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Disability and Rehabilitation

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/idre20

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To cite this article: Odile Chevalley, Steven Truijen, Wim Saeys & Emmanuelle Opsommer (2022) Socio-environmental predictive factors for discharge destination after inpatient rehabilitation in patients with stroke: a systematic review and meta-analysis, Disability and Rehabilitation, 44:18, 4974-4985, DOI: 10.1080/09638288.2021.1923838

To link to this article: https://doi.org/10.1080/09638288.2021.1923838

DISABILITY AND REHABILITATION
2022, VOL. 44, NO. 18, 4974–4985
https://doi.org/10.1080/09638288.2021.1923838

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REVIEW

Socio-environmental predictive factors for discharge destination after inpatient rehabilitation in patients with stroke: a systematic review and meta-analysis

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ABSTRACT

Purpose: To identify which of the socio-environmental factors of patients with stroke are predictive for discharge to their home after inpatient rehabilitation. Because discharge planning is a key component of rehabilitation, it is important to recognize the predictive factors for a discharge home. Other systematic reviews demonstrated the value of functional outcome measures. This review adds to the current literature by assessing the predictive value of socio-environmental factors, which shape the context in which a person lives.

Methods: We performed a systematic search in seven databases. Two independent reviewers selected studies and assessed them for methodological quality. We extracted data to estimate pooled odds ratio for household situation, social support, ethnicity and socioeconomic status.

Results: Forty studies were included. Significant estimates were found for living with others (OR 2.60; 95%CI 1.84–3.68), having support at home (OR 11.48; 95%CI 6.52–20.21), being married (OR 2.05; 95%CI 1.80–2.33) and living at home before stroke (OR 31.01; 95%CI 7.38–130.18).

Conclusion: Living at home and benefiting from social support, including living with others, are important factors to consider during discharge planning after stroke. Further research should consider the impact of socioeconomic status.

ARTICLE HISTORY
Received 6 July 2020
Revised 1 April 2021
Accepted 26 April 2021

KEYWORDS
Meta-analysis; patient discharge; rehabilitation; sociological factors; stroke

➤ IMPLICATIONS FOR REHABILITATION

- Evaluating the social and environmental factors of patients with stroke plays an important role in discharge planning.
- Next to functional status, caregiver availability (support at home) is among the strongest predictive factors for discharge home.
- To assess caregiver availability, the presence of a willing and able caregiver should be surveyed at admission.
- Further predictive factors for discharge home are cohabitation and marital status.

Introduction

Worldwide, one to two thirds of patients with stroke are admitted for inpatient rehabilitation [1]. Due to higher survival rates [2], as well as the increased absolute number of cases with increasing population and life expectancy [3,4], the need for rehabilitation is expected to increase. After inpatient rehabilitation, patients can either be discharged home or to a long-term care facility, including skilled nursing facilities (SNF). The latter can lead to delayed discharge and bed-blocking, which is the inability to admit a new patient to rehabilitation, because of inefficient transition with long-term care facilities [5]. Bed-blocking comes with additional costs and prevents early access to rehabilitation for acute patients [6,7]. To enhance the management of healthcare resources, early predictive factors for discharge destination are essential [6,8].

Recent systematic reviews examined predictive factors for discharge destination after acute hospital care for patients with stroke [2,9,10]. They identified younger age, good poststroke functionality, admission to a teaching hospital, modified or complete cognitive independence, use of statin before and during hospitalization, prestroke household situation and socio-environmental factors (e.g., marital status, insurance, and geographical situation) as predictive factors for discharge home from acute care. An earlier systematic review for patients with subacute stroke [11] recommended further research on socio-environmental factors. Meanwhile, several observational studies examined socio-environmental factors for discharge destination. Among them, presence of a caregiver at home [12,13], number of family members [13], number of cohabiting people [13,14], marital status [12,15,16] and type of insurance [16] were shown to influence the discharge destination. There is, therefore, a need to review the predictive socio-environmental factors for discharge home after inpatient rehabilitation in patients with stroke.

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Supplemental data for this article can be accessed here.

Socio-environmental factors constitute the social and physical conditions in which people live [17]. Bruchon-Schweitzer and Boujut described three levels of socio-environmental factors in health: global, intermediate and proximal [18]. Global factors are structural determinants of health and include governances, policies, and cultural values. Intermediate factors define the position of an individual in society; they include socioeconomic status, ethnicity and community. Proximal factors include living conditions, family, professional environment and peer group. All of these factors are specific to each individual and are interrelated [19].

The purpose of this systematic review and meta-analysis is to identify predictive proximal and intermediate socio-environmental factors for discharge home after inpatient rehabilitation in patients with stroke.

Methods

This review was reported in accordance with the Preferred Reporting of Items in Systematic Reviews and Meta-Analysis guidance [20]. This systematic review was registered in the PROSPERO database with the registration number CRD42020156077.

Eligibility criteria

Studies were eligible if they included adults (>18 years) with stroke who were admitted to an inpatient rehabilitation setting for stroke rehabilitation after acute care. We defined inpatient rehabilitation as a temporary setting for stroke rehabilitation between acute care and return home. Moreover, studies were eligible if they considered socio-environmental factors for discharge home versus other discharge destinations. We included studies that assessed the effect of proximal and intermediate socio-environmental factors. Regarding the proximal factors, we included studies that assessed marital status, family structure (the number of family members or the number of children), social support (the presence of caregivers, family, or peers), prestroke living arrangement (home or SNF) and cohabitation status (alone or with someone). For the intermediate factors, we included studies that assessed ethnicity and socioeconomic status. We defined "home" as an independent living situation without the presence of a professional caregiver and the "other discharge destinations" as settings where the patient does not live independently or receives help from a professional caregiver, e.g., SNF and assisted living. Finally, studies published in peer-review journals in English, Dutch, German or French were eligible.

We excluded studies that reported outcomes specifically on global socio-environmental factors such as governance and policies. Studies were excluded when participants were discharged from an acute care setting, when the participants were not discharged home or when no data about the probability of discharge home was reported.

