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ORIGINAL REPORT

GENDER AND BEING BORN OVERSEAS INFLUENCES THE AMOUNT OF ACUTE STROKE THERAPY

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Objective: **To identify patient factors that influence the amount, frequency and intensity of physical and occupational therapy received by patients each weekday within 14 days of stroke.**

Design: **Exploration of data from studies conducted to monitor activity and therapy.**

Participants: **Stroke patients receiving active treatment (not for palliative care). Physiotherapists and occupational therapists.**

Results: **Therapy data for 274 patients from 7 hospitals were included. Patients received a median of 40.0 min of therapy (physiotherapy plus occupational therapy) per weekday. Multivariable regression found that women had 22% less total therapy per weekday (factor change 0.78, 95% confidence interval (CI): 0.66–0.9, $p=0.001$) and a decreased likelihood of receiving two or more sessions of therapy per weekday. Those born overseas had 23% less high intensity therapy per weekday (Factor change 0.77, 95% CI: 0.71–0.84, $p<0.001$). Those with more severe stroke had a greater likelihood of receiving two or more sessions of therapy per weekday (OR = 1.05, 95% CI: 1.02–1.09, $p=0.006$) but increasing severity increased the odds of receiving no high intensity therapy by 7% (factor change 1.07, 95% CI: 1.02–1.11, $p=0.002$). Age did not exhibit a significant association.**

Conclusion: **There is some evidence that patient factors may influence the amount of therapy provided. Physiotherapists and occupational therapists should be aware of potential biases associated with therapy provision.**

Key words: stroke; physiotherapy; occupational therapy; neglect; gender; acute care.

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INTRODUCTION

Stroke is one of the leading causes of death and disability in the world affecting between 4 and 20 per 1,000 persons a year (1). Stroke not only impacts the lives of patients but is a significant economic burden on health care services, costing an estimated $2.14 billion a year in Australia alone[1]. Importantly, an increase in the number of people affected by stroke is expected as the population ages. Because many stroke survivors are left with disability, stroke patients are among the largest users of rehabilitation services and therapists are important contributors to this rehabilitation.

It has been shown that the amount and type of therapy received by stroke patients has a significant influence on recovery (2). Therapy may help to combat the primary effects of stroke-related impairments (such as weakness) and also assist recovery by preventing secondary effects of stroke (such as disuse atrophy and stiffness). Furthermore reduction of complications due to immobility seem to be an important effect of stroke unit care (3) helping to improve outcome. Consequently, the current emphasis is on providing more therapy in order to help recovery (4), although in reality little is known about the optimal timing and distribution of therapy to help recovery after stroke (5).

Studies have demonstrated that the structure of an organization such as building layouts, gym areas and staffing can influence the amount of therapy delivered (6). Other research has shown that different philosophy, policies and procedures (such as early intervention) can influence the process of care (7). Many of these external and systemic factors are not under the control of a treating therapist. What the therapist can dictate is how they allocate their time, and this decision might be influenced by a range of individual patient characteristics.

We conducted a systematic review of individual factors that may influence therapy, and found studies suggesting that physical factors such as: stroke severity (2, 8–11) sitting balance (12), walking ability (13) and paralysis, incontinence and speech impairment (14) may influence therapy time. Other factors unrelated to physical impairment that were investigated included socioeconomic status (15, 16), age (9, 12, 14, 16–18), gender (15, 16), ethnicity (9, 14, 16), race (19), and neglect

[1]Cadilhac, Carter R, Thrift A, Dewey H. Investing in stroke: what are the potential cost offsets from the strokesafe program. National Stroke Research Institute – Technical report, 2005 [unpublished].

(20). While the heterogeneity of studies makes drawing firm conclusions difficult, it appears the most prominent influences on amount of therapy delivered are stroke severity, neglect, age, gender and premorbid walking ability.

Given the prevalence of stroke and the high demand for rehabilitation services, it is useful to investigate the patient factors that may influence the amount and schedule of therapy. This may: (*i*) help understanding of the allocation and utilization of therapy resources and (*ii*) help therapists gain an appreciation of the possible drivers of therapy after stroke. Understanding these drivers may help in the future development and delivery of therapy services for people with stroke.

