

Transitional care programs to improve outcomes in patients with traumatic brain injury and their caregivers: A systematic review and meta-analysis

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Abstract

Background: Effective nursing interventions for caring for patients with moderate to severe traumatic brain injury are still challenging during a transition from hospital to home. Since traumatic brain injury has deep-rooted sequelae, patients and their caregivers require better arrangement and information on the condition to achieve improved outcomes after discharge.

Objective: This study aimed to assess transitional care programs to improve outcomes of patients with traumatic brain injury and their caregivers.

Methods: A systematic review and meta-analysis were performed on studies retrieved from ProQuest, PubMed, Science Direct, CINAHL, and Google Scholar from January 2010 to July 2021. RevMan 5.4.1 software was used for meta-analysis.

Results: Nine studies were systematically selected from 1,137 studies. The standard approaches of interventions used in patients with traumatic brain injury and their caregivers were education, mentored problem-solving, home- and community-based rehabilitation, counseling, skill-building, and psychological support. We observed that there was significant evidence indicating beneficial effects of intervention in increasing the physical functioning of patients with traumatic brain injury ($SMD = -0.44$, 95% CI -0.60 to -0.28, $p < 0.001$), reducing the psychological symptoms among caregivers ($SMD = -0.42$, 95% CI -0.59 to -0.24, $p < 0.001$), and increasing the satisfaction ($SMD = -0.35$, 95% CI -0.60 to -0.11, $p = 0.005$).

Conclusion: Education, skill-building, and psychological support should be the main components in transitional care nursing programs for patients with traumatic brain injury and their caregivers.

Keywords

hospitals; patient discharge; transitional care; traumatic brain injury; caregivers; nursing; meta-analysis

Traumatic brain injury (TBI) is a critical problem worldwide that causes disability (Roozenbeek et al., 2013). Approximately 69 million individuals experience TBI from various causes (Dewan et al., 2019). Also, TBI is more common in low-middle income countries (LMIC), where it has a more considerable impact than in high-income countries (Iaccarino et al., 2018), partly due to the differences in health services. The previous study clarifies that one of the elements that can cause early mortality in

TBI patients in LMIC is the deferred time from being admitted to the emergency unit to accepting appropriate treatment (Gupta et al., 2020).

Patients with TBI can encounter a wide assortment of neurological deficiencies. The neurological shortfalls experienced by patients depend on the components of the injury, the seriousness of the injury, and the degree of brain damage brought about by the injury (Blennow et al., 2016). Patients can experience headaches, vision loss, loss of

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ability to walk, cognitive impairment, memory loss, and other conditions that result from damage to parts of the brain due to TBI. In addition, recent research focused on TBI suggests that a considerable number of patients have a long-term disabling physical function, neurocognitive and neurobehavioral sequelae (Pavlovic et al., 2019).

The first month home is a transitional and vulnerable period for patients and their caregivers. Previous studies have highlighted that shortly before discharge from the hospital, patients' quality of life is low because of physical limitation, pain, immobility, and anxiety (McAllister et al., 2018). These impacts continue after discharge from the hospital and are associated with significant limitations in daily living activities (Alghnam et al., 2017). Therefore, assistance from their caregivers with activities of daily living (ADLs), such as dressing, bathing, feeding, and managing medications, is required. However, the high demands of care after hospital discharge can affect caregivers' physical and psychosocial conditions because of the loss of time for their own activities such as travel, leisure, social activities, and retirement.

Caregivers of patients with TBI are required to understand the cost of treatment in managing TBI patients. However, in reality, they tend to experience difficulties managing and caring for TBI patients because of difficulty obtaining access to health services and treatment (Lefebvre & Levert, 2012). Consequently, hospital readmission is common among patients with TBI. Of the 15,277 patients with a listed diagnosis of TBI, 35% of them needed at least one-time readmission (Brito et al., 2019). Caring for someone with TBI has been shown to negatively impact caregivers in so many ways that they require interventions designed by health workers (Arango-Lasprilla et al., 2010). A previous study explained that caregivers described the resulting transitional experience as fraught with risks and distress because they felt inadequate, unwilling, or inadequately trained to carry out intervention plans on patients (Mitchell et al., 2018). On the other hand, life satisfaction is based on criteria most relevant to the individual. Still, it has been well documented that TBI-impacted caregivers have highlighted a diminished life satisfaction, high level of caregiver burden, anxiety, social isolation, depression, and emotional difficulties (Manskow et al., 2017). Hence, it is necessary to provide continuity of care to the patients with TBI and their caregivers after being discharged from the hospital (Caro, 2011).