Search strategy

We performed a systematic search of studies published up until June 2020 on seven databases, including PubMed, Embase, CINHAL, The Cochrane Library (Trials), Web of Science, PEDro and PsycINFO.

A broad search strategy was developed with keywords for "stroke," "discharge planning" and "socio-environmental factors". The search strategy was developed for PubMed and adapted to the other databases. The full search string for the databases can be found in Supplementary file 1. A specific search strategy was developed for PEDro using the following search queries: (1) Stroke AND patient discharge, (2) Stroke AND discharge planning, (3) Stroke AND discharge decisions, (4) Stroke AND discharge destination, and (5) Stroke AND discharge location.

Study selection and data collection

Studies were selected by two independent reviewers. Studies were selected first on title and abstract and then on full text. Any disagreement between the two reviewers on study selection was resolved by discussion until a consensus was reached for each step of the selection process.

We extracted the following data from the included studies and reported them in a table:

- Country,
- Study design,
- Period of data collection (in years),
- Information on the sample (number of patients, percentage of men, mean age, functional status at admission and discharge, inclusion and exclusion criteria),
- Information on discharge destination,
- Predictive factor(s) assessed in the study for discharge destination and their results (number of events for each discharge destination and odds ratio).

Methodological assessment

Two independent reviewers assessed the methodological quality of the included studies with the Newcastle-Ottawa Scale (NOS). This scale is designed to evaluate the quality of nonrandomised studies, including cohort and case-control studies. It consists of three different sections with criteria for the two different study designs (i.e., cohort or case-control studies): the selection of the study groups (four items), the comparability of the groups (one item) and the ascertainment of either the exposure in case-control studies (three items) or outcome of interest in cohort studies (three items) [21]. Each item of the first and last sections receives one point in case of low risk of bias or no point. The second section (comparability of the groups) receives two points in case of a low risk of bias, one point in case of low risk of bias for the most important factor of comparison, or no point. The developers of the tool established its face validity [21], nevertheless, its inter-rater reliability has been shown to be fair for the overall score [22].

Synthesis of results

We performed meta-analyses for each socio-environmental factor when at least three studies reported data on the same factor [8], when studies provided numbers of events and number of patients in each group, or odds ratio (OR) and confidence interval (CI) for discharge destination. Social support, family support and caregiver availability are reported under the factor "support at home". For marital status, we compared married patients to any other status, i.e., single, divorced, and widowed. Cohabitation status compared patients living alone with patients living with a spouse, family or friends (cohabiting). Prestroke living arrangement compared patients living at home versus patients living in a SNF. For ethnicity, we compared non-Hispanic Whites with the other ethnicities reported in studies, i.e., African American, Hispanic, and Asian.

We used the inverse variance method with the random-effect model to calculate pooled ORs and 95% CIs. The random-effect model was used as clinical heterogeneity was expected.

Heterogeneity was assessed for each factor using I^2 [23]. I^2 was interpreted with thresholds for considerable (75–100%), substantial (50–90%), moderate (30–60%) and not important heterogeneity (0–40%) [24]. Analyses were performed with Review Manager [25].

Sensitivity analyses were performed to examine the influence of data quality on our results. We removed studies that provided only OR and CI from the meta-analysis. In addition, we removed one study [26] from the meta-analysis on "support at home," because this study reported an exceptionally rare event.

Results

The electronic search identified 8697 non-duplicate titles. Following title and abstract screening, 179 titles were assessed in full text. Forty studies were included in the review and critically appraised. Seven studies were not compared in meta-analysis, as six of them did not provide adequate data and one study only assessed the rehabilitation settings. Thus, 33 studies were included in meta-analyses (Figure 1).

Characteristics of included studies

Characteristics of included studies are reported in Table 1. Forty studies included 225,941 participants receiving inpatient rehabilitation after stroke. The sample sizes varied from 81 to 143,036 participants (median 256, interquartile range (IQR) 827). The mean age of the participants varied in the studies from 61.9 to 80.8 years old. Twenty-one studies were conducted in North America, nine in Europe, seven in East Asia, two in Australia and one in Israel.

In Table 2, we recorded the investigated socio-environmental factors for each study: support at home by family, caregiver or social network, cohabitation status (cohabitation or alone), marital status (married or not married), number of family members (number of children), social risk, prestroke living arrangement (home or institution/facility), employment status, ethnicity, need of support, insurance, socioeconomic status, rehabilitation type, and country of birth.

Methodological assessment

All included studies were critically appraised for methodological quality. Thirty-eight studies were assessed with the assessment scale for cohort studies from the NOS and two studies [27,28] with the scale for case-control studies. The score of the included cohort studies ranged from 6 to 9, with a mean score of 7.6 (SD = 1.1). Both case-control studies scored 7/9. Risk of bias for all included studies was identified for comparability of the groups in several studies because no adjustment for confounders was reported. Low risk of bias was identified in the selection of the

