trials.

Criterion	Aguirrezabal et al., 2013	Bishop et al., 2014	Fens et al., 2014	%
1. Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	+	+	+	100.0
2. Were the participants included in any similar comparisons ?	+	+	+	100.0
3. Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	+	+	+	100.0
4. Was there a control group?	+	+	+	100.0
5. Were there multiple measurements of the outcome both pre and post the intervention/exposure?	-	+	+	66.66
6. Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analysed?	+	+	+	100.0
7. Were the outcomes of participants included in any comparisons measured in the same way?	+	+	+	100.0
8. Were outcomes measured in a reliable way?	+	+	+	100.0
9. Was appropriate statistical analysis used?	+	+	+	100.0
Quality assessment	88.8	100	100	

+ = Yes; - = No; ? = 'Unclear'.

the interpretation of results was based on CIs rather than the average effect.

Measures of treatment effects. Continuous outcomes were pooled using the random effects model; the results were reported using the SMD, as the scores were measured using different scales, except for the evaluation of the effects on stroke survivors' SIS dimensions, which were described with no SMD because they were generated using the same instrument. The effect sizes were interpreted with Cohen's *d*, where values < 0.5 denote a small effect size, values from 0.5 to 0.8 indicate a moderate effect size and values ≥ 0.8 suggest a large effect size.²⁹

Results

Systematic review results

Search results. Literature searches identified 2343 records after duplicates were removed (Figure 1); 35 citations fulfilled the inclusion criteria. After reading the full text, 20 articles were discarded (Figure 1). Five additional papers were identified from reference lists, and one was included in the review. Sixteen total articles were included in the final review. No study was excluded on the basis of the quality critical appraisal tool (Tables 1 and 2); even though two studies^{30,31} received a low score due to a poor description of the methodology, the reviewers decided to include them anyway because they reported important quantitative

data, as suggested by the literature.^{24,32} The included studies were published from 2009 to 2017. Three articles were quasi-RCTs³³⁻³⁵ and 13 were RCTs.^{30,31,36-46}

Methodological quality and risk of bias. The methodological quality of the 13 RCTs and three quasi-RCT is summarized in Tables 1 and 2. Incomplete details on random assignment methods and lack of concealment of assignments were the major concern regarding the risk of selection bias in these studies. Only one study did not provide complete information about random selection,⁴¹ while another study did not explain the assignment of participants to treatment and control groups.³⁰ A risk of performing bias was found in Duncan and colleagues' study,³⁹ which is a cluster RCT and did not provide sufficient data for treatment groups similar to the baseline. Concerning blinding, there were also bias problems in Marsden and colleagues' study.³⁰ A double-blinded procedure (participants and those administering the treatments) was not declared in four studies.^{30,31,37,43} Only five RCTs^{38-40,44,46} are described as triple-blinded (participants, administrators, researchers), while this procedure was absent in two studies^{30,41} and doubtful in six RCTs.^{31,36,37,42,43,45} Analysing the methodological quality, only one RCT⁴⁶ and two quasi-RCTs^{33,34} obtained a score equal to 100. Ten studies (nine RCT and one quasi-RCT) obtained a score > than 80,^{35,36,38-45} while two studies^{31,37} obtained equal 76.9 and one study a score of 61.5%.³⁰

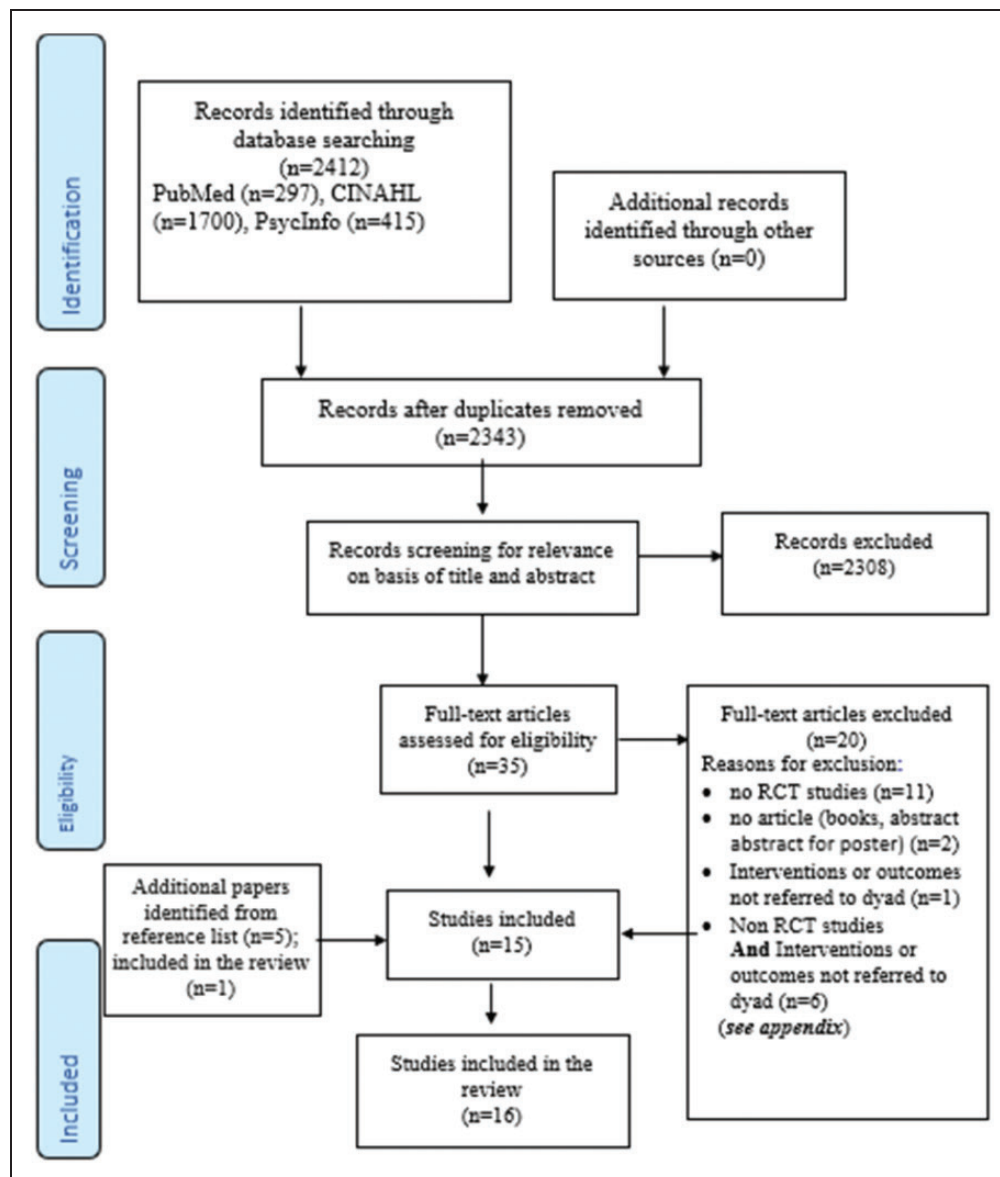


Figure 1. Flow chart.

RCT: randomized controlled trial

Study characteristics. Sixteen studies involving 2997 stroke survivors (interventional group: 1488 vs. control group: 1509) and 2187 caregivers (interventional group: 1078 vs. control group: 1109) were included in this review. The stroke patients were mostly male with a mean age of 69.2 years. Most of the caregivers were female with an average age of 58 years and were mostly partners of the stroke patients (Table 3).

