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A nurse-led educational intervention to improve caregiver preparedness during stroke discharge: a pilot quasi-experimental study with historical comparison

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Background: Stroke caregivers often feel ill-prepared for the transition home, which could compromise quality of care and increase burden. This study aimed to evaluate the effectiveness of a structured educational intervention for caregivers of patients with stroke in improving their preparedness during the hospital-to-home transition.

Methods: A pilot quasi-experimental study with a historical control group was conducted, using full propensity score matching to minimize selection bias. The intervention group included 97 informal caregivers recruited between 2024 and 2025 from two Italian hospitals, while the historical control group comprised 216 caregivers enrolled between 2018 and 2019. The intervention consisted of a personalized nurse-led educational program initiated before discharge and continued after discharge. The control group received standard discharge information only. Caregiver preparedness was assessed using the Caregiver Preparedness Scale at baseline and three months post-discharge.

Results: After matching, the analytical sample included 97 intervention caregivers and 216 controls. Although baseline preparedness was lower in the intervention group, at three months they reported significantly higher preparedness than controls ($B = 9.54$, 95% CI: 8.40–10.44; $p < 0.001$). Sensitivity analyses confirmed the robustness of results.

Conclusions: A structured, individualized educational intervention significantly enhanced caregiver preparedness during the hospital-to-home transition after stroke.

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Introduction

Stroke represents the second leading cause of death worldwide and the third leading cause of death in industrialized countries, after heart disease and cancer.¹ It is also a major contributor to disability in the adult population, imposing significant economic burdens.^{2,3} According to recent global estimates, approximately 12.2 million people experience a stroke each year worldwide. Stroke

causes approximately 6.5 million deaths annually, while millions of survivors live with long-term physical, cognitive, and psychosocial disabilities, making stroke one of the leading causes of disability worldwide.^{4,5}

Individuals who have survived a stroke often face considerable challenges due to the long-lasting disabilities that follow, significantly affecting their physical health and social dynamics, while also placing notable demands on their caregivers.^{6,7} The responsibilities of caregiving can greatly influence a caregiver's quality of life (QOL) and general well-being. Once stroke survivors are discharged from the hospital, a non-professional caregiver, typically a family member or close friend, assumes responsibility for their care at home and plays a pivotal role.^{8,9} Nevertheless, research has indicated that the role of a stroke caregiver often becomes bur-

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densome.^{10,11} Caregivers frequently feel overwhelmed, ill-prepared, and lack confidence in managing the care of stroke survivors,^{12,13} particularly during the critical transition to home care. Insufficient preparation for this transition exacerbates caregiver strain, which in turn lowers their quality of life.^{14–16} These challenges can lead to more care-related errors, redundancy in services, inappropriate or missing treatments for stroke survivors, and an elevated risk of hospital readmission.¹⁷ Numerous studies suggest that caregivers who are well-prepared can play a significant role in enhancing both the recovery and QOL of stroke survivors.^{14,18,19} Therefore, it is crucial for healthcare professionals to evaluate how well informal caregivers are prepared, particularly as they commence their caregiving responsibilities.

To determine the changes that occur in the short-term, it is fundamental to implement a tailored intervention that could improve caregiver preparedness for the transition home after a stroke.²⁰ Enhancing caregivers' readiness is critical, as their competence and confidence directly influence not only their own wellbeing but also the recovery trajectory of the stroke survivor. This perspective underscores the need to shift rehabilitation practices toward a family-centred approach, in which caregivers are empowered through structured education, guided practice, and ongoing support. The theoretical foundation of this intervention is Bandura's Social Cognitive Theory (SCT),²¹ which conceptualizes learning as a dynamic process in which individuals develop the confidence and ability to perform complex tasks through observation, guided practice, and reinforcement. Applying this framework to post-stroke care highlights the importance of involving caregivers early in the care process and providing them with structured, individualized education prior to discharge.

Although caregiver education has long been recognized as an essential component of nursing care, evidence regarding structured, individualized transitional educational programs specifically designed to improve caregiver preparedness after stroke remains limited.^{22,23} Therefore, the objective of this study was to evaluate the effect of a structured educational intervention for caregivers of stroke survivors on their preparedness for the transition from hospital to home. The study compared caregiver preparedness after participation in the tailored educational program with that of a historical cohort of caregivers who did not receive the intervention during the discharge and post-discharge period. The propensity score matching (PSM) method was applied to control for potential confounding biases between the two groups.