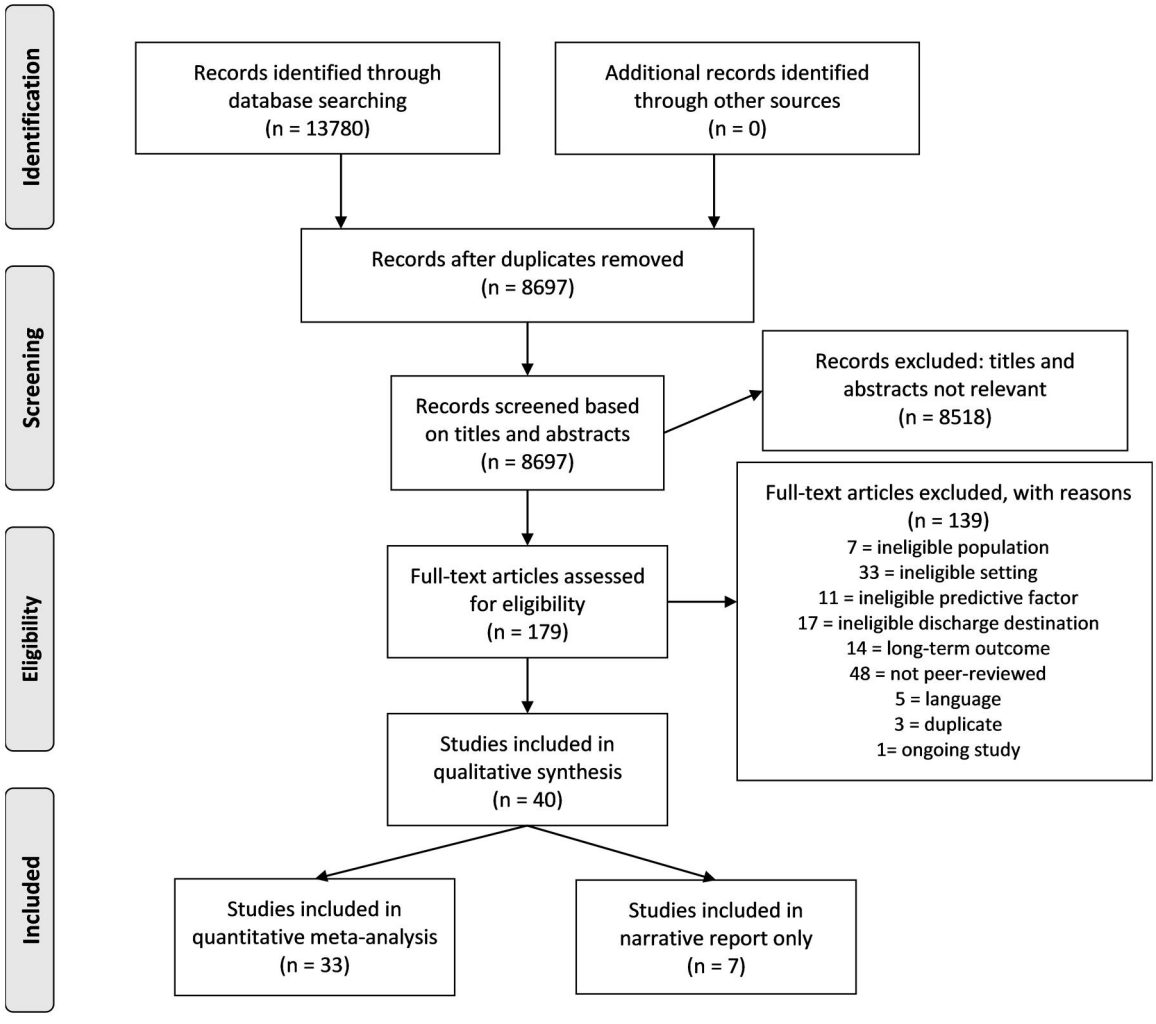

Figure 1. Flow diagram for selection process.

Table 1. Characteristics of included studies.

Study ID (Country)	Design R/P	Data collection period	Population				
			N	Mean age	% male	IS/HS	FIM
Agarwal et al. 2003 (CAN)	R	1993–1996	104	72 ± 10	48	IS + HS	DH: 87 ± 19 DO: 69 ± 19
Bernard 2016 (USA)	R	(3 years)	406	67 ± 14	50	IS + HS	
Bhandari et al. 2005 (USA)	R	1995–2001	1002	72 ± 13	40	IS + HS	57 ± 18
Black et al. 1999 (USA)	R	1994–1996	234	69 ± 13	56	IS + HS	70 ± 19
Brauer et al. 2008 (AUS)	P	2001–2002 2004–2005	566	73 ± 13	54	IS + HS	
Burdge et al. 2017 (USA)	R	2011–2014	181	74 ± 12	44	IS + HS	
Chen et al. 2013 (SGP)	R	1996–2005	3903	DH:71 ± 10 DO: 74 ± 10	49	IS + HS	
Chung et al. 2012 (USA)	R	2008–2009	223		42	IS + HS	DH: 35 ± 11 DO: 29 ± 11
Davidoff et al. 1992 (ISR)	R		192	DH: 61 DO: 65 (7.0)		IS + HS	
Denti et al. 2008 (ITA)	P	1999–2000	359	81 ± 5	38	IS + HS	56 ± 24
Frank et al. 2010 (CHE)	P	1996–2007	1332	77 (median)	49	IS + HS	70 ± 30
Fuentes et al. 1999 (USA)	R	1994–1996	6199	Hisp:69 non-Hisp: 72		IS + HS	
Gabet et al. 2018 (FRA)	R	2010 & 2014	24100				
Garcia et al. 2019 (USA)	R	2002–2018	3876	68 ± 15	50	IS + HS	
Hsieh et al. 2017 (TWN)	R	2011–2013	297	63 ± 13	63	IS + HS	NIHSS 9 ± 6
Koyama et al. 2011 (JPN)	P	2007–2009	163	70 ± 12	61	IS + HS	53 ± 23
Ling 2004 (CHN)	R	2000–2002	1111	70 ± 12	57	IS + HS	69 ± 24
Löfgren et al. 2000 (SWE)		1997–1998	116	75 ± 9	47	IS + HS	
Löfgren et al. 1997 (SWE)		1991–1992	100	76 ± 8	49	IS + HS	
Maeshima et al. 2016 (JPN)		2012–2013	89	62 ± 12	65	putaminal HS	DH: 64 (median) DO: 31 (median)
Massucci et al. 2006 (ITA)		1999–2000	997	70 ± 12	52	IS + HS	
Mutai et al. 2012 (JPN)		2006–2008	174	73 ± 11	51	IS + HS	73 ± 28
Ng et al. 2005 (USA)	R	1996–2003	89	72 ± 13	54	IS + HS	65 ± 25
Nguyen et al. 2007 (AUS)		1999–2004	326			IS + HS	
Nguyen et al. 2015 (USA)	R	2008–2011	2085	DH: 64 ± 14 DO: 70 ± 13	51	IS + HS	
Pereira et al. 2014 (CAN)	R	2005–2009	189	69 ± 14	55	IS + HS	50 ± 11
Petrilli et al. 2002 (FRA)	P	1998–1999	92	65 ± 14	50	IS + HS	
Pinedo et al. 2014 (ESP)	P	2011	241	72 ± 12	57	IS + HS	
Pohl et al. 2013 (USA)	R	2002–2008	31910	78 ± 7	43	IS + HS	60 ± 20
Reistetter et al. 2014 (USA)	R	2006–2007	143036	71 ± 14	48	IS + HS	56 ± 19
Sakurai et al. 2011 (JPN)		2008–2010	189	78 ± 9	43	IS + HS	
Tanwir et al. 2014 (CAN)	R	2011–2012	268		51	IS + HS	
Twigg et al. 1998 (USA)	P		117	65 ± 11	47	IS	
Vluggen et al. 2020 (NLD)	P	2010-2014	92	79 ± 6	49	IS + HS	
Wasserman et al. 2019 (CAN)	R	2008–2017	240	DH: 64 ± 14 DO: 76 ± 12	60	IS + HS	DH: 80 ± 22 DO: 53 ± 16
Wee et al. 1999 (CAN)	R	1995–1996	128	70 ± 12	62	IS + HS	(range 23–124)
Wee et al. 2003 (CAN)	P	1998–2000	313	76 ± 8	52	IS + HS	88 (range 35–125)
Ween et al. 1996 (USA)	P	1993	376	73 ± 12	45	IS + HS	
Ween et al. 2000 (USA)	P	1994–1996	244	73 ± 11		IS + HS	60 ± 20
Wilson et al. 1991 (USA)		1989–1990	282	69	48	IS + HS	