Seven studies were conducted in Europe: four in the United Kingdom,^{30,41–43} one in Spain,³⁵ one in The Netherlands³⁴ and one in Ireland.⁴⁴ Five studies were from the United States;^{33,36,38,39,46} three were published

in Asia: two in Taiwan^{31,37} and one in Iran.⁴⁵ One additional study was conducted in Oceania.⁴⁰

The extraction of other socio-cultural data was not possible because such data were not reported in the original articles.

Details of the interventions. The interventions implemented in the experimental groups were one of four types (Table 3): (a) seven studies (one quasi-RCT³⁵ and six RCTs^{30,31,38,41,42,44}) used an informative and educational intervention, such as a written clinical stroke survivors' guide, video training, group

Table 3. Characteristics of the included studies.

Authors, year (Location) Type of study	Participants Intervention provider	Interventions	Outcome measure (a) Short-term follow-up (b) Long-term follow-up
Forster et al., 2009 (York, UK) RCT	265 stroke patients (mean age 78 years, 55% women) and 106 caregivers (mean age 70 years, 75% women). Multidisciplinary team.	Structured re-assessment system (132 patients and 57 caregivers): – Home assessment conducted by a stroke nurse; – Discussion and case review by multidisciplinary team; – Medically led stroke review clinic; – Established links to therapy; – Established social care service.	Usual care (133 patients and 49 caregivers): A letter sent to their general practitioner recommending a patient review at six months post stroke in accordance with national policy. Patients: – Physical Functioning (BI); – Activities of Daily Living (FAL); – Anxiety and Depression (HADS). Caregivers: – QOL (GHQ) Somatic symptoms; Anxiety and insomnia; Social dysfunction; Severe depression; Total QOL (b) Outcomes after 12 months post stroke
Marsden et al., 2010 (New South Wales, Australia) RCT	25 stroke patients (mean age 71 years, 76% male) and 17 caregivers (mean age 67.6 years, 88.2% female). Multidisciplinary team.	The Community Living After Stroke for Survivors and Carers programme (CLASSIC) : 12 patients and nine caregivers): 2½ h group session for seven weeks – 1 h of physical activities; – 1 h of educational activities with presentation, group discussions and group activities; – Self-management principles; – Information about healthy food.	Patients: – Physical Functioning (BI); – Activities of Daily Living (FAL); – Anxiety and Depression (HADS). Caregivers: – QOL (GHQ) Caregiver strain (CSI). (a) Outcomes at one, nine and 21 weeks post intervention programme: Patients: – Independence (RS); – Cognitive function (MMSE); – Stroke specific QOL (SIS); – Activities daily of living (ADL and IADL); – Walking capacity (6-min walking test).

(continued)

Table 3. Continued

Authors, year (Location) Type of study	Participants Intervention provider	Interventions	Outcome measure (a) Short-term follow-up (b) Long-term follow-up
Perrin et al., 2010 (Florida, USA) RCT	61 dyads with 61 stroke patients (mean 69.4 years, 95.1% men) and 61 caregivers (mean age 58.5%, 91.8% women). Multidisciplinary team.	Transition assistance programme (27 dyads): – Skill development; – Education; – Supportive problem-solving using videophone technology; – Face-to face meeting with caregivers.	Usual care (34 dyads) Patients: – Physical Functioning (FIM). Caregivers: – QOL (HIS); – Caregiver's strain (CSI). (a) Outcomes at one and three months: Patients: – Physical Functioning (FIM). Caregivers: – Caregiver's strain (CSI); – Depression (CESD-10); – Caregiver's satisfaction (CCHTPSS).
Shyu et al., 2010 (Taiwan, China) RCT	158 dyads with 158 stroke patients (mean age 74 years, 53.7% women) and 158 caregivers (mean age 47.9 years, 60.8% women). Multidisciplinary team.	Individualized intervention programme (97 stroke survivor–caregiver dyads): – Assess individual discharge needs within 48 h of admission; – Consultation to anticipate competing needs after discharge; – Provide individualized discharge health educational consultation; – Home visits during one and three weeks after discharge to resolve problems or demonstrate skills.	(a) Outcome at one, three, (b) six and 12 months after discharge: Patients: – Self-care ability (BI); – QOL (SF-36). Caregivers: – Quality of care (FCCI); – QOL (SF-36).
Galvin et al., 2011 (Dublin, Ireland) RCT	40 patients (mean age 66.5 years, 50% female) and 40 caregivers (not described). Physiotherapist staff.	Family-Mediated Exercise Intervention (FAME) : 20 patient–caregiver dyads: – Routine physiotherapy; – FAME programmes to be conducted for 35 min at the bedside with his/her nominated family members; – Training of family/friend members; – Exercise training programme according to the participants' ability.	(a) Outcomes after three months post-intervention: Patients: – Lower Limb section (FIM); – Motor Assessment (MAS); – Walking capacity (6-min walking test); – Balance function (BBS); – Physical Functioning (BI); – Global Function (RNLI); – Activities of daily living (NEADL). Caregivers: – Caregiver's strain (CSI).

(continued)

Table 3. Continued

Authors, year (Location) Type of study	Participants Intervention provider	Interventions	Outcome measure (a) Short-term follow-up (b) Long-term follow-up
Smith et al., 2012 (Kent, USA) RCT	38 dyads with 38 stroke survivors (mean age 59 years, gender not described) and 38 caregivers (mean age 55 years, gender not described). Multidisciplinary team.	Web-based intervention (15 patient-caregiver dyads): – Professional guide; – Educational videos; – Online chat sessions; – Email and message board; – Resource room.	Usual care (17 patient-caregiver dyads): Access only to the Resources Room. Patients: – Depression (CES-D); – Mastery (PMS); – Self-esteem (SES); – Social Support (MOS). Caregivers: – Depression (CES-D); – Mastery (PMS); – Self-esteem (SES); – Social Support (MOS).
Aguirrezabal et al., 2013 (Barcelona, Spain) Quasi-RCT	150 patients (mean age 66.7 years, 70% male) and 158 caregivers (mean age 60 years, 79.6% female and 68.9% partners). Multidisciplinary team (nurse, occupational therapy and physiotherapy).	RHB programme at 149 persons (76 patients and 73 carers) consisted in: – Educational intervention; – Carer training class; – Written clinical patient's guide; – Video-training.	(a) Outcomes at six months post stroke. Patients: – Satisfaction with inpatient care (HospSat); – Satisfaction with services once (HomeSat). Caregivers: – Satisfaction referred to information received, training in patient management and the ease of contact with the RHB team after hospital discharge.
Eames et al., 2013 (Brisbane, Australia) RCT	138 persons with 68 patients and 70 caregivers (the sample described without distinction between patients and caregivers). Multidisciplinary team.	Education and support package (40 patients and 31 caregivers): – Written information booklet; – Verbal reinforcement of information up to three times pre-discharge; – Telephone contacts up to three times post-discharge at intervals of	(a) Outcomes prior to acute stroke unit discharge and via telephone three months after discharge. Patients: – Stroke knowledge (KSQ); – Self-efficacy (Self-efficacy to Perform (continued)