Methods

Study design

This study adopted a pilot quasi-experimental design, in which caregivers who received a structured educational intervention were compared to a historical control group of caregivers who received standard care during the transition from hospital to home. The use of a historical control group was motivated by ethical and practical considerations. Implementing a randomized controlled trial would have required withholding an educational intervention believed to be beneficial from caregivers during a critical period, which was considered neither feasible nor ethical. Furthermore, the availability of comprehensive data from a previous cohort provided a robust basis for comparison, as both groups were recruited from similar clinical settings using identical inclusion criteria and assessment instruments. To minimize potential confounding and selection bias inherent to non-randomized designs, we employed propensity score matching to ensure comparability between groups on key sociodemographic and clinical variables. This methodological approach is increasingly recognized as a rigorous alternative

when concurrent controls are not feasible and is particularly suitable for evaluating real-world effectiveness in clinical practice.^{24–26} The study was reported in accordance with the TREND checklist (Transparent Reporting of Evaluations with Nonrandomized Designs) to ensure methodological rigour and transparency in a pilot quasi-experimental designs.²⁷

Setting and participants

The study was carried out in two central hospitals, one in northern Italy and the other in central Italy. In the Italian health-care system, the hub-and-spoke organisational model structures service delivery into a network where level 2 facilities, known as hub centres, provide a full range of services with extensive specialist and diagnostic availability.²⁸ In contrast, level 1 facilities, referred to as spoke centres, offer limited or time-restricted services, referring patients requiring more intensive care to the hub. The northern Italy hospital includes a stroke unit with 12 semi-intensive care beds and 36 neurology beds, while the central Italy hospital has a stroke unit with 14 beds and 12 neurology beds.

Caregivers were recruited from these two hospitals and evaluated for suitability for the study based on the following inclusion and exclusion criteria. The inclusion criteria were: (1) being identified as the primary informal caregiver by stroke survivors; (2) the stroke survivor's return home; and (3) acceptance to participate in the study. Caregivers were enrolled only if their stroke survivors were included. Additionally, caregivers who were unable to provide continuous assistance were excluded from participation.

Participants in the intervention group were consecutively recruited between January 2024 and January 2025, whereas those in the historical control group were consecutively enrolled in 2018 and 2019, based on the same inclusion criteria.

Intervention group

The educational program was developed by the research team, including nurse researchers with expertise in stroke care, transitional care, and caregiver education. The intervention content was informed by the current evidence on transitional care and caregiver education after stroke and was guided by Bandura's Social Cognitive Theory (SCT).²¹ According to SCT, individuals develop the confidence and ability to perform specific behaviors through the interaction of personal factors, learned skills, and environmental influences. Accordingly, a central objective of the program was to strengthen caregiver self-efficacy, understood as the caregiver's belief in their own capacity to manage the complex demands of post-stroke care at home.^{21,29}

The educational intervention was delivered by an experienced registered nurse with more than five years of clinical experience in stroke care. Before study initiation, the nurse completed an 8-hour standardized training program to ensure consistent delivery of the intervention across participants. The nurse had been directly involved in the care of the stroke survivor during hospitalization, ensuring continuity of care throughout the transition from hospital to home.

The intervention followed a structured protocol consisting of a pre-discharge assessment, education on daily care management (mobility, feeding, communication, and rehabilitation), and post-discharge follow-up through webinars or face-to-face sessions (Fig. 1). The protocol predefined the sequence of intervention phases, the core educational topics addressed at each contact, the minimum frequency and duration of follow-up sessions, and the assessment domains to be reviewed at each encounter. Within this structured framework, the content and pacing of the intervention were individualized according to each caregiver's needs, learning

EDUCATIONAL INTERVENTION

Structured protocol with individualized tailoring

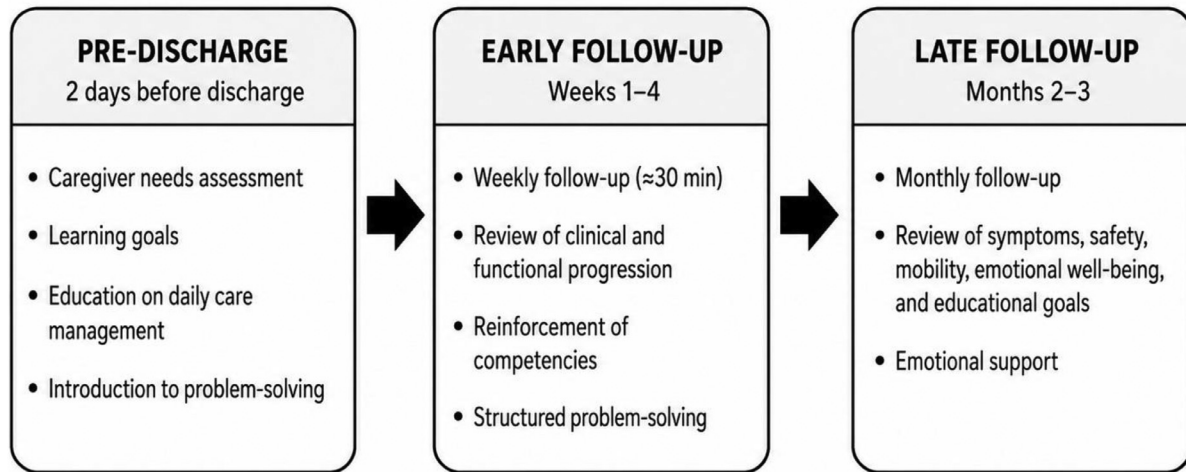


Fig. 1. Structured educational intervention protocol with individualized tailoring.