CAN: Canada; USA: the United States of America; AUS: Australia; SGP: Singapore; ISR: Israel; ITA: Italia; CHE: Switzerland; FRA: France; TWN: Taiwan; JPN: Japan; CHN: China; SWE: Sweden; ESP: Spain; NLD: the Netherlands; R: retrospective; P: prospective; N: sample size; DH: discharged home; DO: discharged to other destination; Hisp: Hispanic; non-Hisp: non-Hispanic; IS: ischemic stroke; HS: hemorrhagic stroke; FIM: Functional Independence Measure; NIHSS: National Institutes of Health Stroke Scale.

study groups and the ascertainment of outcome of interest for cohort studies or ascertainment of exposure for case-control studies.

Meta-analysis

A meta-analysis was possible, according to the criteria, for the following factors: support at home, cohabitation status, marital status, prestroke living arrangement and ethnicity. The other factors are described narratively.

Support at home

Six studies [12,26,29–32] were included in the meta-analysis (Figure 2). Support at home was described as availability of a caregiver in three studies, family support in two and social support in one. Support at home was associated with greater likelihood of discharge home in all studies. The pooled summary effect of patients with available support was significant with OR 11.48 (95%CI 6.52–20.21) compared to patients with no support at home. The statistical heterogeneity in this comparison was substantial ($I^2 = 62\%$). One study not included in meta-analysis reported similar results [33].

Prestroke cohabitation status

Fourteen studies [13,14,16,28,34–43] comparing discharge destination in patients living with a spouse, family or friends (cohabitation) and those living alone before stroke onset were analysed (Figure 3). The pooled OR was 2.60 (95%CI 1.84–3.68) showing a significant effect. This analysis showed a substantial heterogeneity ($I^2 = 80\%$). Two studies not included in meta-analysis reported similar results [44,45].

Table 2. Predictive factors investigated in included studies.

Studies ID	Support at home (presence)	Cohabitation status (living with others)	Marital status (married)	Number of family members (higher number)	Social risk (lower social risk)	Prestroke living arrangement (living home)	Employment status (employed)	Ethnicity (non-Hispanic Whites)	Need for support (patient require support)	Insurance (Medicare)	Socioeconomic status (higher status)	Rehabilitation type (neurological)	Country of birth (English speaking)
Agarwal et al. 2003	+												
Bernard 2016								−					
Bhandari et al. 2005			+					−					
Black et al. 1999		=	=										
Brauer et al. 2008						+							
Burdge et al. 2017		=	=					=					
Chen et al. 2013	+		+								+		
Chung et al. 2012		=	=					=		=			
Davidoff et al. 1992			+										
Denti et al. 2008		+											
Frank et al. 2010		+							−				
Fuentes et al. 1999								−					
Gabet et al. 2018												+	
Garcia et al. 2019								−					
Hsieh et al. 2017				+									
Koyama et al. 2011		+		+									
Ling 2004		+	+			+							
Löfgren et al. 1997						+							
Löfgren et al. 2000		+											
Maeshima et al. 2016		=		=									
Massucci et al. 2006		+											
Mutai et al. 2012		+											
Ng et al. 2005	+								−				
Nguyen et al. 2007			+										=
Nguyen et al. 2015		+	+				=	−		−			
Pereira et al. 2014	+												
Petrilli et al. 2002		+											
Pinedo et al. 2014			+		+								
Pohl et al. 2013			+										
Reistetter et al. 2014			+					−		−			
Sakurai et al. 2011				=									
Tanwir et al. 2014		+											
Twigg et al. 1998			+					=					
Vluggen et al. 2020		=											
Wasserman et al. 2019		+	+				=						
Wee et al. 1999	+												
Wee et al. 2003	+												
Ween et al. 1996	+										na		
Ween et al. 2000			=										
Wilson et al. 1991						+							

The grey cells represent the investigated factors in each study; +: significant factors for discharge home; =: no significant factors; −: significant factors for no discharge home (other destination).

Marital status

Marital status was reported in 13 studies (Figure 4) [12,15,16,27,28,34–36,39,46–49]. Married patients showed a greater likelihood of being discharged home than not married patients, including single, widowed and divorced ones. The pooled OR was 2.05 (95%CI 1.80–2.33) with a substantial heterogeneity (I^2 = 84%). Two studies not included in meta-analysis reported similar results [50,51].

Prestroke living arrangement

Four studies were included [39,52–54]. The overall effect shows a significantly greater likelihood for discharge home in patients living at home before their stroke (Figure 5). The pooled OR was 31.01 (95%CI 7.38–130.18). The large CI can be explained by the difference of the number of patients being discharged home between those living at home and those living in SNF before their stroke. The heterogeneity was moderate (I^2 = 44%).