The transitional care intervention is well recommended to ensure coordination and continuity, based on a comprehensive care plan as patients transfer between different locations (Naylor et al., 2011). Nurses have an essential role in caring for patients with TBI and their caregivers (Oyesanya et al., 2017). However, there are several recommendations for nurses in supporting TBI care after discharge but still insufficient information regarding nursing outcomes. Seeking best interventions in improving TBI nursing outcomes of both patients and caregivers during transition is challenging for nurses. This manuscript aimed to review, analyze, and synthesize the existing

transitional care programs between hospital and home, systematically focusing on the improvement of the outcomes after discharge among patients with TBI and their caregivers. One paper that discussed the transition from hospital to home for patients with acquired brain injury was published in 2008 (Turner et al., 2008). That article used the literature review method to evaluate existing studies without systematic search methods. A systematic review in the current study is essential for nurses to have a useful and reliable resource with evidence-based nursing recommendations on nursing intervention to help achieve the best outcomes. Additionally, a meta-analysis was performed to assess the strength of evidence for the outcomes for the patients with TBI and their caregivers. Meta-analyses can assist in setting up statistical significance among studies that could seem to have conflicting results. That is crucial due to the fact that statistical importance increases the validity of any discovered differences and improves the reliability of the records.

Methods

Literature Search Strategies and Databases

We used "The framework for Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)" to report the findings (Shamseer et al., 2015). We searched electronic databases: Proquest, PubMed, Science Direct, CINAHL, and Google Scholar. This strategy comes from the PICO format (Table 1). Keyword and inclusion criteria used for searching in each database are shown in Table 2. We developed the search terms based on MESH terms: 'transitional care,' 'hospital to home intervention,' 'traumatic brain injury,' 'nursing care,' 'patient outcome,' 'brain injury outcome,' and 'hospital discharge.'

Table 1 PICO Format

PICO	
Population	Patients with TBI and their caregivers
Intervention	Transitional care program between hospital and home
Comparison	Usual care
Outcomes	Physical functioning, psychological distress reduction, satisfaction

Eligibility Criteria

All interventions that focused on increasing favorite outcomes of patients with TBI and their caregivers were included. The inclusion criteria were: (1) types of participants: patients with moderate or severe TBI after discharge from the hospital \geq 18 years old, while the caregivers were the person who cared for the patients after discharge at home; (2) types of outcome measures: physical functioning, psychological distress reduction, and satisfaction; (3) publication language and date of publication: published in English between January 2010–July 2021, to be current with the most recent literature; (4) study design: intervention study, including randomized

controlled trials and (quasi) experimental research; (5) types of interventions: interventions (both caregiver and patients) relevant to transitional nursing care practice after

discharge; and (6) timing: one to the three-month duration of intervention regarding intermediate care.

Table 2 Keywords and inclusion criteria used for searching in each database

Databases	Main search	Limits	N (Total articles)	N (Articles after exclusion)	Reasons for exclusion
PubMed	('transitional care') AND ('traumatic brain injury patient' OR 'caregiver') AND 'intervention' AND 'discharge' AND ('outcome' OR 'patient' OR 'caregiver')	<ul style="list-style-type: none"> English Full-text Year 2010-2021 Human 	117	7	Not intervention studies, pediatric, long-term program, inpatient rehabilitation
ProQuest	('transitional care') AND ('traumatic brain injury patient' OR 'caregiver') AND 'nursing intervention' AND 'hospital discharge' AND ('outcome' OR 'patient' OR 'caregiver')	<ul style="list-style-type: none"> English Full-text Year 2010-2020 Nursing & allied health database, scholarly journal, full text, peer-reviewed Exclude commentary, conference proceeding, undefined, and book 	336	17	Pediatric, not intervention studies, not TBI patient, systematic review article, a transition between ICU and ward, the population was health care, articles discuss patient perception, the population was spinal cord injury, hip fracture, long-term intervention
Science Direct	'transitional care' AND 'traumatic brain injury', 'nursing care' AND 'brain injury outcome'	<ul style="list-style-type: none"> English Year 2010-2021 Full-text Research article 	330	4	Not intervention studies, pediatric, long-term program, inpatient rehabilitation
Google Scholar	"transitional care", "traumatic brain injury", "nursing care", "outcome", and "hospital discharge"	Year 2010-2020	87	8	Not intervention studies, not in the adult population, discuss spinal cord injury and stroke patients
CINAHL	'transitional care' AND 'traumatic brain injury' OR 'brain injury' AND ('patient' OR 'caregiver') AND 'outcome'	<ul style="list-style-type: none"> English 2010-2020 Full-text Academic journal Major headings: brain injuries Age: all adults 	267	4	Population: nursing staff, discuss non-TBI patients, not intervention studies

Study Selection

The studies obtained by searching were divided into two parts, with each having been carried out by a pair of authors (AG with PS and AF with KN, respectively). Each team conducted research selection separately and independently. A consensus meeting with a third author was arranged (PS or KN, respectively). The studies selected were initially assessed on the relevance of the topic to the title and abstract. Then a more in-depth search was conducted based on the inclusion criteria of the review. These studies were included if they met the inclusion criteria. The records of the rejected studies and the reasons for refusal were documented. We used Mendeley software to manage duplicate results.