preferences, emotional readiness, and the stroke survivor's functional status. Individualization applied to the depth of each topic, the pacing of education, and the selection of additional content according to caregiver needs and the stroke survivor's clinical condition. This approach ensured consistency in the educational objectives and core intervention components across participants while preserving flexibility to address diverse caregiving situations and promote engagement and self-efficacy.

The intervention began two days before discharge. Caregivers participated in standardized face-to-face sessions that included a formal needs assessment, the definition of individualized learning goals, and foundational training on core daily care activities such as mobility, positioning, feeding, communication, and safety. Problem-solving strategies were also introduced, with content delivered in a consistent sequence across participants. During the first month after discharge, caregivers received scheduled clinical-educational telemonitoring through video calls and structured telephone contacts. Each encounter followed a structured sequence of educational topics addressing the stroke survivor's clinical and functional progression, adherence to the caregiver's self-management plan, early signs of emotional or organizational strain, and reinforcement of competencies. Problem-solving interventions were carried out during webinars or face-to-face sessions to address challenges related to patient care. Each session lasted approximately 30 min.

Follow-up continued until three months after discharge, with weekly contacts during the first month and monthly contacts thereafter according to caregiver needs. These sessions systematically reviewed symptoms, functional status, safety and mobility issues, emotional well-being, and progress toward educational goals. Additional contacts were provided as needed.

Control group

During the period of data collection for the historical control group, standard care for caregivers consisted of routine discharge planning procedures conducted by the hospital team. This included basic information regarding medication administration, scheduling follow-up appointments, and general advice on patient care at home. However, no structured or tailored educational sessions

were provided to the caregivers. There was no formal assessment of caregivers' needs, and caregivers did not receive ongoing support after discharge.

Instruments

We collected sociodemographic characteristics of caregivers and assessed caregiver preparedness using the caregiver preparedness scale. Data collection occurred at baseline (T0), two days before discharge, prior to the start of the intervention. Caregiver preparedness was re-assessed three months after discharge (T1) to evaluate changes over time. Data were collected using REDCap® (Research Electronic Data Capture), an online survey tool. REDCap® serves as a secure web-based application designed to create and manage online surveys and databases.³⁰ Caregivers' sociodemographic characteristics include age, sex, marital status, family tree, presence and number of children, educational level, and co-habitation with the patient.

The Caregiver Preparedness Scale³¹ is an 8-item instrument designed to assess caregivers' perceived readiness to manage a patient's physical and emotional needs. The scale measures preparedness in areas such as arranging services, coping with caregiving stress, enhancing the caregiving experience for both the caregiver and the patient, responding to and managing emergencies, seeking help and information from the healthcare system, and general readiness for the caregiving role. Each item is rated on a scale from 0 (not at all prepared) to 4 (very well prepared), with higher scores indicating a greater sense of preparedness. This instrument has been validated in stroke caregivers, demonstrating strong reliability (Cronbach's alpha = 0.94).³² In this study, the Caregiver Preparedness Scale demonstrated excellent internal consistency, with a Cronbach's alpha of 0.91, calculated in the total sample of caregivers.

Statistical analysis

The study sample size was not determined by formulating pre-specified hypotheses, and all consecutive patients meeting the inclusion criteria were enrolled. A post-hoc power evaluation was

carried out to estimate the effect size, which may inform the design of future studies.