Ethnicity

Nine studies, conducted in the USA, reported data on the influence of ethnicity on discharge destination [16,19,35,36,46,49,50,55,56]. The likelihood for discharge home after rehabilitation for African Americans, Hispanics and Asians was compared to non-Hispanic Whites (Figure 6). African Americans and Hispanics showed a significant higher likelihood to be discharged home compared to non-Hispanic Whites (OR 1.24, 95%CI 1.05–1.47; and OR 1.37, 95%CI 1.22–1.55, respectively). Asians did not show a significant different likelihood for discharge destination (OR 0.96, 95%CI 0.70–1.31). The overall pooled OR was 1.27 (95%CI 1.15–1.39), indicating that non-Hispanic Whites have a lower likelihood of being discharged home compared to other ethnicities. This analysis showed substantial heterogeneity (I^2 = 69%).

Sensitivity analyses

Sensitivity analyses were performed, and the results are presented in Table 3. Sensitivity analyses did not substantially change the results of the analysis.

Table 3. Sensitivity analysis.

Comparison	Summary effect OR (95%CI)
Meta-analyses with included studies reporting number of events and patients	
Support at home (support vs no support)	11.24 (6.06–20.84)
Cohabitation status (cohabitation vs alone)	2.45 (1.64–3.65)
Marital status (married vs not married)	2.12 (1.74–2.59)
Prestroke living arrangement (home vs institution)	57.33 (16.03–205.01)
Meta-analysis without one study that reported an exceptionally rare event	
Support at home (support vs no support)	8.87 (6.45–12.20)

OR: odds ratio; CI: confidence interval.

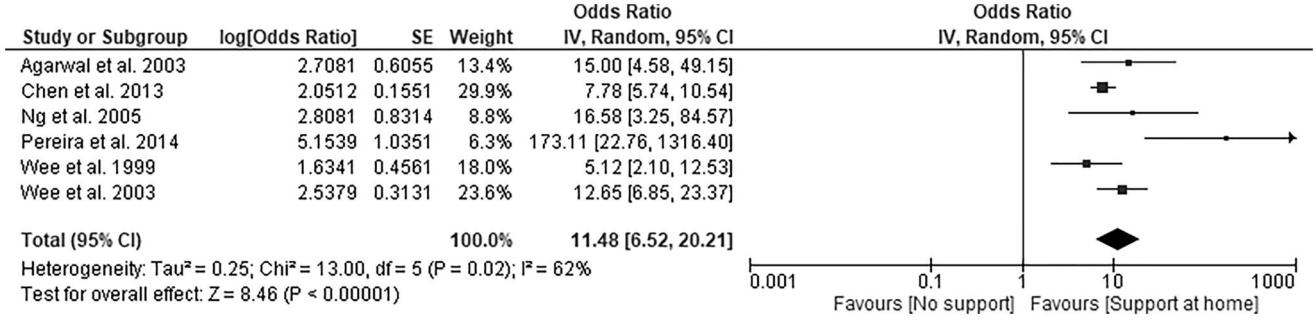

Figure 2. Forest plot of the relationship between discharge destination and support at home for patients with stroke. SE: standard error; IV: inverse variance; CI: confidence interval.

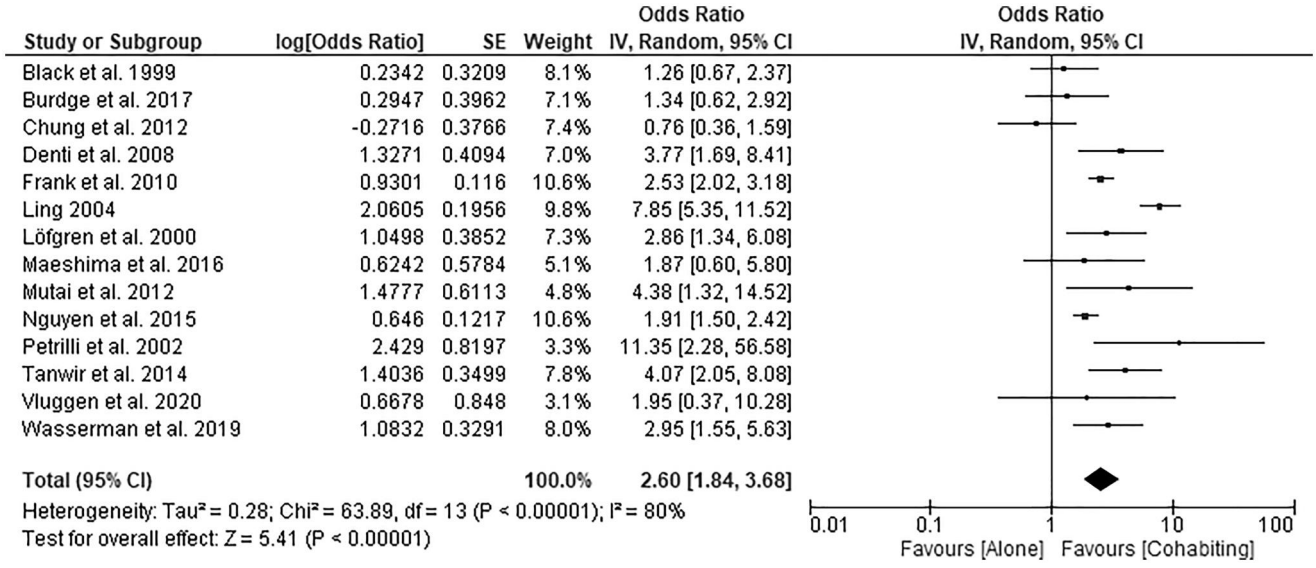

Figure 3. Forest plot of the relationship between discharge destination and cohabitation status of patients with stroke. SE: standard error; IV: inverse variance; CI: confidence interval.