The aim of this study was to identify factors that influenced the amount (minutes), intensity (low v. high) and frequency (number of sessions) of physiotherapy and occupational therapy given to stroke patients during the working week in the first two weeks after stroke.

We hypothesized that:

1. Patients with a more severe stroke would receive more therapy per weekday than those with a less severe stroke (9, 11, 12).
2. Patients with neglect would receive more therapy per weekday than those without neglect (21).
3. Patients whose first language is different to that of the country in which they now live (labeled 'born overseas') would receive less therapy per weekday.
4. Younger patients would receive more therapy per weekday than older patients (17).

METHOD

Study context

We pooled data collected over 10 years as part of studies conducted to monitor physical activity and therapy in stroke units. Eligible sites for this study were stroke units from any country who had participated in behavioural mapping using a standardized method (22) and whose original ethics approvals allowed for secondary exploration of the data. This study was approved by the La Trobe University Faculty Human Ethics Committee.

Participants

Inclusion criteria: Patients who were (*i*) admitted to a stroke care unit, (*ii*) $\geq$18 years, with a clinical diagnosis of first or recurrent stroke (World Health Organization definition), either haemorrhage or infarct (but not transient ischaemic attack), (*iii*) whose stroke onset was 14 days or less from the day of examination, (*iv*) not planned for discharge on the day of examination, and (*v*) able to provide informed consent or a responsible third party was willing to provide consent. *Exclusion criteria:* Patients who had a documented clinical decision for palliative care (i.e. those with devastating stroke) and those with subarachnoid haemorrhage because these patients are typically not managed on stroke units in Australia.

Procedure

Standardized protocol. An investigator at each site was responsible for patient recruitment, data collection and document submission to the central database located at the Florey Neuroscience Institutes, Melbourne. Consenting patients were not made aware of the specific purposes of the study, to reduce the possibility of bias. Ward staff, including therapists, were told that the study aimed to provide information about the structure and current processes of care. Consent from therapists was implied when they completed Therapy Forms (see outcome measures). Data were collected over a single 9 h day (08.00–17.00) providing a snapshot of the usual therapy provided in the early days after stroke.

Outcome measures

Baseline characteristics. Demographic information such as age, gender, date of stroke, if their primary language was other than that of the host country (for simplicity in this study called 'born overseas'), premorbid mobility (walking independence), stroke severity and neglect were acquired from patients' admission records once consent was obtained. Stroke severity was determined using the National Institute of Health Stroke Scale (NIHSS) obtained retrospectively from the medical record (23). The NIHSS has established reliability and validity in acute stroke patients.

Therapy

Therapy was recorded by the treating physiotherapist and occupational therapist for content (category) and length (minutes) on therapy forms for every episode of therapy provided on the day. These forms had been developed and tested previously in consultation with senior neurological therapists and after an extensive collaborative process involving clinical pilot studies. Records of therapy using this method were found to have moderate to high accuracy compared to an electronic timer and a video record of therapy (24). Clinical utility, good accuracy and the fact that the method required classification of therapy according to patient behaviour/activity made the approach ideal for the monitoring studies that form the basis of this research. Time spent (minutes) with the patient engaged in activity in the following categories; 1) bed mobility, 2) sitting (supported and active), 3) sitting to standing, 3) standing, 4) early gait activities, 5) advanced gait activities and 6) upper limb activities was recorded. A category of 7) 'other' was used to record cognitive, subjective and activity of daily living assessments, which did not fit into the specified activity categories. The therapy form is available from the researchers.

Therapy outcome definitions. The therapy form captures all patients' interaction time with the therapist(s) in minutes, including time spent in low activity states (e.g. subjective and cognitive assessments). Only therapy provided by a qualified therapist was included in the analyses. Therapy was grouped into physiotherapy, occupational therapy and combined therapy (physiotherapy and occupational therapy).

Although total amount of therapy time per weekday (minutes) was of primary interest, frequency (number of therapy sessions) and intensity of therapy per weekday (high and low intensity states) were also examined (Table I). Intensity relates to the expected physical exertion involved in the activities undertaken with the therapists. Therapy intensity is described as the percentage of high intensity therapy as a component of total therapy. Average total therapy time per session was also calculated.