Continuous variables were expressed as means $\pm$ standard deviation (SD), while categorical variables as frequencies (%). The background characteristics of the caregivers were compared across the control and intervention group by means of chi-square tests or *t*-tests, depending on the nature of the variable. We used a propensity score approach to control for background characteristics of caregivers in the treatment and control group. According to the literature, predictor variables of age, gender, marital status, occupation, education, family tree, presence of children, and co-habitation with the patient were used to calculate propensity scores. Full propensity score matching was performed because this method allows each treated participant to be matched with one or more control participants who share similar covariate patterns, thereby minimizing confounding due to baseline differences. Unlike traditional 1:1 or nearest-neighbor matching, full matching preserves the entire sample by assigning appropriate weights to all units, maximizing statistical power and improving covariate balance across groups. This approach produces subclasses in which treated and control participants have comparable propensity scores, ensuring optimal adjustment for measured confounders and reducing model dependence in subsequent analyses.^{33,34} Balance was reported by displaying the standardized mean differences (SMD) in numerical and tabular form. SMD for all covariates ≤ 0.25 for the matched pairs are indicative of satisfactory balance post-matching.³⁵ Subsequently, we estimated the intervention effect using the *g* computation. We conducted a linear regression with caregiver preparedness scores at three months as the dependent variable and the grouping variable, covariates, and postmatching weights as predictors. Inclusion of the covariates used in the matching procedure provides robustness to slight imbalances left after matching and can improve the precision of the estimate. The results were expressed as unstandardised coefficients, 95% confidence intervals, and *p*-values. The estimate of the treatment effect was also computed in the unmatched sample, as part of a sensitivity analysis. The propensity score analysis was performed with RStudio (v. 2024.12.1 Build 563)³⁶ with the packages 'Matchit'³⁷ and 'marginal effects'³⁸ SPSS v. 25 (IBM Corp, Armonk, NY, USA) was used for the descriptive analyses.

Ethical statement

Ethical approval was obtained from the Ethics Committee of the Central Area of the Veneto Region (Italy), Code CESC 5766/AO/23 (November 23, 2023), the Ethics Committee of Azienda USL Toscana Centro (Resolution No 680; March 22, 2024), and the Eth-

ical Committee of the Lazio 2, Rome (Resolution No 26.15). This study adhered to the ethical standards and principles established by the Declaration of Helsinki.³⁹ Protection of personal data was ensured in accordance with Regulation 2016/679 of the European Parliament (GDPR) and the relevant data protection legislation.

Participation in the study was voluntary. Caregivers received a detailed explanation of the purpose, methodology, and implications of the study through a comprehensive written information sheet. Written informed consent was obtained from all participants before they were included in the study. The collected data were completely anonymised, securely stored in a customisable web-based database, and handled in a manner that ensured that the participants' identities remained untraceable.

Results

The original historical control group consisted of 415 caregivers who participated in the study. However, 201 participants were excluded from this analysis due to incomplete data. Therefore, data from 216 caregivers in the control group were used in the final analysis. The treatment group consisted of 97 caregivers, with no loss encountered during follow-up (Fig. 2).

The sociodemographic characteristics of the caregivers are reported in Table 1. Significant differences emerged in the pre-matched sample regarding caregiver occupation, with a higher prevalence of active workers in the treatment (60.8%) compared to the control group (47.7%; *p* = 0.031). Indeed, caregivers in the treatment group reported significantly lower baseline preparedness score than those in the control group (10.92 vs. 15.24, *p* < 0.001). Regarding the stroke survivors the mean age was approximately 74 years in both groups (74.01 $\pm$ 11.69 in the treatment group and 74.32 $\pm$ 11.69 in the control group) and slightly more than half were female (56.7% in the treatment group and, 52.0% in the control group). Approximately one-quarter were still actively employed (24.7% in the treatment group and, 21.7% in the control group), while about one-third had >8 years of education (25.8% in the treatment group and, 31.8% in the control group). Most patients experienced an ischemic stroke (85.6% in the treatment group and 92.6% in the control group), whereas widespread stroke involvement was observed in 29.9% and 39.6% of patients, respectively.

To minimize potential confounding due to baseline differences, full propensity score matching was applied. This approach allowed all treated cases to be retained, while assigning appropriate weights to control participants, thereby maximizing the use of available information and improving covariate balance. After matching, the distribution of baseline covariates between groups was well balanced, with no statistically significant differences ob-

Table 1

Sociodemographic characteristics of caregivers in the intervention and historical control groups before and after propensity score matching.

	Before PSM			After PSM		
	Treatment (n = 97)	Control (n = 216)	<i>p</i>	Treatment (n = 97)	Control (n = 216, weighted)	<i>p</i>
Age (years), mean (SD)	60.45 (13.56)	52.70 (13.09)	<0.001	60.45 (13.56)	60.13 (11.11)	0.824
Gender (female), n (%)	61 (62.9)	140 (64.8)	0.742	61 (62.9)	127 (58.8)	0.494
Marital status (married), n (%)	80 (82.5)	160 (74.1)	0.104	80 (82.5)	156 (72.2)	0.071
Occupation (active worker), n (%)	59 (60.8)	103 (47.7)	0.031	59 (60.8)	133 (61.6)	1.000
Education (>8y), n (%)	52 (53.6)	91 (42.1)	0.059	52 (53.6)	125 (57.9)	0.562
Family tree (child or spouse), n (%)	11 (11.3)	30 (13.9)	0.537	11 (11.3)	24 (11.1)	1.000
Children (yes), n (%)	75 (77.3)	166 (76.9)	0.928	75 (77.3)	147 (68.1)	0.125
Cohabitation with the patient (yes), n (%)	53 (54.6)	118 (54.6)	0.999	53 (54.6)	132 (61.1)	0.341
Caregiver Preparedness Scale (baseline score), mean (SD)	10.92 (10.92)	15.24 (6.91)	<0.001	10.92 (7.61)	11.37 (6.40)	0.610

Legend. PSM, propensity score matching; SD, standard deviation; *p*, *p*-value.