Quality Appraisal of the Studies

The quality of the selected articles was critically analyzed using the Checklist for Randomized Controlled Trial Study

(Joanna Briggs Institute (JBI), 2020). The possible score range was 0 to 13.

Data Extraction

Data were extracted from the nine articles following the PRISMA guidelines (Shamseer et al., 2015), including authors, year of publication, tools, provider of intervention, effect size, intervention method, duration of intervention, outcome measures, and study results. All the items were included in data extraction (Table 3).

Risk of Bias

We used the free software (RevMan version 5.4.1) to assess the risk of bias. High risk consisted of blinding participants and personnel (performance bias). However, the risk of bias in our review was similar and low in the majority of the studies. The results of bias were assessed and presented in Figure 1 and Figure 2.

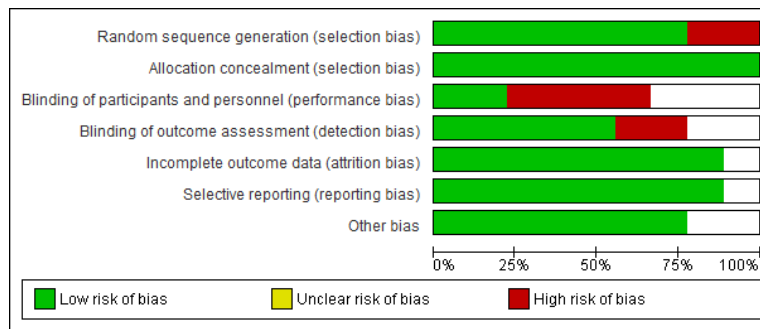


Figure 1 Risk of bias graph: review authors' decisions about each risk of bias item used RevMan 5.4.1

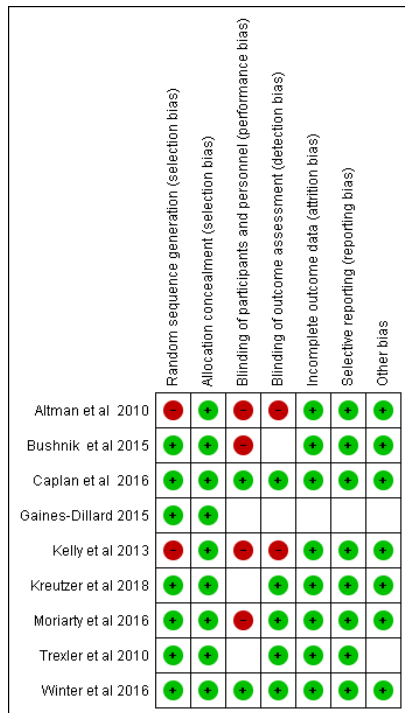


Figure 2 Risk of bias summary used RevMan 5.4.1

Data Synthesis

We used a model of meta-analyses of similar outcomes reported by several studies (Schmidt et al., 2009). For this meta-analysis, the physical functioning of patients with TBI, the psychological distress symptoms of caregivers, and the satisfaction were used as indicators of follow-up received from the research. We analyzed the model of meta-analyses in RevMan V 5.4.1 software using the inverse variance method, a model of fixed effect, and continuous data. The heterogeneity taken into consideration to guarantee measurable investigation consistency was $I^2 < 50\%$ and $Ch^2 < 0.10$, with confidence intervals of 95% (Higgins et al., 2003).

Results

With the search strategies, we identified 1,137 articles. We removed one hundred and seventy-one duplicated articles

and then selected 966 papers. After the title and abstract reading, we decided on 41 articles for full reading (Figure 3). Of those articles, nine studies fulfilled the inclusion standards in the analysis, while 32 were excluded. Keywords and inclusion criteria used for searching in each database and the reasons for excluding these articles are shown in Table 2. We categorized the intervention types, module items used in the intervention, strengths, and limitations of each study in Table 3.