Patients restricted to bed rest on the day of data collection were excluded from therapy intensity analyses (but included for therapy amount and frequency), as their restriction to bed rest limited their ability to have high intensity therapy.

Classification of patient factors. Premorbid mobility was classified into 'walking independently' which included independent walking without an aid, and 'not walking independently', which included being independent with aid, walking with supervision, walking with assistance, and not walking/dependent.

The NIHSS score was grouped into mild (NIHSS $<$8), moderate (NIHSS 8–15), and severe (NIHSS 16+) stroke categories. Neglect (extinction/inattention, item 15 on the NIHSS) was not recorded separately in all cases and if missing was retrieved retrospectively from the patient's medical admission record. Neglect was rated as present or absent according to the NIHSS item 15.

Table I. *Therapy intensity: grouped categories of the therapy form*

	Activities involved in each category
Low intensity	
Lying down[a]	Resting between activities/talking
Bed mobility	Rolling, bridging, lying down from sitting, wriggling across bed, sitting from lying, isolated hip/knee control
Supported sitting[a]	Out of bed, resting/talking
Active sitting (no support)	Facilitation and maintenance of symmetrical posture, weight shift side to side, facilitation of righting/ equilibrium reactions, wriggling, reaching, turning
Upper limb activities	Facilitation of movement, treatment of stiffness, pain Treatment in sitting position is assumed
Assessments (other)	Cognitive, subjective, activities of daily living assessment
High intensity	
Sitting to standing	Repeated sit to stand, any height chair, transfers: chair to bed, bed to chair
Standing	Facilitation of symmetrical posture, maintenance of posture, weight shift side to side or forward and back, turning, facilitation of righting and equilibrium reactions, stepping (single step)
Early gait activities	On level surface only. Assisted by therapist/race, supervised by therapist, with any gait aid
Advanced gait activities	Work on other surfaces. Stairs, obstacle course any surface, treadmill walking

Intensity categories were based on the expected physical exertion for each group of activities.
[a]Resting categories.

Statistical analyses of data

Data were analysed with SPSS (version 19) and STATA (version 11.IC). Threshold value for statistical significance was set as $p = 0.05$ for all analyses. Association between individual outcome measures (amount, frequency, intensity) and patient-related factors was estimated using appropriate regression models: a zero-inflated negative binomial regression model for total amount of therapy in minutes; a zero-inflated Poisson regression model for amount of high intensity therapy; and binary logistic regression for an outcome of two or more therapy sessions a day, as the typical frequency of therapy in acute stroke is one or less session per day (25). Zero-inflated count models are appropriate in situations where zero outcomes are overrepresented (such as a subgroup of patients having no therapy at all, i.e. zero minutes of therapy). Such models assume that there exist two latent groups: an "always zero" group that has the count outcome of zero with certainty, and a "not always zero" group that may have a zero or a positive count outcome. The model estimates two sets of coefficients: the coefficients estimating change in the odds of belonging to "always zero" group compared to "not always zero" group by a unit change in independent variable (holding all other variables constant), and, for "not always zero" group, the coefficients describing an expected change in the outcome variable by a unit change in independent variable (holding all other variables constant). Specific regression models were chosen on the combination of standard fit criteria and tests as implemented in SPost suit of command in STATA (26).

To avoid excessive multicollinearity the following 5 patient characteristics were chosen as independent variables: age, gender, born overseas, premorbid mobility (walking independently) and NIHSS score. The NIHSS score was selected as the most widely used measure that best captures the severity of stroke symptoms. It is highly correlated with other patient factors influencing therapy such as sitting balance (12) and walking ability (13). Separate analyses were also performed where NIHSS score was replaced as an independent variable by the presence of neglect (NIHSS item 15).

RESULTS

Data were collected from 7 metropolitan teaching hospitals (6 in Melbourne, Australia, 1 in Trondheim, Norway), all with established stroke units. The number of dedicated stroke beds in the units ranged from 6–20, with a mean length of stay ranging from 5–14 days. The therapist to patient ratio ranged from 1:10–1:12 (physiotherapists) and from 1:11–1:14 (occupational therapists).