Note. Values are presented as mean (standard deviation) for continuous variables and n (%) for categorical variables. *P*-values refer to group comparisons (*t*-test or chi-square test) before and after full matching (weighted analysis).

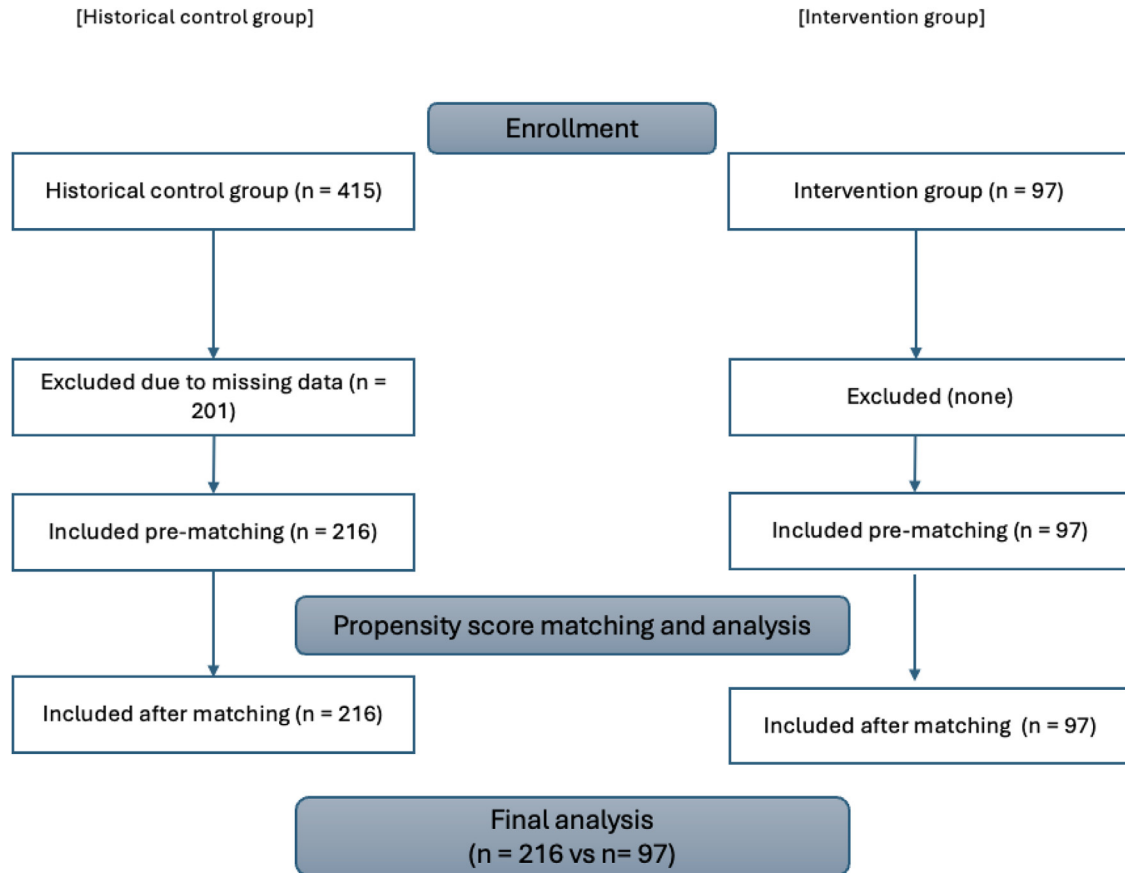


Fig. 2. Flow chart of the selection and matching process of the participants.

Note. The diagram illustrates the inclusion process for participants in the historical control and intervention groups, detailing the stages of exclusion, the 1:1 propensity score matching procedure, and the final number of caregivers analyzed in each group.

served (all $p > 0.05$), indicating that the matching procedure effectively created comparable groups for subsequent analysis (Fig. 3). Moreover, after matching, all SMD values were below 0.25 and most were under 0.10 (Table S1), confirming excellent balance across baseline covariates and supporting the robustness of the matched sample. In the weighted analysis, caregivers in the treatment group showed significantly higher preparedness scores than those in the control group ($B = 9.54$, $p < 0.001$, 95% CI 8.40–10.44). The model explained 67% of the variance in the outcome variable. In the sensitivity analysis using the unmatched sample, the intervention effect remained significant ($B = 8.91$, $p < 0.001$, 95% CI 7.69–10.12), with an explained variance of 50%, thus confirming the robustness of the results (Fig. 4). Post hoc power analysis, based on the observed weighted group means (22.46 vs. 13.41), pooled SD (4.87), and an effective sample size equivalent to 97 per group, showed a statistical power exceeding 99% (Cohen's $d = 1.76$, $\alpha = 0.05$).