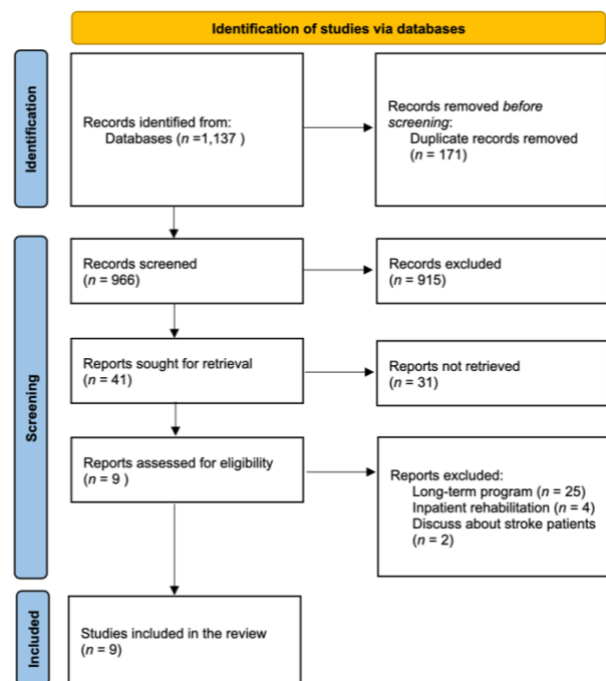


Figure 3 PRISMA Flow Diagram

None of the included studies scored the maximum JBI quality score of 13 points. Among the nine reviewed studies, three articles had a methodological quality score of 11 (Bushnik et al., 2015; Winter et al., 2016; Kreutzer et al., 2018) and have a score of 10 (Trexler et al., 2010; Caplan et al., 2016; Moriarty et al., 2016). Additionally, two studies had a methodological quality score of 7 (Altman et al., 2010; Gaines-Dillard, 2015), and one had a score of 6 (Kelly et al., 2013), as presented in Table 3.

Descriptive characteristics for nine included studies are presented in **Table 3**. Of the nine studies, eight studies were conducted in various places in the USA (Altman et al., 2010; Trexler et al., 2010; Bushnik et al., 2015; Gaines-Dillard, 2015; Caplan et al., 2016; Moriarty et al., 2016; Winter et al., 2016; Kreutzer et al., 2018) but only one study in Australia (Kelly et al., 2013). The studies varied in patients' demography, duration of the intervention (from one to three months), type of procedures used, and the intervention sample size (23 to 489). One thousand three hundred seventy-two participants (both of intervention and control group) in the samples were included in the nine studies.

Intervention Characteristics

A wide range of interventions was used in improving the outcomes among patients with TBI and their caregivers. We categorized the transitional care program for patients with TBI, including primary interventions and the other components. The primary interventions were education (Trexler et al., 2010; Kelly et al., 2013; Bushnik et al., 2015; Gaines-Dillard, 2015; Caplan et al., 2016; Moriarty et al., 2016; Kreutzer et al., 2018) and home/community-based rehabilitation (Altman et al., 2010; Winter et al., 2016). Patient education was delivered after discharge by various personnel or methods: telephone, face-to-face visits, group-education, and in-person education (both patient and caregiver) education (Trexler et al., 2010; Kelly et al., 2013; Bushnik et al., 2015; Gaines-Dillard, 2015; Caplan et al., 2016; Moriarty et al., 2016; Kreutzer et al., 2018), while home/community-based rehabilitation refers to home visits by a healthcare provider, such as a nurse, doctor, or occupational therapist, who educated and gave the self-care instructions, undertook the physical examination, or provided other care rehabilitation (Altman et al., 2010; Winter et al., 2016).

In addition, there were the other components of transitional care program, including mentored problem solving (Kelly et al., 2013; Caplan et al., 2016), counseling (Moriarty et al., 2016; Winter et al., 2016), skill-building and psychological support (Bushnik et al., 2015; Kreutzer et al., 2018). The interventionist guided the patients and their caregivers in problem-solving such as physiological problems and memory difficulties (Caplan et al., 2016). Counseling was wider, taken at-home visits by a licensed healthcare provider and two telephone contacts with the patient and caregivers together to obtain their concerns and discuss intervention objectives (Moriarty et al., 2016). On the other hand, both programs were designed to resolve the most common problems identified by patients with TBI and included emotion and stress management and good communication (Bushnik et al., 2015; Kreutzer et al., 2018).

Materials used in delivering intervention included a booklet and handbook on various aspects of TBI patient and caregiver management. The duration of the transitional care program was between one and three months. We assessed the effect size of each study regarding Cohen's

guide categorization (Cohen, 1992). The effect is considered small if the effect size is <0.1, medium if between 0.3 and 0.5, and large if above 0.5. Three studies in this systematic review indicated a large effect of the intervention (Altman et al., 2010; Winter et al., 2016; Kreutzer et al., 2018).