Patient characteristics

Two hundred and seventy-four patients were included in the analyses (Table II). Mean age was 71.4 years (standard deviation (SD) = 13.4), and mean NIHSS score at admission with stroke was 10.0 (SD 7.0) (i.e. moderate severity). Therapy data were obtained in most cases from patients treated within a week of stroke (range 0–14, mean days post stroke 6.3 (SD 3.5)).

Patients restricted to bed rest

Twenty patients were restricted to bed rest due to unstable blood pressure ($n = 4$), reduced consciousness ($n = 2$), pulmonary emboli ($n = 1$), femoral haematoma ($n = 1$), suspected hip

Table II. *Patient characteristics (*n = *274)*

	n (%)
Gender	
Male	157 (57)
Female	117 (43)
Age	
< 65 years	68 (25)
65–74 years	70 (26)
75–84 years	97 (35)
> 85	38 (14)
Missing data, $n = 1$	
Born overseas	
Yes	67 (24)
No	206 (76)
Missing data, $n = 1$	
Premorbid mobility	
Independent	226 (82)
Not independent	48 (18)
Stroke type	
Ischemic	234 (85)
Haemorrhagic	40 (15)
Stroke severity	
Mild (NIHSS < 8)	131 (48)
Moderate (NIHSS 8–15)	80 (29)
Severe (NIHSS 16+)	63 (23)
Neglect	
Present	98 (36)
Absent	152 (55)
Missing	24 (9)

NIHSS: National Institute of Health Stroke Scale.

fracture ($n=1$), unstable heart rate ($n=2$), drowsiness ($n=2$), melaena ($n=1$), requiring oxygen ($n=1$), chest infection ($n=1$), treatment with tissue plasminogen activator ($n=2$), suspected deep vein thrombosis ($n=1$) and bleeding from the bowel ($n=1$). The patients placed on bed rest had higher mean age (74.5 years), and higher mean NIHSS score (14.3).

Therapy

Of the 274 patients, 257 (94%) received therapy (physiotherapy and/or occupational therapy), with 216 (79%) receiving physiotherapy and 143 (52%) receiving occupational therapy (Table III). Two hundred and nineteen (86%) patients received low intensity therapy and 186 (73%) received high intensity therapy, excluding those indicated for bed rest ($n=20$). A summary of the results for patient characteristics and therapy dimensions is displayed in Table IV.

As data were acquired over a number of years, we investigated whether therapy changed over the time range for this study by examining data from site A (where data had been continuously acquired). Mean minutes of therapy per day were consistent across 3 time epochs from 2001 (30.0, $n=20$) to 2005 (30.7, $n=15$) to 2009 (25.5, $n=13$).

Relationship between patient factors and therapy

Amount of therapy. According to zero-inflated regression assumptions, the existence of two latent groups is assumed: patients who definitely do not have therapy ("always zero" group) and those having therapy ("not always zero" group). None of the independent variables were significantly associated with the probability of being in the "always zero" group (i.e. definitely having no therapy). At the same time, in the "not always zero group", being female decreased the expected number of total therapy minutes by 22% (factor change 0.78, 95% confidence interval (CI): 0.66–0.9, $p=0.001$) as compared to being male, keeping all other factors constant. Having neglect increased the expected number of total therapy minutes by 26% (factor change 1.26, 95% CI: 1.07–1.47, $p=0.004$). All other hypothesized patient factors were not significantly associated with the amount of therapy. A summary of the regression results are displayed in Table V.

Table III. *Therapy dimensions per weekday*

Measure of therapy	Total therapy Median (IQR)	Physiotherapy only Median (IQR)	Occupational therapy only Median (IQR)
Amount of therapy (min)	40.0 (21.5–60.0)	26.0 (9.75–40.0)	10.0 (0.0–30.0)
High intensity therapy (min)[a]	11.0 (0.0–24.3)	10.0 (0.0–20.3)	0.0 (0.0–0.0)
High intensity therapy (%)	26.3 (0.0–54.8)	34.4 (0.0–70.3)	0.0 (0.0–0.0)
Therapy session, (*n*)	1.0 (1.0–2.0)	1.0 (1.0–1.0)	1.0 (0.0–1.0)
Mean time/ session (min)	25.5 (15.3–35.0)	20.0 (7.8–35.0)	10.0 (0.0–30.0)

Analyses included all patients (ie. some who received no therapy).
[a]Excluding patients indicated for bed rest $n=20$.
IQR: interquartile range (denoted by 25th and 75th percentile).