Discussion

The aim of this study was to compare caregiver preparedness after a customised intervention, with that of a historical cohort of caregivers who did not receive an intervention during the transition period from hospital to home, using full propensity score matching analysis. In this study, caregiver preparedness significantly improved in the intervention group compared to the historical control group, as measured three months after discharge using the CPS. After propensity score matching, caregivers who re-

ceived the structured educational intervention scored, on average, 9.54 points higher on the CPS than their matched counterparts ($p < 0.001$). Regarding stroke survivors' characteristics, no relevant differences were observed between groups.

Before matching, significant differences emerged between the two groups in some sociodemographic variables. A higher proportion of caregivers in the intervention group were active workers compared to the control group. Additionally, caregivers in the intervention group showed significantly lower baseline preparedness scores than their counterparts. These differences could reflect a greater need for support among caregivers in the intervention group, potentially linked to their occupational status or time constraints. This interpretation is consistent with previous research showing that the simultaneous demands of employment and caregiving can compromise caregivers' ability to manage both roles effectively.^{40,41} The cumulative stress associated with juggling these responsibilities may negatively impact caregivers' sense of competence and preparedness in providing care.

While much of the existing literature has focused on primary outcomes such as caregiver burden, psychological stress, or depression,^{42–44} less attention has been paid to secondary stressors, such as caregiving-work conflict, that influence other aspects of caregivers' lives, including occupational functioning and overall well-being. Furthermore, previous studies have identified several factors that contribute to caregiver burden, including gender, employment status, education level, age, hours of care provided, and the clinical condition of the care recipient, particularly functional limitations and symptom severity.⁴⁵

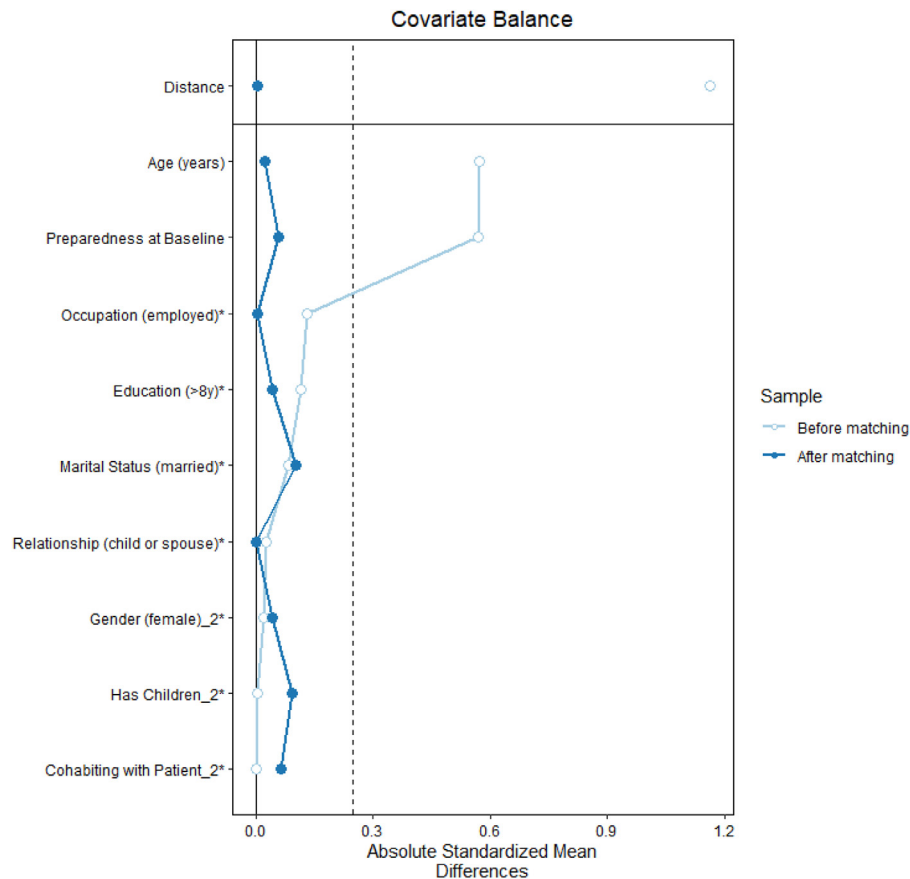


Fig. 3. Standardized mean differences of covariates before and after propensity score matching.