Table 3. Continued

Authors, year (Location) Type of study	Participants Intervention provider	Interventions	Outcome measure (a) Short-term follow-up (b) Long-term follow-up
Forster et al., 2013 (Yorkshire, North West, South West, London, UK) Cluster RCT	928 dyads with 928 patients (mean age 71.0 years, 56% men) and 928 caregivers (mean age 61.0 years, 69% women). Multidisciplinary team.	Interventions approximately one month over a three-month period; – Telephone number that participants could call with questions. A structure training programme for caregivers of inpatients after stroke (TRACS); 450 patient-caregiver dyads; – Caregiver training programme; – Caregiver’s assessment of competencies in knowledge or skills; – Slides and records.	Outcome measure (a) Short-term follow-up (b) Long-term follow-up Self-Management Behaviour); – Anxiety and depression (HADS). – QOL (SAQOL-39g). Caregivers: – Stroke knowledge (KSQ); – Self-efficacy (Self-efficacy to Perform Self-Management Behaviour); – Anxiety and depression (HADS); – Caregiver’s burden (CSI). Outcomes at six and 12 months after discharge: Patients: – Activities of Daily Living (NEADL); – Anxiety and Depression (HADS); – QOL (SIS); – Physical Functioning (BI). Caregivers: – Caregiver’s Burden (CBS); – Activities of daily living (FAL); – Anxiety and depression (HADS); – QOL (QALYs).
Bishop et al., 2014 (Providence, Rhode Island, USA) Quasi-RCT	49 dyads with 49 patients (mean age 70 years; 65.3% female) and 49 caregivers (mean age 57 years; 65.3% female and 77.6% spouses). Multidisciplinary team.	Telephone tracking (FITT) model at 23 dyads consisted in: Telephone contacts (education and follow-up support) for six weeks, biweekly for the next two months, and then monthly for two months, for a total of 13 calls to each individual (26 calls per dyad). Standard medical follow-up (26 dyads).	(a) Outcomes at three months post stroke: – Health care utilization (doctor visits, days rehospitalized, therapy hours); – Family functioning (FAD, PCS1, PCS2); – General functioning (GDS, FIM, FAI). (b) Outcomes at six months post stroke: – Health care utilization (doctor visits, days rehospitalized, therapy hours); – Family functioning (FAD, PCS1, PCS2); – General functioning (GDS, FIM, FAI).

(continued)

Table 3. Continued

Authors, year (Location) Type of study	Participants Intervention provider	Interventions	Outcome measure (a) Short-term follow-up (b) Long-term follow-up
Nayeri et al., 2014 (Tehran, Iran) RCT	60 dyads with 60 stroke patients (mean age 69 years, 51.7% women) and 60 caregivers (mean age 38 years, 61.7% women). Multidisciplinary team.	Family-centred care programme (30 stroke patient–caregiver dyads): – Needs assessment; – Educating families based on the patients' needs; – Phone follow-up through conversations; – Coordination between families and other health-care professionals.	Usual care (30 stroke patient–caregiver dyads): routine care provided by the hospitals setting for two months. Patients: – Adherence to the rehabilitation; – Adherence to the therapeutic regimen; – Adherence to the dietary regimen; – Adherence to the medication regimen.
Fens et al., 2014 (Maastricht and Eindhoven, The Netherlands) Quasi-RCT	191 persons with 117 patients (mean age 71.9 years, 54% male) and 74 caregivers (mean age 64.3 years, 74% female and 76% spouse). Multidisciplinary team with a nurse stroke care coordinator.	Model for long-term care after stroke (62 patients and 41 caregivers): A stroke care coordinator (nurses from home care services specialized in stroke) visited the stroke patients at home 1–2 weeks and three, six, 12 and 18 months after discharge. During each home visit administered a structured assessment tool to assess a broad spectrum of stroke-related problems. Based on these assessments, provided suitable follow-up care during the home visits.	(a) Outcomes at 2–4 weeks after discharge; (b) Outcomes at six, 12 and 18 months after discharge. Patients: – QOL (SASIP-30); – ADL (BI); – Social activities (FAI); – Depression and anxiety (HADS). Caregivers: – QOL (LISAT-9); – Caregiver's burden (HADS and CSI).
Ostwald et al., 2014 (Texas, USA) RCT	159 dyads with 159 stroke patients (mean age 68 years, 75% men) and 159 caregivers (mean age 62 years, 75% women). Multidisciplinary team.	Home-based psychoeducational programme (80 patients and 80 caregivers): – Personalized mail with information on signs and symptoms of stroke, stroke prevention, stress reduction strategies, diet and exercise guidelines, links to supports groups and advocacy organizations; – Home visits for first six months	(a) Outcomes at three and (b) six, nine and 12 months post discharge: Patients: – Health status (SF-36); – Depression (GDS); – Stress (PSS); – Stroke impact (SIS); – Physical and cognitive capacity (FIM); – Mutuality (MS). Mailed information programme (79 patients and 79 caregivers): The participants received only the personalized mail with information on signs and symptoms of stroke, stroke prevention, stress reduction strategies, diet and exercise guidelines, links to support

(continued)

Table 3. Continued

Authors, year (Location) Type of study	Participants Intervention provider	Interventions	groups and advocacy organizations.	Outcome measure (a) Short-term follow-up (b) Long-term follow-up
Forster et al., 2015 (Bradford, UK) Cluster RCT	800 patients (mean age 71 years, 54% male) and 208 caregivers (not described). Multidisciplinary team.	(nurses, occupational and physical physiotherapist); – Information about 39 pre-determine protocols; – Provide education; – Support; – Skill training; – Counselling.	Usual care (401 patients and 108 caregivers): the control group received the service in accordance with the existing local policies and practice.	Caregivers: – Health status (SF-36); – Depression (GDS); – Stress (PSS); – Burden (ZBI); – Mutuality (MS); – Preparedness (CPS-4); – Social Support (MOS); – Coping (F-COPES). (b) Outcomes at six and 12 months post stroke: Patients: – QOL (GHQ-12 and EQoL-5 dimensions); – Activities daily of living (FAI); – Stroke related needs (LUNSO); – Economic needs (CSRI).
Wang et al., 2015 (Taiwan, China) RCT	51 dyads with 51 stroke patients (mean age 63 years, 58.7% men) and 51 caregivers (mean age 63 years, 71% spouse). Physical therapist.	Caregiver-mediated home based intervention (CHI; 25 dyads): – Improve patients' body functions and structural components (weeks 1–4); – Improve patients' ability using task-specific restorative and compensatory training (weeks 5–8); – Patients' reintegration to the society (weeks 9–12); – Physical therapist once weekly for 90 min to teach patients personalized rehabilitation skills and caregiver skills.	Usual care (26 dyads): Physical therapist without intervention.	Caregivers: – QOL (GHQ-12); – Caregiver's burden (CBS). (a) Outcomes at baseline and endpoint. Patients: – Stroke Impact (SIS); – Physical Functioning (BI); – Balance capacity (BBS); – Mobility (10-m walk test, 6-min walk test). Caregivers: – Burden (CBS).

(continued)

Table 3. Continued

Authors, year (Location) Type of study	Participants Intervention provider	Interventions	Outcome measure (a) Short-term follow-up (b) Long-term follow-up
Duncan et al., 2017 (North Carolina, USA) Cluster RCT	41 hospitals in North Carolina (6000 patients, 3000 for arm) The sample was described without distinction between patients and caregivers. Multidisciplinary team.	COMPASS Care Plan™ (20 hospitals; 3000 patients): – Two-day telephone follow-up after discharge; – Clinic visit two weeks after discharge (with neurological evaluation, assessments of social and functional determinants of health, and an individualized COMPASS Care Plan™); – Telephone follow-up at 30 and 60 days to evaluate adherence to the COMPASS Care Plan™.	(a) 90 days post-stroke discharge. Patients: – Functional status and quality of life (SIS-16); – Independence (mRS); – Health status (PHQ-2); – Cognitive status (MoCA); – Adherence therapy (MMAS-4); – Fatigue (PROMIS F-SF). Caregivers: – Caregiver's burden (mCSI).