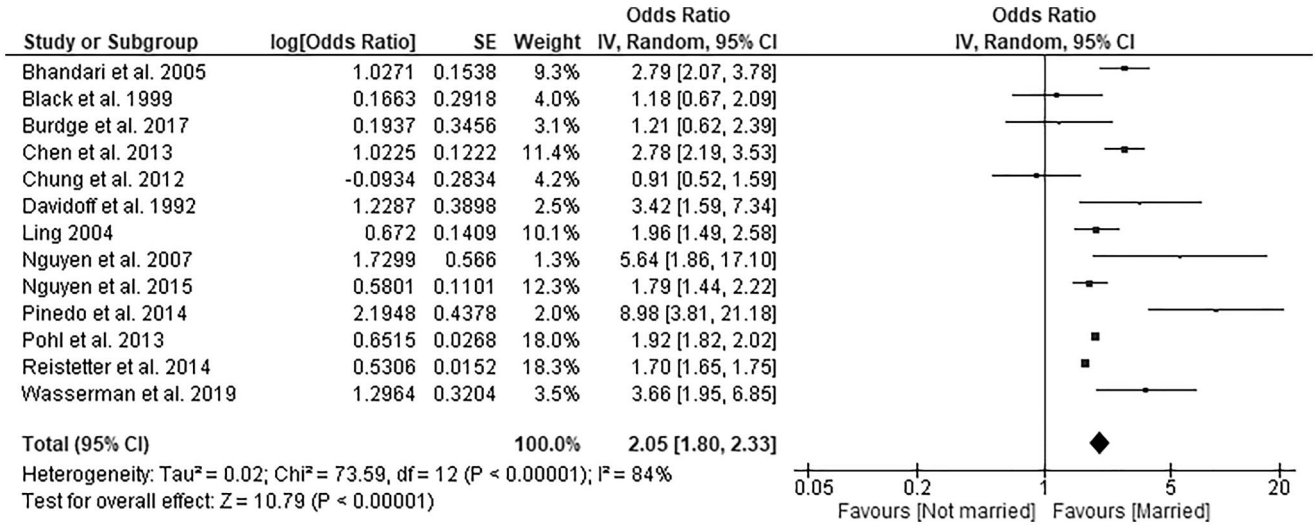

Figure 4. Forest plot of the relationship between discharge destination and marital status of patients with stroke. SE: standard error; IV: inverse variance; CI: confidence interval.

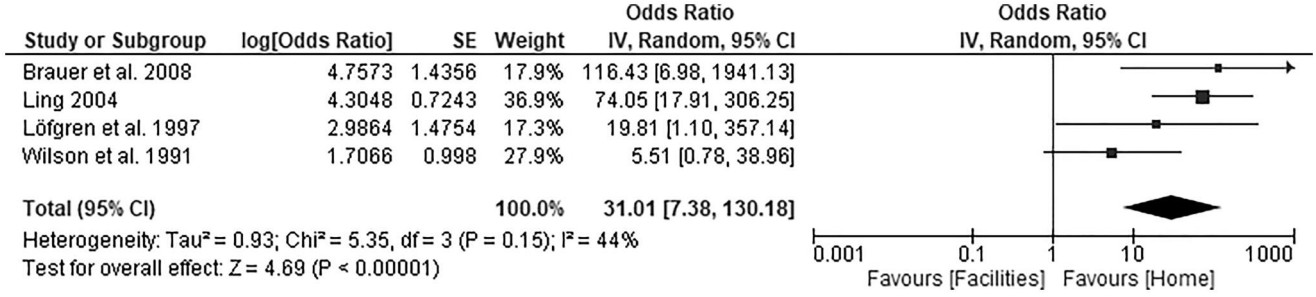

Figure 5. Forest plot of the relationship between discharge destination and prestroke living arrangement of patients with stroke. SE: standard error; IV: inverse variance; CI: confidence interval.

Further factors

Two studies [16,28] assessed employment status and reported non-significant effect on discharge destination after stroke. Need of professional support was reported in two studies. Frank et al. [38] reported a negative correlation between patients who require prestroke professional help and discharge home. Ng et al. [30] found that patients who do not require 24-h support showed a greater likelihood of being discharged home (OR 12.52, 95%CI 2.42–64.89). In addition, one study [47] reported that patients at lower social risk have a statistically higher probability of returning home. Social risk was assessed using the Gijon Scale [57] which evaluates socio-familial risk based on five items (family, economic, housing and relational situation and social support). Furthermore, socioeconomic status was evaluated in two studies, but one study [33] reported that assessment was not reliable and therefore not reported. Chen et al. [12] mentioned that the lower socio-economic group was represented by a higher level of subsidy in Singapore and they compared the different levels of subsidy on discharge destination. They reported that patients from higher socioeconomic status (lower level of subsidy) had a greater likelihood of being discharged home (OR 3.26, 95%CI 2.44–4.36). Likewise, three studies in the USA assessed the type of insurance and the discharge destination [16,36,49]. Patients with Medicare health insurance were less likely to be discharged home compared with other types of insurance [16,49], whereas patients with Medicaid showed no significant difference to patients with private insurance [16,36,49]. When comparing the country of birth, Nguyen et al. [15] found no significant difference between non-English speaking and English-speaking background. Two studies [45,58] found a relation between higher numbers of family members and discharge home, whereas two other ones [13,59] found no significant difference regarding the number of family members. Finally, one study [60] compared rehabilitation outcome in a neurological unit with a geriatric and general unit and found that patients receiving neurological rehabilitation had a greater likelihood of returning home (OR 1.38, 95%CI 1.29–1.47) (Table 4).

Discussion

The aim of this review was to identify predictive socio-environmental factors for discharge home after inpatient stroke rehabilitation. Significant results were found for the presence of support at home, living with others, being married, and living at home before stroke onset. In addition, studies conducted in the USA assessed the influence of ethnicity. Further factors were identified but studies did not present sufficient data for meta-analysis: need of support, number of family members, country of birth, employment status, socioeconomic status, social risk, and rehabilitation type. The present results add to previous systematic reviews on acute care [9,10] by providing an updated and quantitative synthesis of socio-environmental factors for discharge home after inpatient stroke rehabilitation.