Outcome Measures

Types of outcome measures in this article include the physical functioning, psychological distress reduction, and satisfaction of caregivers or patients with TBI. The decision to classify outcomes into three groups, namely physical functioning, psychological distress, and service satisfaction, made it easier for the authors to synthesize data through meta-analysis. Studies that contain physical functioning as outcomes include physical and cognitive abilities, physical problem severity, physical signs and symptoms in patients with TBI. Meanwhile, those with outcomes of anxiety, stress, burden, and depression are classified as studies with psychological distress as outcomes. Also, studies containing patient satisfaction with TBI and their caregivers are grouped as having satisfaction with the services as an outcome. Some studies assessed the improvement of caregiver outcomes, such as coping responses and emotional symptomatology (Trexler et al., 2010; Caplan et al., 2016; Moriarty et al., 2016). Other studies assessed the caregiver burden reduction and satisfaction improvement (Bushnik et al., 2015; Moriarty et al., 2016). For the patients' outcomes, one study measured self-management improvement (Kelly et al., 2013), while other studies measured the increase the physical functioning, reduction in psychological symptoms, and improvement in cognitive abilities (Altman et al., 2010; Gaines-Dillard, 2015; Winter et al., 2016), physiological well-being (Trexler et al., 2010; Kelly et al., 2013; Kreutzer et al., 2018), and community or work participation (Altman et al., 2010; Trexler et al., 2010; Winter et al., 2016). In summary, most studies in this systematic review measured the physical functioning among patients with TBI and the psychological symptoms of their caregivers.

Intervention Effects on Patients with TBI and Their Caregivers

From the nine eligible studies in this review, only five (Altman et al., 2010; Trexler et al., 2010; Caplan et al., 2016; Moriarty et al., 2016; Kreutzer et al., 2018) provided statistical data of standard deviation of physical functioning of patients with TBI, and six studies (Trexler et al., 2010; Bushnik et al., 2015; Caplan et al., 2016; Moriarty et al., 2016; Winter et al., 2016; Kreutzer et al., 2018) provided statistical data of standard deviation of psychological distress symptoms of caregivers to be included in this meta-analysis.

We did not find significant heterogeneity among studies that mentioned the physical functioning of patients with TBI as the outcomes ($p = 0.24$, $I^2 27\%$). Then, we used the fixed-effects model to conclude the mean effect size and found that transitional care program intervention can lead

to a significant increase in patient physical functioning (*SMD (Standard Mean Difference) = -0.44, 95% CI -0.60 to -0.28, p <0.00001*) (**Figure 4**). Finally, we used sensitivity analysis using different pooled models and indicated a

significant difference between the two groups (*MD = -0.21 95% CI -0.49, p <0.00001*), indicating that the summary effect size is robust.

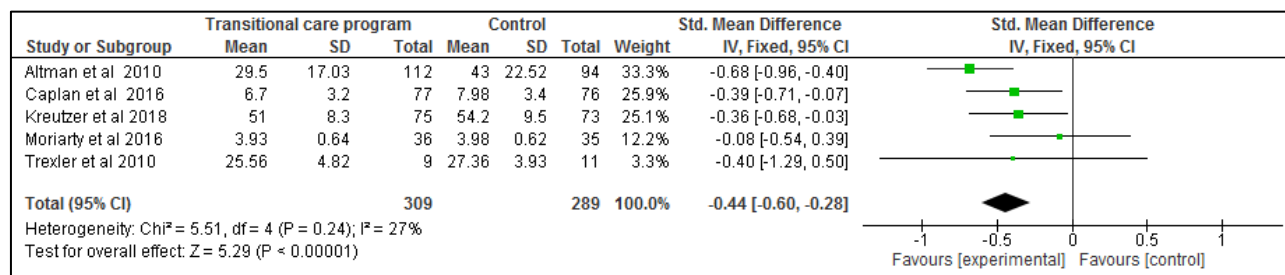


Figure 4 Forest plot: Evaluation of physical functioning improvement after transitional care program in patients with TBI versus control group

We also found no significant heterogeneity between studies that mentioned the psychological symptoms of caregivers as the outcomes (*p = 0.28, I² 21%*). We used the fixed-effects model to calculate the mean effect size. We found that transitional care program intervention leads to a significant reduction in caregiver’s psychological distress symptoms (*SMD= -0.42, 95% CI -0.59 to -0.24, p <0.00001*) (**Figure 5**). In addition, we used sensitivity analysis using other pooled models and indicated a significant difference between the two groups (*MD= -0.40, 95% CI -0.60, p <0.00001*), meaning that the summary effect size is robust.

satisfaction as the outcomes (*p = 0.26, I² 26%*). Then, we used the fixed-effects model to conclude the mean effect size and found that transitional care program intervention can significantly increase satisfaction (*SMD= -0.35, 95% CI -0.60 to -0.11, p = 0.005*) (**Figure 6**). According to the result of critical methodology appraisal, risk of bias assessment, effect size assessment, and meta-analysis, we assumed that education combined with skill-building and psychological support to be the best transitional care program between hospital and home, which can improve the outcomes of traumatic brain injury patients after discharge (Kreutzer et al., 2018).