ADL: Activities of Daily Living; BBS: Berg Balance Scale; BI: Barthel Index; CBS: Caregiver Burden Scale; CCHTPSS: Care Coordinator and Home Telehealth Patient Satisfaction Survey; CES-D: Center for Epidemiologic Studies Depression Scale; CESD-10: Center for Epidemiologic Studies Depression Scale-10; CPS-4: Caregiver Preparedness Scale 4-item; CSI: Caregivers Strain Index; CSRI: Client Service Receipt Inventory; EQoL-5 dimensions: European Quality of Life -5 dimensions; FAD: Family Assessment Device; FAI: Frenchay Activities Index; FCCI: Family Caregiving Consequence Inventory; F-COPEs: Family-Crisis Oriented Personal Evaluation Scale; FIM: Functional Independence Measure; FITT: Family Intervention: Telephone Tracking; FM: Fugl Meyer Assessment; GDS: Geriatric Depression Scale; GHQ: General Health Questionnaire; GHQ-12: General Health Questionnaire-12; HADS: Hospital Anxiety Depression Scale; HIS (Health Impact Scale); IADL (Instrumental Activities of Daily Living); KSQ: Knowledge of Stroke Questionnaire; LiSAT-9: Life Satisfaction questionnaire-9; LUNSQ: Longer-term Unmet Needs after Stroke Questionnaire; MAS: Motor Assessment Scale; mCSI: Modified Caregiver Strain Index; MMAS-4: Morisky Green Levine Scale; MMSE: Mini Mental State Examination; MoCA: Montreal Cognitive Assessment; MOS: Medical Outcome Study Support Scale; mRS: Modified Rankin Scale; MS: Mutuality Scale; NEADL: Nottingham Extended Activities of Daily Living Index; PCS1: Perceived Criticism Scale 1; PCS2: Perceived Criticism Scale 2; PHQ-2: Patient Health Questionnaire; PMS: Pearlin Mastery Scale; PROMIS F-SF: PROMIS Fatigue Instrument; PSS: Perceived Stress Scale; QALYs: Quality Adjusted Life Years scale; QOL: quality of life; RCT: randomized controlled trial; RHB: rehabilitation; RNLI: The Reintegration to Normal Living Index; RS: Rankin Scale; SAQOL-39g: Stroke and Aphasia Quality of Life Scale-39 Generic; SASIP-30: Stroke Adapted Sickness Impact Profile-30; SES: Self-Esteem Scale; SF-36: Short Form Health Survey-36; SIS: Stroke Impact Scale; SIS-16: Stroke Impact Scale 16 item; ZBI: Zarit Burden Inventory

discussions and face-to-face consultations implemented in a hospital setting as well as evaluations of outcomes post discharge; (b) three studies (one quasi-RCT³³ and two RCTs^{40,45}) used an educational intervention and telephone support after discharge; (c) four studies (one quasi-RCT³⁴ and three RCTs^{37,43,46}) offered an educational intervention and support with home visits following discharge; and (d) two RCTs^{36,39} used an educational intervention and telephone support with home visits after discharge. Details of the studies and the possible interventions are provided in Table 3. Nine studies were developed specifically to treat the stroke survivor-caregiver dyads^{31,33,36-38,42,44-46} while seven studies^{30,34,35,39-41,43} were primarily developed for stroke survivors, including caregivers in the sample, where possible.

Results of meta-analysis

Effects for the stroke survivors. The effect of the educational interventions on stroke survivors' outcomes, such as depression, physical functioning, QOL and SIS memory dimensions, are reported in Figure 2, while ADL and SIS composite physical, emotional and communication dimensions are only described.

Depression. Data on the effect of educational intervention on stroke survivors' depression (Figure 2) were available in five studies,^{34,38,41,46,47} where low heterogeneity was observed ($I^2=40\%$, $p=0.15$). Stroke survivors who received educational interventions were found to have lower levels of depression after pooling included trials, although no significant differences were observed (SMD= -0.16, 95% CI: -0.33 to 0.02, $p=0.08$). When these studies were singularly analysed, no significant differences were observed between depression in both groups, with the exception of one study.^{38,46} In the first study,³⁸ authors implemented a web-based intervention, which provided professional guide, educational videos, online chat sessions and email and message board. In another study,⁴⁶ although authors observed a decrease on both experimental and control groups' depression, the depression level of the experimental group was significantly lower than the control group's. In this study the authors sent a personalized mail with information about stroke signs and symptoms, stress reduction strategies, diet and exercise guidelines and home-based dyads in the home-based intervention.

Physical functioning. Data on the effects of educational interventions on stroke survivors' physical functioning (Figure 2) were available in five studies.^{31,37,41,42,44} Stroke survivors who received an educational intervention were found to have better

physical functioning than those who did not receive these treatments (SMD=0.17, 95% CI: -0.00 to 0.35, $p=0.05$). There was low evidence of heterogeneity across studies ($I^2= 39\%$, $p=0.16$). The effect size was largest in Wang and colleagues' study,³¹ where a caregiver-mediated home-based intervention was applied, while the effect size was smallest in the study by Forster et al.,⁴⁷ who offered a structured training programme for caregivers. A singular analysis of these studies revealed that only two^{31,44} showed a significant effect of the intervention on stroke survivors' physical functioning, while the three other studies^{37,41,42} did not report differences between the experimental and control groups. Both these two studies applied a family-mediated exercise intervention. In Wang and colleagues' study,³¹ the authors implemented an intervention based on a caregiver-mediated home programme where a physiotherapist visited each stroke survivor in the intervention group once weekly for 90 min. During these meetings, the physiotherapist explained and demonstrated tasks to the stroke survivors and caregivers and requested that they practise the tasks to ensure correctness. Instead, Galvin et al.⁴⁴ developed an intervention where, in addition to routine physiotherapy, each programme comprised training the informal caregiver with the skills necessary to carry out the additional exercises.

Generic quality of life. Data on the effects of educational interventions on stroke survivors' generic QOL (Figure 2) were available in five studies.^{34,37,40,43,46} Significant differences were observed between stroke survivors who received the treatment and those who were in the control group (SMD=0.17, 95% CI: 0.03 to 0.30, $p=0.01$). Stroke survivors who were in the experimental groups were found to have significantly better QOL. There was no evidence of heterogeneity across studies ($I^2= 11\%$, $p=0.34$). Although these studies observed higher levels of stroke survivors' QOL in the experimental groups than in the control groups, only one study⁴⁶ showed significant differences between these two groups. In this study the authors sent a personalized mail with information about stroke signs and symptoms, stress reduction strategies, diet, exercise guidelines and home-based intervention.

Stroke-specific quality of life dimensions. Four studies^{30,31,46,47} have analysed the effect of the educational intervention on stroke survivors' stroke-specific QOL dimensions (such as communication, composite physical, memory and emotional dimensions). The pooled analysis showed a significant effect (SMD=4.07, 95% CI: 1.14 to 7.01, $p=0.007$) on the SIS memory dimension (Figure 2). Stroke survivors who were included in an interventional group were found to have better