Note. The plot shows the absolute standardized mean differences (SMDs) for each covariate between intervention and historical control groups, before (open circles) and after (filled circles) full matched propensity score matching. The vertical dashed line at 0.25 represents the commonly accepted threshold for adequate covariate balance. After matching, all covariates demonstrate satisfactory balance, with SMDs below the threshold.

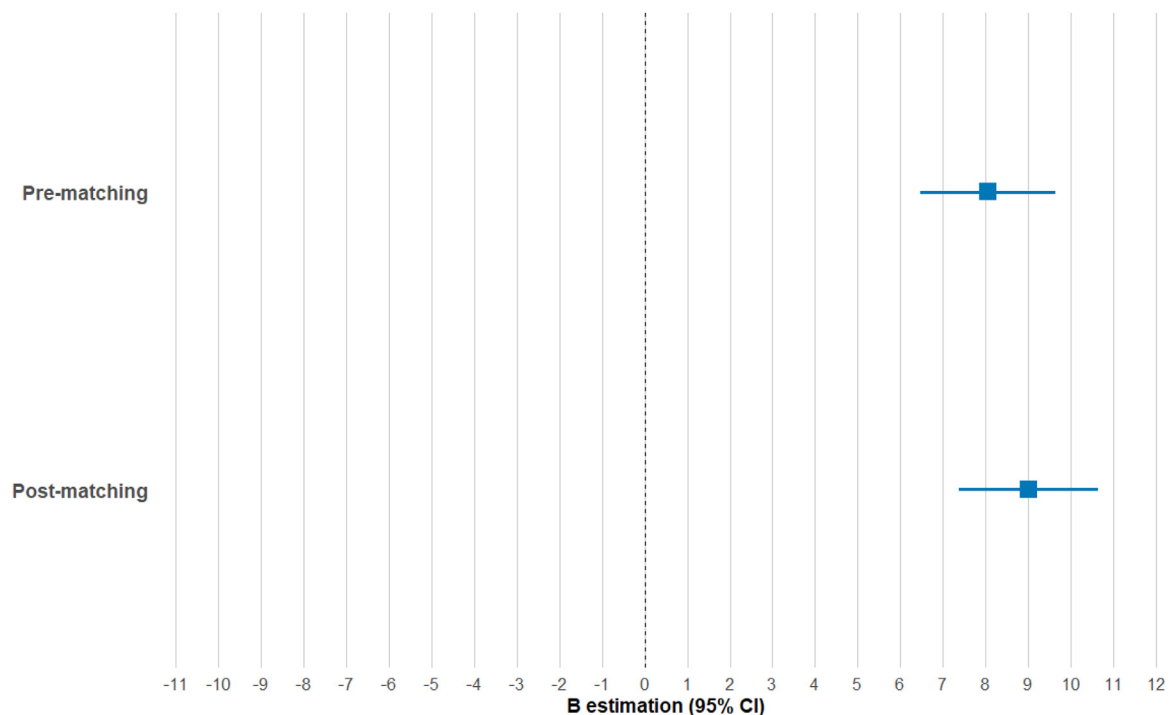


Fig. 4. Forest plot displaying the point estimates (B) and 95% confidence intervals for the main effect pre- and post-matching.

Note. The plot compares the effect size of the intervention before and after full propensity score matching, highlighting changes in the estimated association and its statistical precision.

The significant improvement observed across the matched sample indicates that the intervention likely addressed several of these dimensions through tailored education, continuity of support, and direct problem-solving. These findings are particularly noteworthy given that, at baseline, the intervention group reported lower preparedness scores than the control group. Despite starting from a more vulnerable position regarding preparedness than the control group, caregivers in the intervention group exceeded their counterparts after three months, highlighting the impact and clinical relevance of the program.

The positive outcomes observed in caregiver preparedness and reduced strain suggest that the tailored, focused intervention effectively addressed both emotional and practical needs through continuity of care, individualized education, and timely support. The focus on mutual adaptation and support within the caregiving relationship likely played a key role in enhancing caregivers' sense of competence and confidence. The intervention functioned as a key moderating factor, strengthening caregiver resources through targeted education, emotional support, and sustained contact. These elements align with the framework's emphasis on the role of preparedness and support in promoting adaptation.⁴⁶

These findings are also supported by a recent systematic review on transitional care interventions, which suggests that programs incorporating health coaching activities, home visits, telephone follow-up, and informative support during the transition from hospital to home can significantly improve QOL, self-efficacy, and activities of daily living (ADLs) in both stroke survivors and their caregivers.⁴⁷ In addition, caregivers in the intervention groups experienced lower levels of perceived strain at follow-up compared to those receiving usual care.^{48,49} These findings reinforce the relevance of multicomponent, structured transitional care models, which appear to offer dual benefits: they not only enhance caregiver preparedness but may also indirectly support improved recovery and functional outcomes for stroke survivors.^{50,51}