For the third outcome, we found no significant heterogeneity among those studies that measured

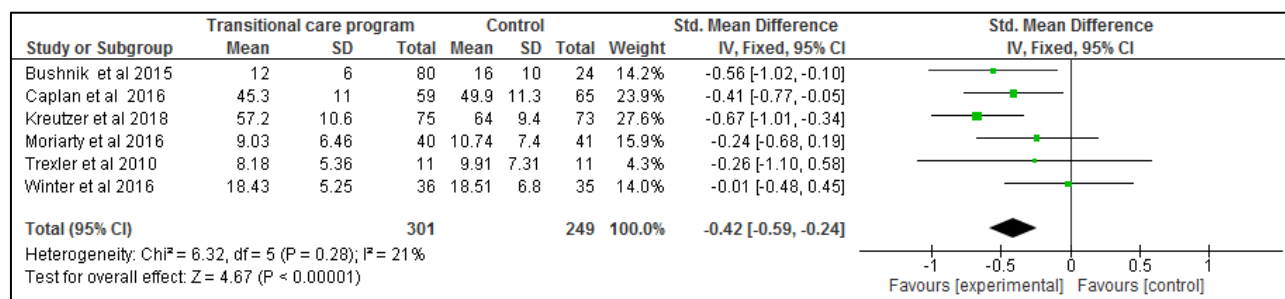


Figure 5 Forest plot: Evaluation of the psychological distress reduction after transitional care program in caregivers for patients with TBI versus control group

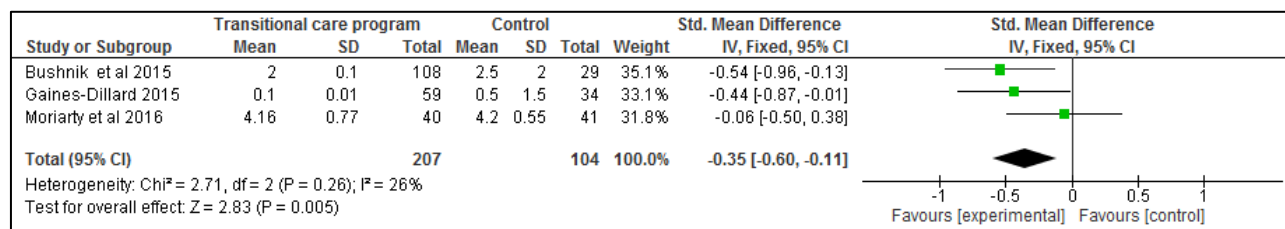


Figure 6 Forest plot: Evaluation of the satisfaction after transitional care program versus control group

Discussion

The transition period from hospital to home is the crucial phase in patients with TBI and their caregivers. Patients with TBI are discharged home with several deficits,

creating considerable difficulties for caregivers regarding readiness and preparation (Imanigoghary et al., 2017). Thus, during the transition between hospital and home, these patients’ outcomes and their caregivers need close attention. Based on the theory of Meleis (2010), nurses can

help patients, families, and networks adapt to advance care by envisioning reactions, giving expectant direction, reducing side effects, upgrading well-being and prosperity, and supporting the improvement of self-care activities (Meleis, 2010). Also, a systematic review mentioned that it requires magnificent correspondence during the transition to home and has suggestions for coordination and association of care across settings and nursing ability (Coffey et al., 2017). Using the systematic review and meta-analysis, the current study confirms the effect of transitional care programs and suggests a continuation of care coordination across settings and nursing capability.

This is the first systematic review of transitional care intervention in patients with TBI and their caregivers. The results of our study indicated that transitional care program between hospital and home compared with usual care was helpful regarding improvement of caregiver outcomes, such as coping responses, emotional symptomatology, and reducing the burden. Also, the intervention can improve caregiver satisfaction, patients' self-management and functional status, psychological, cognitive, physiological well-being, and community or work participation. According to the meta-analysis result, there was a significant difference in psychological distress symptoms score in caregivers between the intervention and control groups. These positive post-discharge results are presumably connected to a superior progression of care, with correspondence between various medical care experts and caregivers being a remembered segment for some intercessions (Chen et al., 2020).

Education, mentored problem-solving, home-and community-based rehabilitation, counseling, skill-building, and psychological support can be applied in the transitional care program between hospital and home for caregivers and patients with TBI. A telephone-based intervention combining individualized education and mentored problem-solving can extend the interventions to people with transportation or other access hindrances. It could be more practical than giving face-to-face benefits (Caplan et al., 2016). In LMIC, because of distance and transportation troubles, follow-up and patient recovery measures experience challenges and encounter difficulties. This result is in line with the study in Indonesia as an LMIC showing that direct subsequent phone conferences and meetings with TBI patients after release from a neurosurgery ward at 1, 2, and 3 months were valued by patients (Sutiono et al., 2018).