Table IV. *Patient characteristics and therapy dimensions per weekday*

Patient characteristics	Therapy, mins Median (IQR)	Total high intensity therapy[a] Median (IQR)	Therapy session Median (IQR)
Gender			
Male	45.0 (28.0–60.5)	10.0 (0.0–24.0)	2.0 (1.0–2.0)
Female	35.0 (16.5–52.5)	11.0 (0.0–25.0)	1.0 (1.0–2.0)
Age			
<65 years	40.0 (29.3–60.0)	10.0 (0.0–21.0)	1.0 (1.0–2.0)
65–74 years	45.5 (26.0–71.3)	12.0 (0.0–26.0)	2.0 (1.0–2.0)
75–84 years	41.0 (16.0–56.0)	11.0 (0.3–20.0)	1.0 (1.0–2.0)
85+ years	34.0 (17.3–50.0)	11.0 (5.5–25.0)	1.0 (1.0–2.0)
Missing data, $n=1$			
Born overseas			
Yes	40.5 (25.0–60.0)	8.0 (0.0–20.0)	1.0 (1.0–2.0)
No	39.0 (16.0–60.0)	13.0 (0.0–25.0)	1.0 (1.0–2.0)
Missing data, $n=1$			
Premorbid mobility			
Independent	26.8 (15.6–37.5)	15.0 (1.0–25.0)	1.0 (1.0–2.0)
Not independent	24.0 (13.5–30.4)	10.0 (0.0–23.0)	1.0 (1.0–2.0)
Stroke severity			
Mild (NIHSS <8)	35.0 (17.0–55.0)	13.0 (3.8–25.0)	1.0 (1.0–2.0)
Moderate (NIHSS 8–15)	50.0 (27.8–73.8)	14.0 (3.0–25.0)	2.0 (1.0–2.0)
Severe (NIHSS 16+)	45.0 (29.0–61.0)	5.0 (0.0–15.0)	2.0 (1.0–2.0)
Neglect			
Present	46.0 (30.0–65.0)	11.0 (0.0–21.0)	2.0 (1.0–2.0)
Absent	37.5 (18.3–57.0)	12.0 (0.0–25.0)	1.0 (1.0–2.0)
Missing data, $n=24$			

[a]Excluding patients indicated for bed rest $n=20$.
IQR: interquartile range.

High intensity therapy. A zero-inflated Poisson regression model was selected for total high intensity therapy analyses. A one point increase in stroke severity score increased the odds of receiving no high intensity therapy by 7% (odds ratio 1.07, 95% CI: 1.02–1.11, $p=0.002$). None of the other independent variables were significantly associated with the probability of not receiving any high intensity therapy.

In the "not always zero group" of patients, being born overseas decreased the amount of high intensity therapy by 23% (factor change 0.77, 95% CI: 0.71–0.84, $p<0.001$) as compared to being born in the country where the study took place. All other hypothesized patient factors were not significantly associated with the amount of high intensity therapy.

Number of therapy sessions. Median number of sessions was 1.0 (IQR 0.0–2.0) with a minimum of zero and a maximum of four. With these data dichotomized (0–1 versus 2–4 sessions), logistic regression was found to fit the data. According to the binary logistic regression model, being female decreased the odds of receiving two or more sessions of therapy (OR = 0.56,

Table V. *Regression analyses: Patient factors' associated with outcomes of therapy*