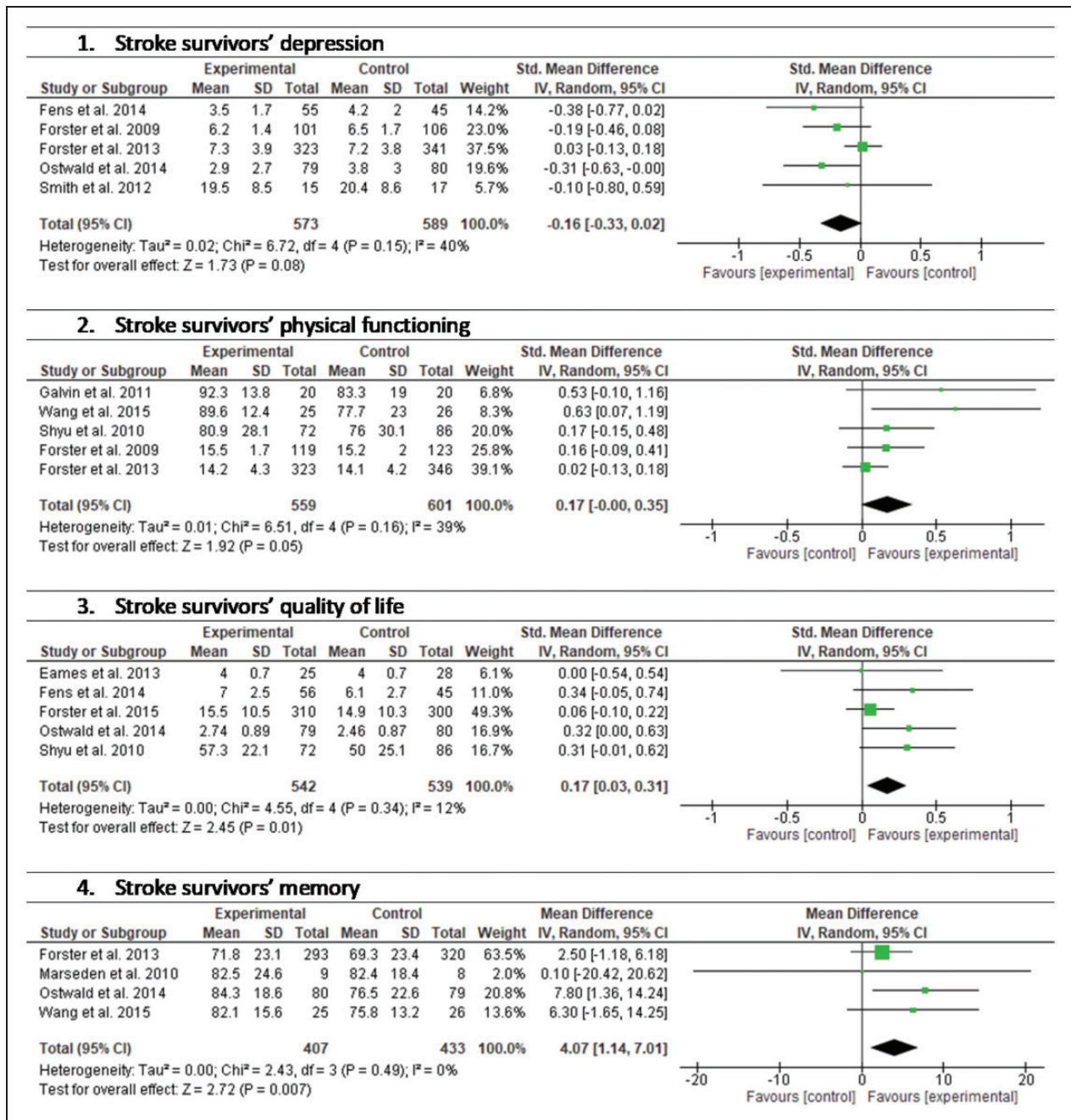


Figure 2. Effects of the educational intervention on stroke survivors' outcomes – forest plots. CI: confidence interval; IV: inverse variance; Std.: standardized

memories than those who did not receive an interventional treatment. There was no evidence of heterogeneity across studies ($I^2 = 0\%$, $p = 0.49$). The effect size was largest in the study by Ostwald et al.,⁴⁶ who applied a mail-based educational programme including personalized mail with information about stroke, stress reduction strategies, diet and exercise guidelines.

No significant differences were observed in the SIS composite physical (SMD = 1.92, 95% CI: -4.99 to

8.84, $p = 0.59$), emotional (SMD = 0.20, 95% CI: -3.99 to 4.39, $p = 0.92$) and communication dimensions (SMD = 0.83, 95% CI: -1.63 to 3.29, $p = 0.51$).

ADL. Data on the effects of educational interventions on stroke survivors' ability to perform ADL were available in seven studies.^{31,33,34,42-44,46} The pooled analysis did not observe a significant effect on stroke survivors' ADL (SMD = -0.02, 95% CI: -0.16 to

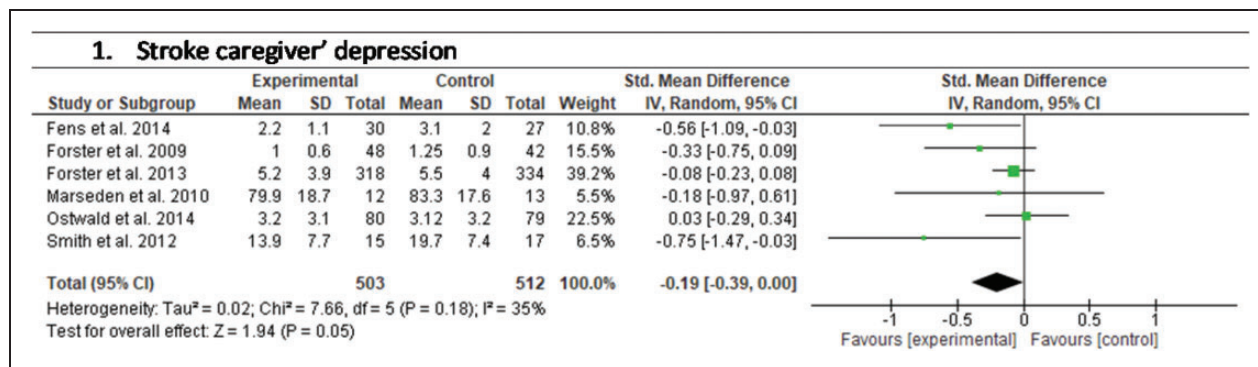


Figure 3. Effects of the educational intervention on stroke caregivers' outcomes – forest plots.
CI: confidence interval; IV: inverse variance; Std.: standardized

0.12, $p=0.76$). The level of stroke survivors' ADL in the intervention group was similar to that of the control group. However, in only one study⁴⁴ the authors observed a significant effect on ADL in the experimental group. In this study, the authors developed an intervention where, in addition to routine physiotherapy, each programme comprised training the informal caregiver with the skills necessary to carry out the additional exercises. There was low evidence of heterogeneity across studies ($I^2 = 35%$, $p=0.16$).

Effect for the caregivers. We also determined the effect of the educational interventions on stroke caregivers' outcomes, such as depression (Figure 3), QOL and caregiver burden.

Depression. Data on the effect of an educational intervention on caregivers' depression (Figure 3) were available in six studies.^{30,34,38,41,46,47} Substantially, caregivers who received an educational intervention were found to have significantly lower depression levels than those in the control group, although no significant differences were observed between these two groups (SMD = -0.19 , 95% CI: -0.40 to 0.00 , $p=0.05$). There was low evidence of heterogeneity across studies ($I^2 = 37%$, $p=0.18$). A singular analysis revealed that in each study, caregivers in the experimental groups had lower depression scores after the intervention than those in the control group. However, in two studies,^{34,38} the authors observed a significant difference between these two groups. In the first study,³⁴ the authors developed an intervention where all stroke patients were referred to a stroke care coordinator after being discharged home from hospital or inpatient rehabilitation. During each home visit they were administered a structured assessment tool to assess a broad spectrum of stroke-related problems. Based on these assessments, they were provided with suitable follow-up care during the home visits. In the

second study,³⁸ the authors implemented a web-based intervention, which provided professional guide, educational videos, online chat sessions and email and message board.