On the other hand, skill-building and psychological support effectively improved the outcomes of traumatic brain injury patients after discharge (Bushnik et al., 2015; Kreutzer et al., 2018). Neurobehavioral sequelae of TBI are commonly shown, leaving numerous survivors jobless and dependent on relatives for help (Oyesanya et al., 2021).

Psychological strategies were utilized to assist patients with TBI in perceiving their sentiments and improve their emotion or passionate prosperity. At the same time, the ability to manage care was fused to enhance correspondence, critical thinking, and enthusiastic control (Kreutzer et al., 2018). A couple of studies have shown that enhanced energetic prosperity is connected with better utilitarian outcomes post-injury, including social joining and return to work (Iverson, 2010; Hart et al., 2014; Fann et al., 2017).

A prospective cohort study led to quantifying rates of adverse mental events in caregivers of patients with TBI at post-discharge and three months after discharge. In addition, the results showed caregiver dissatisfaction at one-month post-discharge, and a further reduction after three months showed that injury time elapsed was inversely related to caregiver burden (Turner et al., 2010).

This meta-analysis aimed to improve understanding of how transitional care could help patients with TBI and their caregivers during discharge and transition from hospital to home, increase physical functioning and satisfaction, and reduce the caregivers' psychological distress. It also showed that studies have homogeneity and found that transitional care program intervention led to a significant increase in physical functioning among patients with TBI (Altman et al., 2010)(Trexler et al., 2010; Caplan et al., 2016; Moriarty et al., 2016; Kreutzer et al., 2018) and reduction in caregiver's psychological distress symptoms (Trexler et al., 2010; Bushnik et al., 2015; Caplan et al., 2016; Moriarty et al., 2016; Winter et al., 2016; Kreutzer et al., 2018). This result is in line with the previous study that the most commonly utilized intervention component of the caregiver of the patients with TBI was illness education, including skills training, social support, and therapy (Shepherd-Banigan et al., 2018).

Study Limitations

This paper aims to synthesize the existing transitional care program between hospital and home, which can improve the outcomes of traumatic brain injury patients after discharge. Although the review presents strong evidence with study target tests, plan, and result estimation to advise future examination, some potential limitations in this review were found. These include small studies; searches were limited to articles published in English and various outcome measures. Also, we did not have sufficient studies to conduct robust assessments of publication bias. A common criticism of meta-analysis is that analysts join multiple types of study in a similar investigation so that the overall impact may disregard conceivably significant contrasts across studies. The publication bias of the study could be found when using various measurements and outcomes in the meta-analysis.

Table 3 Transitional program for patients with TBI and their caregivers

Author (year), Location	Type of studies	Population & Sample	Tools	Provider	Effect size	Intervention	Duration of Intervention	Outcome measures	Results
(Caplan et al., 2016) Washington, USA	Randomized Controlled Trial	153 caregivers of persons with moderate to severe TBI Two groups	Brief Symptom Inventory (BSI-18)	A master's level social worker with experience in TBI and problem-solving studies	0.20 to 0.41 (small to medium)	Individualized training and mentored trouble-solving intervention via up to ten phone calls at 2-week durations.	One month	Emotional symptomatology	Emotional symptomatology discharge of the patients with TBI resulted in better caregiver outcomes
(Kelly et al., 2013) Victoria, Australia	Pre-post-test design	41 adults with TBI Two groups	The Self-Concept Scale: Second Edition (TSCS: 2), the Family Assessment Device (FAD), the Rosenberg Self-Esteem Scale (RSE) and the Hospital Anxiety and Depression Scale (HADS)	A clinical psychologist with 15 years of experience and training and a medical neuropsychologist with clinical level in brain injury rehabilitation	0.046 to 0.158 (small)	Family inclusive intervention on the multidimensional self-concept of individuals TBI	Three months	Self-concept, self-esteem, anxiety and depression, family functioning	Temper and circle of relatives functioning was not enhanced for the TBI pattern
(Altman et al., 2010) Indianapolis, USA	Retrospective analysis of program evaluation data for treatment	489 adults with TBI Two groups	Mayo-Portland Adaptability Inventory and Injury Severity	Licensed or certified clinicians and/or assistants	0.52 to 0.58 (large)	Home- and community-based post-acute brain injury rehabilitation (PABIR)	Three months	Physical and cognitive abilities, adjustment, and community participation	Results provided evidence of the effectiveness of home-and community-based care
(Trexler et al., 2010) Midwest of the USA	Randomized Controlled Trial	23 people with TBI (and their caregivers) Two groups	O-Log, C-Log, the Participation Index of the Mayo-Portland Adaptability Inventory (M2PI), Patient Health Questionnaire-9 (PHQ-9)	Resource facilitators	0.04 to 0.05 (small)	Resource Facilitation (RF): resource facilitator to assist TBI patients in returning to work and community activities	Three months	Return to work, participation in home and community activities, and depression	Participation increased significantly for the intervention group
(Moriarty et al., 2016) Pennsylvania, USA	Randomized Controlled Trial	81 adults with TBI and their family member Two groups	The Center for Epidemiologic Studies Depression Scale, The Modified Caregiver Appraisal Scale (CAS), Caregiver	A licensed occupational therapist with clinical experience	0.01 to 0.311 (small to medium)	Veteran's In-Home Program (VIP) by phone: compensatory strategies to enhance cognitive functioning; emotion-	Three months	Depressive symptomatology, caregiver burden, and caregiver satisfaction	Own family contributors in the VIP confirmed an appreciable decrease in depressive symptom