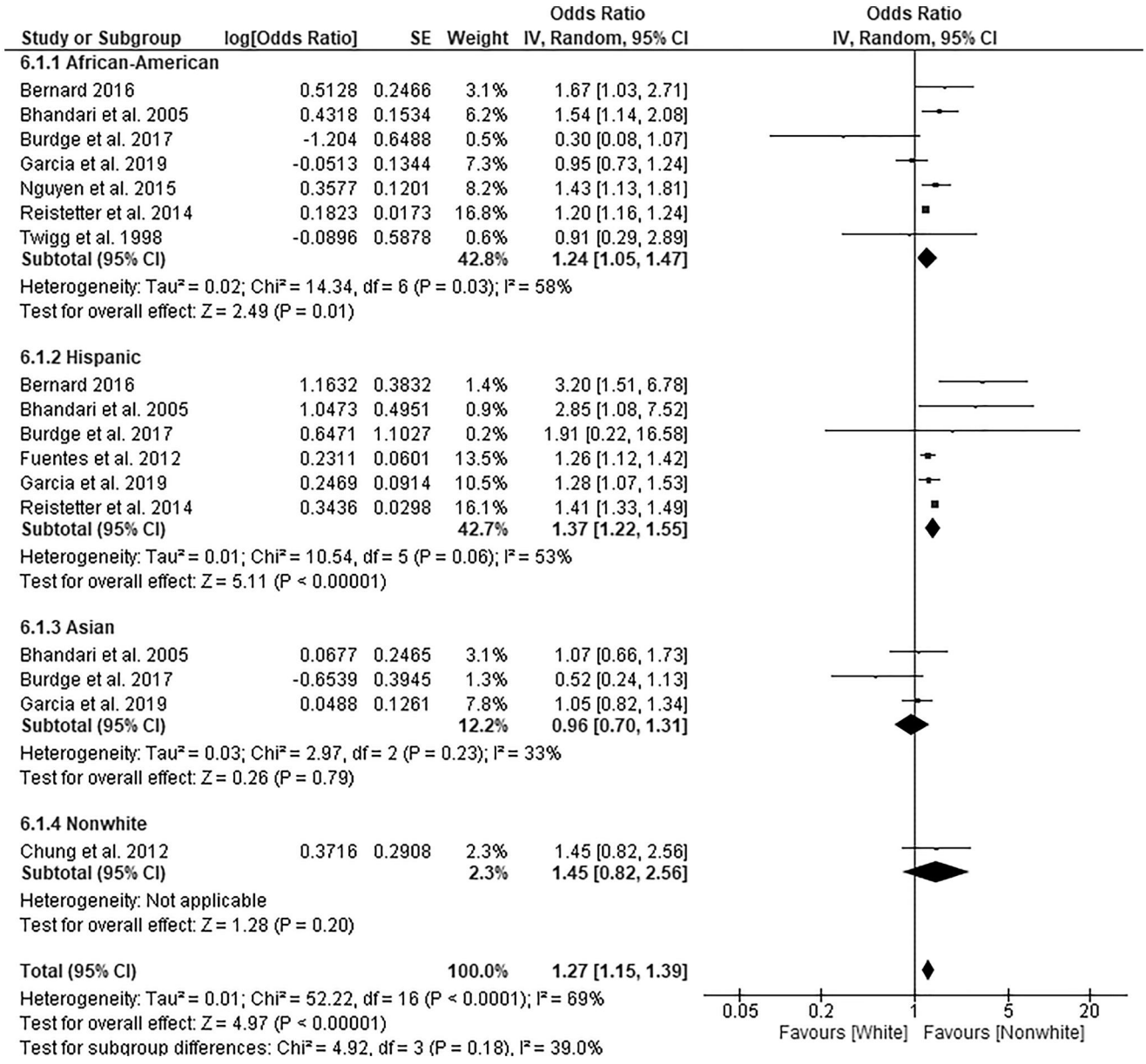

Figure 6. Forest plot of the relationship between discharge destination and ethnicity of patients with stroke. Subgroup analyses for African American, Hispanic and Asian are presented. SE: standard error; IV: inverse variance; CI: confidence interval.

The majority of factors identified in this systematic review are from the proximal level as fewer factors from the intermediate level were assessed in the included studies.

In light of this study's findings, social support, marital status, cohabitation status and prestroke living arrangement should be assessed during discharge planning after inpatient stroke rehabilitation. Included studies reported that different forms of support, family, presence and availability of a caregiver and social network, showed an increased likelihood of returning home [12,26,29–32,33]. The positive results of cohabitation and marital status seem to be linked to those of support at home. Indeed, married people and people living with others may benefit from their support. Therefore, it is important to inquire after marital and cohabitation status, so as to consider intimate partners who live together and are not married, as well as intimate partners who live apart [61]. However, our results showed that support at home has a higher likelihood for discharge home than cohabitation or marital status have. As such, at admission to inpatient rehabilitation, healthcare professionals should investigate if the patient benefits from support at home, specifically, the presence of a willing and able caregiver [26,29,31,32].

The above-mentioned results are consistent with previous systematic reviews. Two reviews on discharge from acute care assessed marital status and showed positive [10] or conflicting results [9]. Cohabitation status also showed positive results [10]. Similarly, Burton et al. [8] assessed predictive factors for discharge to long-term care and showed that unmarried, divorced or widowed people, as well as people with "poor social support" were more likely to be discharged to long-term care. Furthermore, these factors were also identified in studies assessing the long-term living setting after discharge from inpatient rehabilitation. Marital status was also a significant factor for living at home up to two years after discharge [62,63], while social support was associated with community reintegration at three months post-discharge [64]. This indicates that the need for support exists beyond inpatient rehabilitation [65].

Table 4. Further factors for discharge home.