Generic quality of life. Seven studies^{30,34,37,41–43,46} have investigated the effect of interventions on stroke caregivers' QOL in the medium term following a stroke. A pooled analysis of these seven studies demonstrated no significant effect on caregivers' QOL (SMD = -0.05 , 95% CI: -0.36 to -0.25 , $p=0.73$). However, high heterogeneity was observed in this forest plot ($I^2=81%$, $p=0.0001$). Analysing singly these studies, we observed that educational interventions did not improve the caregivers' QOL. Indeed, only in one study⁴⁶ did the authors observe a higher QOL in the experimental group than in the control group.

Caregivers' burden. Data on the effects of educational interventions on the caregivers' burden were available in eight studies.^{31,34,40–44,46} There was low evidence of heterogeneity across studies ($I^2 = 49%$, $p=0.06$). As shown by the pooled analysis, no significant effect was observed on caregivers' burden (SMD = -0.09 , 95% CI: -0.26 to 0.09 , $p=0.34$). However, in two studies^{42,44} the authors found that stroke caregivers in the control groups had a lower burden than caregivers in the experimental groups. The effect size was largest in the study by Fens et al.,³⁴ who applied a model for long-term care after stroke where a stroke care coordinator provided specific information about stroke-related problems (i.e. ADL, cognition, communication, fatigue, caregiver strain, etc.).

Discussion

The current study described which educational interventions have been implemented in stroke survivor–

caregiver dyads to improve stroke survivors' and caregivers' outcomes (i.e. QOL, anxiety, depression, physical functioning, ADL and caregiver burden) and used a meta-analysis to determine which intervention was the most effective at improving stroke survivors' and caregivers' outcomes (i.e. QOL, anxiety, depression, physical functioning, ADL and caregiver burden). Although most authors^{16–18} have offered an overview of the educational interventions implemented with the dyads in a stroke population, Bakas et al., in both their study¹⁶ and their update,¹⁸ performed only a systematic review and not a meta-analysis. In the study conducted by Cheng et al.,¹⁷ while the authors did carry out a meta-analysis, they focused mainly on studying the effects of the educational intervention on the caregivers' outcomes, while in stroke survivors they analysed only the effects of the use of healthcare resources. Minshall et al.¹⁹ also conducted a systematic review and meta-analysis; however, they analysed only the psychosocial interventions, observing the effects on psychological outcomes, such as anxiety, depression, coping, self-efficacy and carer strain, while in our systematic review, we analysed the effects of the educational intervention on both physical and psychological outcome. Therefore, 16 final studies, which were subdivided into three quasi-RCTs and 13 RCTs that included 2997 stroke survivors and 2187 caregivers, were systematically reviewed and meta-analysed to evaluate the application of dyadic interventions for stroke survivors and caregivers. The purpose was to investigate how an educational intervention implemented in a stroke survivor–caregiver dyad population may significantly improve the stroke survivors' physical functionality, memory, QOL and caregivers' depression.

We assessed the methodological quality of 16 studies (13 RCTs and three quasi-RCTs) on educational interventions to improve stroke patient–caregiver dyads' outcomes after discharge published from 2009 to 2019. Analysing the methodological quality, only one RCT⁴⁶ and two quasi RCTs^{33,34} obtained a score equal to 100. Ten studies (nine RCTs and one quasi-RCT) obtained a score greater than 80,^{35,36,38–45} while two studies^{31,37} were equal with 76.9 and one study had a score of 61.5%.³⁰ The proportion of studies with high methodological quality (93%) is high. Only one study showed a medium quality.³⁰ The majority of the analysed studies adequately satisfied the quality items, such as evidence of allocation concealment at randomization, details of study sample withdrawals, and inclusion and exclusion criteria for the study sample.

The forest plots showed that stroke survivors who received an educational intervention were more likely to have better physical functioning (SMD=0.17, 95% CI: –0.00 to 0.35, $p=0.05$), better memory (SMD=4.07,

95% CI: 1.14 to 7.01, $p=0.007$) and better QOL (SMD=0.17, 95% CI: 0.03 to 0.30, $p=0.01$) than those who did not receive an intervention. With reference to the stroke survivors' physical functioning, although the data may be interesting, they are not new. In their systematic review, Bakas et al.¹⁶ observed that several studies found significant improvements in stroke survivors' physical functioning relative to a control group. In our study, educational interventions implemented in stroke survivor–caregiver dyads were also found to improve the stroke survivors' QOL. In contrast, Bakas et al. found that only a few studies showed a difference between groups, while most of them highlighted no differences. In our meta-analysis, all included studies^{34,37,43} reported a higher QOL in stroke survivors who had received an educational intervention, except for Eames and colleagues' study,⁴⁰ where no differences were observed.

Our meta-analysis did not find significant improvements in stroke survivors' depression. These findings are consistent with a previous systematic review⁴⁸ conducted only in stroke survivors. Bakas et al.¹⁶ also did not report significant differences between groups. However, although their findings may suggest the ineffectiveness of the educational intervention, they also might indicate that stroke survivors did not express enough depressive symptomatology at baseline to demonstrate significant improvements following the intervention. In our meta-analysis, one study³⁸ conducted with 38 dyads observed that a web-based intervention, composed of a professional guide, educational videos, online chat sessions and an email/message board, had a significant impact on stroke survivors' depression after only a short time (< 3 months). Indeed, stroke survivors included in the intervention group had lower depression scores than those who received typical care.

The forest plots showed that the educational intervention significantly improved the stroke caregivers' depression levels but not their QOL and burden. Stroke caregivers in the interventional groups were found to have lower depression levels than those in the control groups. In contrast, Cheng et al.¹⁷ did not report any significant improvement in caregiver depression after the treatment. And although Bakas et al.¹⁶ did not conduct a meta-analysis, they observed that several studies had reported significant improvements in caregiver depression, highlighting the importance of implementing an intervention for stroke caregivers. When stroke survivors are discharged from rehabilitation hospitals, caregivers often feel unprepared, and this lack of preparedness increases their burden, anxiety and depression levels. Caregivers often feel left alone⁴⁹ without healthcare providers' support, and implementing an intervention likely has a strong

impact on their feelings of loneliness and therefore improves their depression levels. In accordance with our systematic review, several authors^{17,50} have observed that short-term effects on caregivers' QOL were not significant. However, significant improvements in the caregivers' psychological and social domains of QOL were found in the intervention group with a face-to-face interaction at six months post intervention.⁵¹

The included studies observed significant improvements on stroke survivors' physical functioning,^{31,33,44} ADL,⁴⁴ depression³⁸ and QOL⁴⁶ and on caregivers' burden⁴⁴ and depression^{34,38} through educational interventions. However, the observations in the present meta-analysis were made within the limitations of the quality of available data. The review included many small studies, and these studies were also conducted in very different healthcare settings of stroke survivors. For example, stroke survivors may be expected to have varying degrees of comorbidity regardless of the presence of any interventions. Additional differences were the use of a variety of methodologies in the evaluation of both stroke survivors' and their caregivers' outcomes in the identified studies, thus limiting a meaningful inclusion of many studies in our quantitative syntheses without compromising heterogeneity.