	Amount of therapy: zero inflated negative binomial regression		Amount of high intensity therapy: zero inflated poisson regression[a]		Having a mean of ≥2 therapy sessions per day: logistic regression	
	p-value	Factor change (95% CI)	*p*-value	Factor change (95% CI)	*p*-value	OR (95% CI)
Expected amount (min) for patients getting some or no therapy						
Female	0.001	0.78 (0.66–0.9)	0.441	0.97 (0.91–1.04)	0.028	0.56 (0.34–0.94)
Age (per year increase)	0.844	1.00 (0.99–1.01)	0.216	1.00 (0.99–1.00)	0.813	1.00 (0.98–1.02)
Born overseas	0.305	0.92 (0.77–1.08)	0.000	0.77 (0.71–0.84)	0.472	0.81 (0.46–1.43)
Premorbid independent mobility	0.552	1.07 (0.86–1.31)	0.702	0.98 (0.9–1.07)	0.992	1.00 (0.51–1.94)
Stroke severity – NIHSS (per one point increase)	0.071	1.01 (1.00–1.02)	0.417	1.00 (1.00–1.00)	0.006	1.05 (1.02–1.09)
Odds of definitely getting no therapy						
Female	0.780	0.86 (0.3–2.45)	0.794	0.92 (0.51–1.68)		
Age (per year increase)	0.883	1.00 (0.96–1.04)	0.223	0.99 (0.97–1.01)		
Born overseas	0.534	0.66 (0.18–2.43)	0.859	1.06 (0.55–2.06)		
Premorbid independent mobility	0.218	0.48 (0.15–1.54)	0.470	0.64 (0.54–2.73)		
Stroke severity – NIHSS (per one point increase)	0.204	0.95 (0.87–1.03)	0.002	1.07 (1.02–1.11)		

[a]Excluding patients indicated for bed rest $n = 20$.
CI: confidence interval; OR: odds ratio.

95% CI: 0.34–0.94, $p = 0.028$) while a higher stroke severity score independently increased the likelihood of receiving two or more sessions of therapy (OR = 1.05, 95% CI: 1.02–1.09, $p = 0.006$). Having neglect also independently increased the likelihood of receiving two or more sessions of therapy (OR = 2.23, 95% CI: 1.31–3.80, $p = 0.003$). The other hypothesized patient factors were not significantly associated with receiving two or more sessions of therapy.

DISCUSSION

The key findings of this study were that patients with a more severe stroke had a greater likelihood of receiving two or more sessions of therapy (but were less likely to receive high intensity therapy). Those with neglect received more therapy, women tended to receive less therapy, and those who were born overseas received less high intensity therapy. Age was not a significant predictor of any therapy dimension. While these results were statistically significant, individual patient factors only explained a small amount of variance in therapy provided.

This study identified that a median of 26 min of physiotherapy and 10 min of occupational therapy were provided on a weekday. A previous review identified that stroke units with proven effectiveness in reducing death and disability report a median intensity of 45 min of physiotherapy and 40 min of occupational therapy per patient per weekday (27). It is hard to compare results from this review as it included both acute plus rehabilitation care (comprehensive stroke unit) and sub acute rehabilitation care (rehabilitation stroke units), which are different to the majority of acute stroke units investigated in our study. Nevertheless, the amount of therapy identified in this study would be considered low compared with other studies (25) and does not meet the dose of 'at least 1 h of physical therapy per day' recommended in current clinical guidelines (28).

Previous work indicates that patients with more severe stroke received longer physiotherapy sessions than those with less severe stroke (9, 11, 12). Our results reflect this, with a pattern of more sessions but of low intensity. A possible explanation of why those with a more severe stroke received more therapy sessions but lower intensity is that they have more impairments (i.e. greater need for therapy) and their severity is likely to limit their ability to complete higher level tasks (e.g. sit-to-stand and gait activities) in the acute phase. One American study (10) reported that patients with more- and less-severe impairments received equivalent total therapy units, although this may be due to the health system mandate of 3 h of therapy per day.

Past literature has identified that patients with neglect had more therapy input than patients without neglect (21), though one small study reported no significant difference in the amount of therapy received in an acute hospital setting between patients with and without neglect (20). It is difficult to tease apart overall stroke severity (NIHSS) and neglect (an item in the NIHSS) as their intercorrelation meant they could not be included in the same regression. We found that patients with neglect received more total therapy and had a greater likelihood of receiving two or more sessions of therapy.

A possible reason for the difference in high intensity therapy between patients with different language backgrounds is the verbal communication barrier which limits the ability of the therapist to effectively communicate complex therapeutic activities involved in high intensity therapy. These activities often require specific instructions (along with facilitation) for different body parts to allow therapy to be effective and safe. Therapists should aim to provide clear verbal instructions along with non-verbal communication strategies (i.e. demonstrations and physical guidance) to best manage potential language challenges.