Factor	Definition	Study ID	Odds Ratio (95% CI) or *narrative*	*N*
Employment status	Not working vs employed	Nguyen et al. 2015	1.21 (0.95–1.53) $p = 1.117$	806
	Paid employment vs retired and unemployed	Wasserman et al. 2019	*No significant difference*	240
Need of support	Need of professional help before stroke onset	Frank et al. 2010	*Negative correlation*	1332
	24-h support not required	Ng et al. 2005	12.52 (2.42–64.89) $p = 0.003$	87
Social risk	Normal vs moderate and high	Pinedo et al. 2014	*Higher probability of returning home when patients were at lower social risk.*	240
Socioeconomic status	Patients without subsidies vs patient with subsidies	Chen et al. 2013	3.26 (2.44–4.36) $p < 0.05$	3903
	Financial status	Ween et al. 1996	*Assessment of financial status was not reliably reported*	376
Insurance	Medicaid vs private insurance	Chung et al. 2012	*No statistical difference*	223
	Medicaid vs private insurance	Nguyen et al. 2015	1.14 (0.92–1.42)	2085
	Medicare vs private insurance		0.56 (0.48–0.65)	
	Medicaid vs Medicare	Reistetter et al. 2014	1.21 (1.12–1.30)	143,036
	Medicare managed vs Medicare		1.08 (1.03–1.14)	
	Commercial insurance vs Medicare		1.45 (1.38–1.51)	
	Managed Care vs Medicare		1.40 (1.31–1.50)	
Country of birth*	Non-English-speaking vs English-speaking background	Nguyen et al. 2007	1.65 (0.80–3.41) when adjusted for sex, age and stroke	326
Rehabilitation type	Neurological vs geriatrics or general	Gabet et al. 2018	1.38 (1.29–1.47)	24,100
Number of family members	Number of daughters and sons	Hsieh et al. 2017	*Having more daughters independently predicts home discharge*	297
	Number of household members	Koyama et al. 2011	*More populous household were significantly more likely to lead to discharge home*	163
	Number of family member living together	Maeshima et al. 2016	*No significant difference in number of family member between patient discharge home or not.*	89
	Number of family members	Sakurai et al. 2011	*No significant difference with the probability of discharge to home.*	189

*To assess the effect of culture in discharge location; *N*: number of participants.

Additionally, the influence of ethnicity was assessed in the USA. Although the effect of ethnicity did not present clear results in previous systematic reviews [10], our review showed that non-Hispanic Whites were less likely to be discharged home after inpatient rehabilitation. Similarly, a systematic review of discharge after inpatient rehabilitation of older patients [66] showed that non-white ethnicity was significantly associated with discharge home. Reasons for this result are likely to be multifactorial. One hypothesis is the influence of cultural values, for example, a larger proportion of African Americans and Hispanics live with family compared to non-Hispanic Whites [19,55]. The influence of cultural values was also examined in an Australian study [15], however, they reported no significant difference between patients born in a non-English-speaking country and patients born in an English-speaking country.

Regarding socioeconomic status, a difficult concept to assess, patients with lower socioeconomic status tended to be less likely to return home [12,16]. Other research on socioeconomic status showed that it influences mortality [67] and recovery [68] of patients with stroke during the acute and subacute phase. Further research is needed to assess the influence of socioeconomic status on discharge destination after inpatient stroke rehabilitation. International standards could be used to assess this factor, such as the International Standard Classification of Education and the Organization for Economic Co-operation and Development (OECD) modified equivalence scale.

This systematic review and meta-analysis uncovered methodological and clinical heterogeneity among included studies. Methodological heterogeneity was present with prospective and retrospective cohort studies. Clinical heterogeneity was present in the population and in the target factors. Some studies included older patients, whereas most studies included adults over 18 years old. Definition and assessment of some factors varied between studies (e.g., socioeconomic status and support at home). Further factors showed insufficient evidence to date. The influence of employment status, type of insurance, as well as the impact of family structure and household organisation should be examined in further research.

In addition, besides discharge destination, socio-environmental factors were shown to have an impact on health status [18] and are considered responsible for health inequities in the world [17]. During rehabilitation, we should be aware that healthcare professionals cannot directly influence socio-environmental factors. Moreover, factors other than socio-environmental variables may influence discharge destination. In included studies, socio-environmental factors were combined with age, gender, functional status measured with the Functional Independence Measure (FIM), sitting balance, postural stability, or the presence of multiple comorbidities [26,29,38,47,48,53,60]. Functional status assessed with the FIM was also evaluated in a previous systematic review [2] that showed the positive impact of increased FIM scores on discharge home in patients with stroke. In brief, discharge planning should

involve healthcare professionals and patients [69], and should consider all significant factors for discharge destination. This can enhance the discharge planning process and, subsequently, have an influence to minimize costs and to avoid bed-blocking.

Limitations of the review

Some limitations of this systematic review and meta-analysis must be taken into consideration. Firstly, rehabilitation lengths of stay varied between studies from different countries, which could be a bias for the present results. Studies in the USA showed the shortest length of stay in rehabilitation and acute care, whereas studies in Japan had the longest length of stay for both settings. This bias might be limited as patients' admission and discharge from rehabilitation occurred during the subacute phase of recovery as defined by the Stroke Recovery and Rehabilitation Roundtable taskforce [70]. Thus, the recovery phase of the patients was similar in all included studies.

Secondly, caution must be taken with the results of the methodological assessment using the NOS. Although this tool has been suggested for the assessment of cohort and case-control studies [71], it showed poor to substantial inter-rater reliability for each item in a validation study [22]. To enhance the reliability between reviewers, the tool was first tested with one case-control study and two cohort studies, and reviewers decided on specific decision rules for the current review. No study was excluded based on methodological assessment.

Lastly, this review focused on proximal and intermediate socio-environmental factors. Global socio-environmental determinants, such as health policies and availability of care [45], were not included in the present systematic review. However, these factors might have an impact on the discharge destination. Koyama and colleagues [45] hypothesized that an improved social care network might influence the rate of discharge home. A synthesis of the potential impact of health policies on stroke recovery and discharge planning would add to the current review and support the decisions of policy makers.

Conclusion

This review identified predictive proximal and intermediate socio-environmental factors for the discharge home in patients with stroke after inpatient rehabilitation. During discharge planning, healthcare professionals should evaluate the availability of support at home for patients with stroke in addition to other outcomes, such as functional status. This review showed that living at home, having available support, living with someone and being married were predictive factors for a return home after inpatient stroke rehabilitation. Therefore, including these factors in the clinical process of discharge planning is essential.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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