Due to the differences between the applied interventions and due to the few significant effects, which were observed in both stroke survivors and their caregivers, it has not been easy to identify one study that showed greater efficiency in its treatment. In regard to stroke survivors' and caregivers' depression, we observed that studies which carried out constant communication with stroke survivors showed significant effects on depression. For example, Smith et al.³⁸ implemented a web-based intervention which provided professional guide, educational videos, online chat sessions and email and message, while Ostwald et al.⁴⁶ sent a personalized mail with information about stroke signs and symptoms, stress reduction strategies, diet and exercise guidelines. This highlights how important it is for stroke survivors and their families to have a constant connection with healthcare professionals. This connection probably makes them feel more secure and safer.⁵² Instead, in the stroke survivors' physical functioning and ADL a family-mediated exercise intervention plays an important role.^{31,44} These studies highlighted the importance to develop interventions where caregivers are trained and educated in assisting the stroke survivors' physical functioning. When caregivers are trained and prepared their stroke survivors show better physical functioning. Through a careful analysis of the studies, we observed that the most effective intervention was that developed by Ostwald et al.⁴⁶ Indeed, several significant effects were shown in the experimental group, such as lower

stroke survivors' depression, higher SIS dimensions and QOL and better ability during ADL in stroke survivors, while in caregivers, better QOL and lower depression and burden. In this study authors sent a personalized mail with information about stroke signs and symptoms, stress reduction strategies, diet and exercise guidelines and home-based dyads in the home-based intervention. Dyads in the experimental group also received home visits for the first six months post-discharge by advanced practice nurses and occupational and physical therapists, who provided information following 39 pre-determined protocols, developed to provide education, support, skill training, counselling and linkages to social and community resources.

This study supports the importance of the dyad in the care process. Indeed, we observed that an educational intervention implemented to stroke survivor-caregiver dyads could improve several outcomes in both stroke survivors and caregivers. For example, in stroke survivors, studies showed an improvement in stroke survivors' physical functioning,^{31,33,44} ADL,⁴⁴ depression³⁸ and QOL,⁴⁶ and in caregivers' burden⁴⁴ and depression.^{34,38} These findings highlight how stroke survivors and informal caregivers experience and navigate illness together. Thus, our study gives strength to a dyadic conceptual framework of stroke¹² that emphasizes a holistic approach to stroke survivors and caregivers, given the interdependent nature of their experiences. In accordance with Lyons and Lee, who developed the theory of dyadic illness management,¹¹ this systematic review and meta-analysis have highlighted the importance to implement interventions with a dyadic approach in the stroke population. Indeed, both elements of the dyad (patient and caregiver) have benefited from an educational intervention, not focused on the individual but on the dyad.

Our study had several implications. Our meta-analysis has provided a general overview of the possible interventions that may be implemented on stroke survivor-caregiver dyads. We used a rigorous protocol with a high sensitivity and specificity to detect included studies. This meta-analysis provides evidence for researchers and healthcare providers who plan to design and implement stroke survivor-caregiver dyadic interventions to enhance the coordination of care and to better meet caregivers' and survivors' needs after stroke. However, prior to implementation in clinical practice, it will be necessary to conduct trials with larger samples and to observe the real efficacy of these educational interventions on stroke survivor-caregiver dyads.

There are several limitations in the current meta-analysis. First, although we used thorough search

strategies to minimize inclusion and publication biases, it is still possible that some studies were missed. The second limitation was that the current study applied the total score of the analysed outcomes in the meta-analysis because the instruments used to evaluate the outcomes varied for each study. Future studies will be required to fully investigate the effect of educational interventions on specific aspects of the variable construct. In addition, although the overall sample size was adequate (2847 stroke survivors and 1770 caregivers), several trials included in our meta-analysis enrolled only a small sample. As such, future studies should include larger samples. Another limitation was the linguistic limits placed on articles included in the study. However, after removing the linguistic criteria, we did not observe major differences with our review.

Conclusions

The results of this study provide support for the use of an educational intervention in improving outcomes in both stroke survivors (i.e. physical functioning, memory and QOL) and caregivers (depression). For example, we observed that educational interventions which carried out constant communication with stroke survivors and their family showed significant improvement on depression, while educational intervention based on family-mediated exercises showed significant improvement on stroke survivors' physical functioning. However, although many authors have used a dyadic approach in their studies, some interventions were not supported by specific dyadic theories.¹¹ Indeed, as suggested by Lyons and Lee,¹¹ dyadic interventions may be more efficacious when they are not just dyad based (i.e., both members are included) but instead when they are dyad focused (i.e. the dyad is the target). It is interesting to observe that educational intervention had no significant effect on stroke survivors' depression and caregivers' burden and QOL. Future trials should aim to improve these variables. Indeed, as described in the literature,^{7,14} stroke survivors' depression could have a negative impact on both stroke survivors' and caregivers' QOL. Furthermore, also caregiver burden could impact negatively on the stroke survivor-caregiver dyad's QOL. Having stroke survivors and caregivers with lower QOL would mean having stroke survivors and caregivers more likely to have a negative prognosis. Future research is needed to determine whether improvements in stroke survivors' and caregivers' outcomes can be sustained over a longer

period by providing further support after the intervention ends.

Implications for practice

- Educational interventions improve stroke survivors' physical functioning, quality of life and memory but not stroke survivors' depression and ability during activity of daily living.
- Effect of the educational interventions on stroke caregivers' outcomes, significant effects were observed on caregivers' depression between experimental and control groups but not on caregivers' quality of life and burden.

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Declaration of conflicting interests

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Supplemental material

Supplemental material for this article is available online.

References

1. Arntzen C, Borg T and Hamran T. Long-term recovery trajectory after stroke: An ongoing negotiation between body, participation and self. *Disabil Rehabil* 2015; 37: 1626–1634.
2. Pucciarelli G, Ausili D, Reboria P, et al. Formal and informal care after stroke: A longitudinal analysis of survivors' post rehabilitation hospital discharge. *J Adv Nurs* 2019; 75: 2495–2505.
3. Pucciarelli G, Ausili D, Antonella Galbussera A, et al. Quality of life, anxiety, depression and burden among stroke caregivers: A longitudinal, observational multi-centre study. *J Adv Nurs* 2018; 74: 1875–1887.
4. Shyu YI, Maa SH, Chen ST, et al. Quality of life among older stroke patients in Taiwan during the first year after discharge. *J Clin Nurs* 2009; 18: 2320–2328.
5. Clarke PJ, Lawrence JM and Black SE. Changes in quality of life over the first year after stroke: Findings from the Sunnybrook Stroke Study. *J Stroke Cerebrovasc Dis* 2000; 9: 121–127.