Author (year), Location	Type of studies	Population & Sample	Tools	Provider	Effect size	Intervention	Duration of Intervention	Outcome measures	Results
			burden, and the Caregiver Relationship Satisfaction	in patient and family interventions		regulation strategies to manage behavioral and interpersonal disturbances.			rankings, lower burden scores, and better caregiver pleasure when compared to controls at follow-up.
(Bushnik et al., 2015) Virginia, USA	Randomized Controlled Trial	108 family caregivers after TBI Two groups	The Service Obstacles Scale (SOS), the Family Needs Questionnaire (FNQ, and Zarit Burden Inventory (ZBI)	Therapists included family therapists and clinical psychologists with doctoral degrees	0.3 to 0.37 (medium)	The Brain Injury Family Intervention: psychological support, addressing needs, skill-building, and emphasizing education	Three months	Family members' perceived needs, satisfaction, and quantified caregiving burden	Treatment group caregivers showed an increase in met desires, greater satisfaction with services, and decreased burden relative to pretesting.
(Kreutzer et al., 2018) Virginia, US	Randomized Controlled Trial	160 adults with TBI Two groups	The Connor-Davidson Resilience Scale (CD-RISC), Brief Symptom Inventory-18 (BSI-18), Mayo-Portland Adaptability Inventory-4 (MPAI-4), and the 13 Item Stress Test	Doctoral-level psychologists who received training from the first author	-0.54 to 0.60 (small to large)	The Resilience and Adjustment Intervention (RAI) objectives adjustment demanding situations: emphasizes education, skill-building, and mental help.	Three months	Resilience measurement scales, problem severity, and stress symptoms	A resilience-focused intervention improved psychological health and adjustment after TBI
(Winter et al., 2016) Philadelphia, USA	Randomized Controlled Trial	81 veterans with TBI and a key family member Two groups	The Centre for Epidemiologic Studies Depression Scale (CES-D), The Patient Competency Rating Scale, and The Community Re-integration for Service Members scale (CRIS),	Health professional	0.01 to 0.68 (small to large)	Veterans' In-home Programme (VIP), applied in veterans' houses, regarding a family member and focused on the environment, carried out in homes or by smartphone.	Three months	Community re-integration, mitigation of trouble with the maximum troubling TBI signs, and facilitation of day-by-day functioning	VIP participants had significantly higher community re-integration scores and less difficulty managing targeted outcomes.
(Gaines-Dillard, 2015) Newark, USA	Pre-post-test design	93 adults with TBI Two groups	Trauma Follow-up Tracking Tool (TFTT)	Nurses	0.34 to 0.37 (medium)	Education and follow-up by phone (TFU)	Three months	Patient satisfaction, communication, and knowledge deficit	TFU can improve patient satisfaction in patients with TBI.

Conclusion

This systematic review supports the transitional care programs for improving the outcomes, particularly in physical functioning, psychological distress reduction, and satisfaction among patients with TBI and their caregivers. Nurses' role is highly prominent in transitional care as they are involved in education, mentored problem solving, supporting home-and community-based rehabilitation, counseling, skill-building, and psychological support for patients with TBI and their caregivers. This review concludes that education combined with skill-building and psychological support is the main component in transitional care programs between hospitals and homes for improving the outcomes of traumatic brain injury patients and their caregivers. For the clinical implication, nurses should give efforts to education along with skill-building and psychological support to improve the physical functioning of patients with TBI, increase satisfaction and reduce the psychological distress of TBI caregivers. Future research is necessary to test its effectiveness in different contexts of care in LMIC.

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Authors' Contributions

AG designed the study, wrote and revised the manuscript. AG and PS analyzed the data, wrote and revised the manuscript. KN designed the study, wrote and revised the manuscript. All authors agreed with the final version of the article to be published.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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