Limitations of the study

This study has some limitations that should be considered during the interpretation of the results. First, although propensity score matching was used to rigorously control for confounding variables, the study was not a randomized controlled trial. The lack of randomization means that residual confounding from unmeasured or unknown variables cannot be excluded. Second, the use of a historical control group may have introduced the possibility of temporal bias. However, this bias is likely minimal for several reasons. First, the standard discharge procedures and caregiver education routines in the participating hospitals have remained substantially unchanged over the years, following stable regional and institutional protocols. Second, both cohorts were recruited from the same clinical settings and under the same organizational models of care, minimizing the likelihood that contextual or systemic changes influenced caregiver outcomes. Although full matching on key covariates was performed, it is not possible to account for all potential time-related confounders. Third, the clinical and organizational characteristics of the participating hospitals (hub-and-spoke model, different geographical areas) may limit the generalizability of the findings to other settings. Fourth, a substantial proportion of caregivers in the historical control group (201 out of 415) were excluded due to incomplete data. Although such exclusions are common in real-world datasets, they may introduce selection bias if excluded participants differ systematically from those included in the analysis. Fifth, the outcome evaluation was limited to caregiver preparedness at three months post-discharge. The absence of longer-term follow-up data precludes conclusions regarding the sustainability of the intervention's effects over time.

Sixth, only patients with mild-to-moderate disability were enrolled in the study. However, the severity of disability of stroke survivors was not assessed using a standardized or objective measure but was based on clinical judgment during recruitment. This may limit the generalizability of the findings to stroke survivors with more severe disability and introduces the possibility of misclassification. Finally, the study relied on self-reported measures, which may be subject to social desirability bias, which potentially influences the accuracy of reported caregiving preparedness.

Implications for practice and research

The results of our study suggest that the systematic integration of caregiving education into the discharge pathway of stroke patients represents a concrete opportunity to improve caregivers' preparedness and adaptive capacity during the post-discharge period. Adopting an individualized educational model—initiated during hospitalization and continued at home—can help reduce caregivers' sense of inadequacy, mitigate care-related burden, and enhance the quality of home-based care. This approach should be incorporated into the discharge programme of stroke care units, transforming caregiver education from a secondary activity into a structural component of transitional care. To achieve this, it is essential to promote specific training pathways for nurses, focused on developing educational, communication, and relational skills necessary to support caregivers effectively. The positive experience described in this study highlights the added value of continuity in education provided by the same nurse who cared for the patient during hospitalization, reinforcing trust and personalization of the intervention.

To strengthen the evidence of the observed results, future studies should include randomized controlled trials (RCTs) to confirm the effectiveness of the educational intervention in a larger and more representative sample. Additionally, long-term follow-up is essential to assess the sustainability of the intervention's benefits, both in terms of caregiver well-being and patient clinical and functional outcomes. Another important area for future research is the cost-benefit analysis of implementing such programs as standard practice, to document their economic feasibility and support widespread adoption within healthcare systems. From an equity perspective, it will also be important to explore how socioeconomic and cultural factors influence participation and intervention effectiveness, to develop accessible and inclusive strategies.

Conclusion

This study demonstrated that a structured and personalized educational intervention delivered during the critical transition from hospital to home, significantly improves caregiver preparedness in comparison to standard care. By targeting individual caregiver needs and providing ongoing support, the intervention was effective in enhancing caregivers' readiness to assume their roles in post-stroke care. These findings highlight the value of integrating caregiver-focused interventions into discharge planning processes to support informal caregivers in assuming their roles more confidently. Future research should explore the long-term effects of such interventions and evaluate their impact on additional caregiver and patient outcomes.

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Declaration of competing interest

The authors declare no conflicts of interest.

CRediT authorship contribution statement

Mayra Veronese: Writing – original draft, Investigation, Data curation, Conceptualization. **Paolo Iovino:** Writing – review & editing, Software, Formal analysis. **Cristiana Rago:** Writing – original draft, Investigation, Data curation, Conceptualization. **Matteo Rota:** Software, Formal analysis. **Eroale Vellone:** Writing – review & editing, Supervision. **Rosaria Alvaro:** Supervision. **Gianluca Pucciarelli:** Writing – review & editing, Supervision, Methodology, Conceptualization.

Data availability

The datasets generated and/or analysed during the current study are not publicly available due to ethical and privacy restrictions but are available from the corresponding author on reasonable request.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.jvn.2026.09.005](https://doi.org/10.1016/j.jvn.2026.09.005).

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