6. Jonsson AC, Lindgren I, Hallstrom B, et al. Determinants of quality of life in stroke survivors and their informal caregivers. *Stroke* 2005; 36: 803–808.
7. Pucciarelli G, Vellone E, Savini S, et al. Roles of changing physical function and caregiver burden on quality of life in stroke: A longitudinal dyadic analysis. *Stroke* 2017; 48: 733–739.
8. Wan-Fei K, Hassan STS, Sann LM, et al. Depression, anxiety and quality of life in stroke survivors and their family caregivers: A pilot study using an actor/partner interdependence model. *Electron Physician* 2017; 9: 4924–4933.
9. Bhattacharjee M, Vairale J, Gawali K, et al. Factors affecting burden on caregivers of stroke survivors: Population-based study in Mumbai (India). *Ann Indian Acad Neurol* 2012; 15: 113–119.
10. Young ME, Lutz BJ, Creasy KR, et al. A comprehensive assessment of family caregivers of stroke survivors during inpatient rehabilitation. *Disabil Rehabil* 2014; 36: 1892–1902.
11. Lyons KS and Lee CS. The theory of dyadic illness management. *J Fam Nurs* 2018; 24: 8–28.
12. Savini S, Buck HG, Dickson VV, et al. Quality of life in stroke survivor–caregiver dyads: A new conceptual framework and longitudinal study protocol. *J Adv Nurs* 2015; 71: 676–687.
13. Cramm JM, Strating MM and Nieboer AP. Satisfaction with care as a quality-of-life predictor for stroke patients and their caregivers. *Qual Life Res* 2012; 21: 1719–1725.
14. Pucciarelli G, Lee CS, Lyons KS, et al. Quality of life trajectories among stroke survivors and the related changes in caregiver outcomes: A growth mixture study. *Arch Phys Med Rehabil* 2019; 100: 433–440 e1.
15. Malhotra R, Chei CL, Menon E, et al. Short-term trajectories of depressive symptoms in stroke survivors and their family caregivers. *J Stroke Cerebrovasc Dis* 2016; 25: 172–181.
16. Bakas T, Clark PC, Kelly-Hayes M, et al. Evidence for stroke family caregiver and dyad interventions: A statement for healthcare professionals from the American Heart Association and American Stroke Association. *Stroke* 2014; 45: 2836–2852.
17. Cheng HY, Chair SY, Chau JP. The effectiveness of psychosocial interventions for stroke family caregivers and stroke survivors: A systematic review and meta-analysis. *Patient Educ Couns* 2014; 95: 30–44.
18. Bakas T, McCarthy M and Miller ET. Update on the state of the evidence for stroke family caregiver and dyad interventions. *Stroke* 2017; 48: e122–e125.
19. Minshall C, Pascoe MC, Thompson DR, et al. Psychosocial interventions for stroke survivors, carers and survivor–carer dyads: A systematic review and meta-analysis. *Topics Stroke Rehabil* 2019; 26: 554–564.
20. Bramer WM, Milic J and Mast F. Reviewing retrieved references for inclusion in systematic reviews using EndNote. *J Med Libr Assoc* 2017; 105: 84–87.
21. Sim J and Wright CC. The kappa statistic in reliability studies: Use, interpretation, and sample size requirements. *Phys Ther* 2005; 85: 257–268.
22. Haidich AB. Meta-analysis in medical research. *Hippokratia* 2010; 14: 29–37.
23. Borenstein M. *Introduction to meta-analysis*. Chichester: John Wiley & Sons, 2009.
24. Tufanaru C, Munn Z, Aromataris E, et al. Systematic reviews of effectiveness. In: E Aromataris and Z Munn (eds) *Joanna Briggs Institute reviewer's manual*. Adelaide, South Australia: The Joanna Briggs Institute, 2017, Chapter 3, pp. 111–117.
25. Egger M, Schneider M and Davey Smith G. Spurious precision? Meta-analysis of observational studies. *BMJ* 1998; 316: 140–144.
26. Hedges LV. Distribution theory for Glass's estimator of effect size and related estimators. *J Educ Stat* 1981; 6: 107–128.
27. Petitti DB. Approaches to heterogeneity in meta-analysis. *Stat Med* 2001; 20: 3625–3633.
28. Pigott TD. *Advances in meta-analysis*. New York: Springer, 2012.
29. Higgins JPT and Cochrane Collaboration. *Cochrane handbook for systematic reviews of interventions*. Second ed. Chichester, UK, 2019.
30. Marsden D, Quinn R, Pond N, et al. A multidisciplinary group programme in rural settings for community-dwelling chronic stroke survivors and their carers: A pilot randomized controlled trial. *Clin Rehabil* 2010; 24: 328–341.
31. Wang TC, Tsai AC, Wang JY, et al. Caregiver-mediated intervention can improve physical functional recovery of patients with chronic stroke: A randomized controlled trial. *Neurorehabil Neural Repair* 2015; 29: 3–12.
32. Polit DF, Beck CT. *Essentials of nursing research: Appraising evidence for nursing practice*. 8th ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins, 2014.
33. Bishop D, Miller I, Weiner D, et al. Family Intervention: Telephone Tracking (FITT): A pilot stroke outcome study. *Topics Stroke Rehabil* 2014; 21(Suppl. 1): S63–S74.
34. Fens M, van Heugten CM, Beusmans G, et al. Effect of a stroke-specific follow-up care model on the quality of life of stroke patients and caregivers: A controlled trial. *J Rehabil Med* 2014; 46: 7–15.
35. Aguirrezabal A, Duarte E, Rueda N, et al. Effects of information and training provision in satisfaction of patients and carers in stroke rehabilitation. *Neurorehabilitation* 2013; 33: 639–647.
36. Perrin PB, Johnston A, Vogel B, et al. A culturally sensitive transition assistance program for stroke caregivers: Examining caregiver mental health and stroke rehabilitation. *J Rehabil Res Dev* 2010; 47: 605–617.
37. Shyu YI, Kuo LM, Chen MC, et al. A clinical trial of an individualised intervention programme for family caregivers of older stroke victims in Taiwan. *J Clin Nurs* 2010; 19: 1675–1685.

38. Smith GC, Egbert N, Dellman-Jenkins M, et al. Reducing depression in stroke survivors and their informal caregivers: A randomized clinical trial of a Web-based intervention. *Rehabil Psychol* 2012; 57: 196–206.
39. Duncan PW, Bushnell CD, Rosamond WD, et al. The Comprehensive Post-Acute Stroke Services (COMPASS) study: Design and methods for a cluster-randomized pragmatic trial. *BMC Neurol* 2017; 17: 133.
40. Eames S, Hoffmann T, Worrall L, et al. Randomised controlled trial of an education and support package for stroke patients and their carers. *BMJ Open* 2013; 3.
41. Forster A, Young J, Green J, et al. Structured re-assessment system at 6 months after a disabling stroke: A randomised controlled trial with resource use and cost study. *Age Ageing* 2009; 38: 576–583.
42. Forster A, Dickerson J, Young J, et al. A structured training programme for caregivers of inpatients after stroke (TRACS): A cluster randomised controlled trial and cost-effectiveness analysis. *Lancet* 2013; 382: 2069–2076.
43. Forster A, Young J, Chapman K, et al. Cluster randomized controlled trial: Clinical and cost-effectiveness of a system of longer-term stroke care. *Stroke* 2015; 46: 2212–2219.
44. Galvin R, Cusack T, O’Grady E, et al. Family-mediated exercise intervention (FAME): Evaluation of a novel form of exercise delivery after stroke. *Stroke* 2011; 42: 681–686.
45. Nayeri ND, Mohammadi S, Razi SP, et al. Investigating the effects of a family-centered care program on stroke patients’ adherence to their therapeutic regimens. *Contemp Nurse* 2014; 47: 88–96.
46. Ostwald SK, Godwin KM, Cron SG, et al. Home-based psychoeducational and mailed information programs for stroke-caregiving dyads post-discharge: A randomized trial. *Disabil Rehabil* 2014; 36: 55–62.
47. Forster A, Dickerson J, Young J, et al. A cluster randomised controlled trial and economic evaluation of a structured training programme for caregivers of inpatients after stroke: The TRACS trial. *Health Technol Assess* 2013; 17: 1–216.
48. De Man-van Ginkel JM, Gooskens F, Schuurmans MJ, et al.; Rehabilitation Guideline Stroke Working Group. A systematic review of therapeutic interventions for post-stroke depression and the role of nurses. *J Clin Nurs* 2010; 19: 3274–3290.
49. Simeone S, Coehn MZ, Savini S, et al. [The lived experiences of stroke caregivers three months after discharge of patients from rehabilitation hospitals]. *Prof Inferm* 2016; 69: 103–112.
50. Cheng HY, Chair SY and Chau JP. The effectiveness of caregiver psychosocial interventions on the psychosocial wellbeing, physical health and quality of life of stroke family caregivers and their stroke survivors: A systematic review. *JBI Libr Syst Rev* 2012; 10: 679–797.
51. Wilz G and Barskova T. Evaluation of a cognitive behavioral group intervention program for spouses of stroke patients. *Behav Res Ther* 2007; 45: 2508–2517.
52. Connolly T and Mahoney E. Stroke survivors’ experiences transitioning from hospital to home. *J Clin Nurs* 2018; 27: 3979–3987.