The impact of age on therapy received is difficult to determine. It has been suggested that older people may not get as

much therapy (29), and any imbalance in therapy in this age group is important as older stroke patients often have worse outcomes (30). Younger patients received more therapy than older patients (32) in a study including 1,847 participants. One smaller study has also suggested that a greater proportion of physiotherapy on the stroke unit was devoted to more basic activities in older patients compared with younger patients, in whom more time was devoted to gait correction and individual rehabilitation. When determining who gets therapy, older people were more likely to have physiotherapy and occupational therapy (16). A recent review (29) investigating age related differences in stroke care quality suggested that older patients may be disadvantaged in elements of acute care, including aspects of therapy. We found, however, that age was not a significant factor influencing therapy, and several other studies have also shown this (9, 14). It is important to guard against ageism in therapy provision, given the finding that when evidence-based care is provided, patient outcomes improve by the same magnitude, regardless of age (31).

Our results suggest that being female reduces the amount of total therapy and decreases the chance of receiving two or more sessions of therapy. We know that women have lower incidence of stroke, have more severe strokes (29, 32), and are older on average than men at stroke onset (32, 33). Our analyses controlled for age and stroke severity, so we were surprised to find that women received less therapy. Past research found no association between gender and the frequency of physiotherapy and occupational therapy (15), nor does gender appear to be a factor influencing who receives therapy (16). Possible reasons for the gender bias we indentified may be men being more likely to demand therapy than women, or there could be a relationship between the gender of the therapist and the gender of the patient (i.e. female therapist being more caring towards male patients (34)). This is supported by a study (35) which asked nurses to plan actions in a case description where the same patient was alternately described as male or female. Nurses planned significantly more ambulation, analgesic administration, and emotional support time for the male rather than female patients. It is possible that this same bias identified in nursing practices may be present in allied health fields.

A number of study limitations need to be acknowledged. Recommendations for acute stroke care have changed over time and it is true that therapy provided in 2001 may have been different to that provided in 2011. However, all stroke units included in this study were well established, stable services, and inspection of the data from site A did not reveal large changes in therapy over time. We investigated some, but probably not all, factors that may influence therapy. Other factors such as pre-existing or new depression or fatigue (not measured using the NIHSS) may also influence therapy delivery but were not measured in this study.

Although the researchers who developed the therapy data recording method showed that therapist reports were consistent with videotapes of therapy (24), a more recent study (36) has suggested physiotherapists' recording of duration of treatment time is systematically higher than therapy time as measured by video recording. This has been supported by another study (37), which identified that physiotherapists systematically overestimated total therapy time and active time but underestimated inactive time. Nevertheless, a generalized over-estimation of the amount of therapy delivered by physiotherapists would not affect the relationship between factors influencing therapy in this study, as the overestimation should be relatively consistent across all patients. Furthermore, if the 'real' amount of therapy found in this study is even lower than that reported, this should be of some concern as levels were already lower than recommended (28). We believe that bias was minimized as therapists were not informed of the specific purpose of the study.

Another potential confounding factor was the variability between sites. Including site as an independent variable in the regressions was considered as we expected that staffing levels and policies may lead to variation in therapy across stroke units. However, within each site therapy was expected to vary according to patient characteristics and needs. An assumption was made that while there could potentially be differences between sites in the amount of therapy delivered, this would not interact with the influence of patient factors. It is possible that individual patient factors may not greatly influence therapy, as therapy can be determined by how the health system allocates sessions (i.e. site management and policies). However, we found significant relationships that are likely to be real and clinically relevant.

Unlike other studies, we only measured therapy delivered within the first 14 days after stroke. We were unable therefore to examine how therapy on a day to day basis may have varied over the course of stay (38). However, an advantage of this study was that all data were gathered prospectively which is superior to retrospective data collection methods.

In conclusion, we identified several patient factors influencing therapy provided by physiotherapists and occupational therapists, and these may be important predictors to consider in improving the allocation of therapy and standardizing access to acute rehabilitation services following acute stroke.

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