

Hospital Differences in Motor Activity Early after Stroke: A Comparison of 11 Norwegian Stroke Units

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Background: Activity levels in patients early after stroke vary across the world. The primary aim of this study was to assess the variation in motor activity in patients admitted to multiple Norwegian stroke units and to identify factors which explained the variation between hospitals. *Methods:* Eligible patients were those less than 14 days after stroke, more than 18 years, not receiving palliative care. Activity levels, people present, and location were recorded by the use of a standard method of observation between 8 AM and 5 PM. Hospital policy on serving meals in communal areas was also registered. Mixed general binomial model was used to analyze, which factors explained variation in activity levels between hospitals, after adjusting for age and stroke severity. *Results:* A total of 393 patients from 11 stroke units were included. The patients spent 44.1% of the day in bed, 43.2% sitting out of bed, and 8.3% in higher motor activities (4.4% were not observed). Increased physical activity was associated with spending more time with a physical therapist, odds ratio (OR), 1.05 (95% confidence interval [CI], 1.03-1.08, $P < .001$) and admitted to a hospital serving the meals in communal areas, OR, 1.46 (95% CI, 1.09-1.95, $P = .011$). *Conclusions:* Despite variation between the hospitals, patients admitted to Norwegian stroke units spend most of the day out of bed. Time spent with a physical therapist and hospitals having a policy of serving meals in communal areas explained most of the variation in activity between hospitals. **Key Words:** Stroke—stroke units—rehabilitation—physical activity.

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Stroke unit treatment is effective in reducing death and dependency after acute stroke.¹ Fast-track diagnosis and medical treatment, early mobilization out of bed, physical activity, and coordinated interdisciplinary stroke care^{2,3}

are identified as features of stroke unit care that are common in successful stroke units.¹ Increased amount of physical activity in the early phase after stroke appears to promote earlier discharge to home and better long-term

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Received December 12, 2014; revision received February 6, 2015; accepted February 9, 2015.

The sources of funding are Liaison Committee between the Central Norway Regional Health Authority and the Norwegian University of Science and Technology and The Research Council of Norway (NRC no 205309).

There are no conflicts of interest.

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1052-3057/\$ - see front matter

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<http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2015.02.009>

outcome^{4,5} and seems to be more important than simply the timing of first mobilization.³⁻⁷ Nevertheless, previous research has shown that activity levels vary to a large extent in patients admitted to stroke units across different countries.⁸⁻¹⁰ Understanding what drives these discrepancies could help us improve stroke care and early rehabilitation.

Common models of stroke unit care are the acute stroke unit focusing on acute medical management, and the comprehensive stroke unit (CSU) combining acute medical treatment and early rehabilitation including multidisciplinary teamwork. Observational studies show that activity levels vary to a large degree, with some studies suggesting those admitted to a CSU are more active than those admitted to an acute stroke unit.^{10,11} Patients with severe stroke are shown to spend more of their daytime in bed.^{5,11} But not only patient-related factors are likely to influence activity in hospital. Staff:patient ratio and mobilization policy might also influence activity levels.^{11,12} There is evidence that environmental factors, like access to communal areas may help to increase activity levels in a rehabilitation setting.¹³ Regardless of stroke unit model, it appears that patients spend most of their day alone.^{4,14} Better understanding of the facilitators of activity could help improving stroke unit care.

The stroke units in Norway are organized as CSUs in accordance with The Norwegian National Guidelines for Stroke Treatment and Rehabilitation, published in 2010. Acute stroke patients are treated in 53 Norwegian hospitals, and out of these, 46 have well-defined stroke units. According to the Norwegian Stroke Registry, 91% of the stroke patients were treated in a CSU during their hospital stay in 2013.

The purpose of this study was to determine the amount of early motor activity in patients admitted to different Norwegian stroke units and to explore which factors explained the variation in activity between hospitals and to assess where and with whom patients spent most of their daytime.

The primary hypothesis was that patient activity levels varied across the Norwegian CSUs. The secondary hypothesis was that variation in activity between hospitals could be explained by differences in hospital characteristics and the amount of time nurses and physical therapist (PT) spent with the patients.

Material and Methods

Study Design

This was a prospective observational study including patients admitted to 11 Norwegian hospitals.

Setting

The participating hospitals were CSUs located in 3 of 4 Norwegian Health Authorities, 8 hospitals from Central

Norway Health Authority, 1 hospital from Northern Norway Health Authority, and 2 hospitals from South-East Norway Health Authority. The hospitals were 2 university hospitals, 2 small (treating less than 100), and 7 middle sized (treating between 100 and 400 stroke patients per year).

Patients were eligible if they were diagnosed with a stroke within the last 14 days, age older than 18 years, Norwegian speaking, and not receiving palliative care. Patients were excluded if they were likely to be discharged from hospital with less than 5 hours of observation.

Informed consent was obtained from those able to agree. Patients who were not able to give informed consent were included if their next of kin gave oral consent to participation. This is in keeping with Norwegian consent procedures for patients unable to consent.

Also in line with the Norwegian Act on medical and health research, the Regional Committee for Medical and Health Research Ethics in Central Norway approved the study and storage of data on behalf of all participating hospitals (REC no 2011/1428).

Observational Methods

For observation, the method of behavioural mapping was used.^{11,14} Observations were mainly conducted every 10 minutes from 8 AM to 5 PM. However, because of long traveling distances some of the observations were undertaken across 2 consecutive days, but covering the same period. At each time point, the observer recorded patient activity, who was attending the patient, and the patient's location. When patients were out of view (eg, in the bathroom or off ward), activity was acquired retrospectively, by questioning either the patient or the caregiver or from a separate activity form completed by the therapists (PTs and occupational therapists) during off ward treatment. However, when data could not be retrieved, they were recorded as not observed. The patients were observed for approximately 1 minute at each time point. The hospitals were contacted every second week, and observation was performed if there were 2 or more eligible patients. Four well-trained observers did all the observations. The training of the observers included assessment of agreement, and the training was not concluded until the agreement was excellent.

At each observation, 12 activities could be recorded; (1) no active motor supine; (2) no active motor on left side; (3) no active motor on right side; (4) sit support in bed; (5) sit support out of bed; (6) transfer with hoist; (7) roll and sit up; (8) sit with NO support; (9) transfer with feet on floor; (10) standing; (11) walking; and (12) stairs. We were interested in 3 main activity categories: in bed (activities 1, 2, 3, and 4), sitting out of bed (activities 5, 6, 7, and 8), and upright activity (activities 9-12).^{14,15}

Five main categories of location were registered; (1) bedroom, (2) on ward communal area (hall and patient lounge), (3) therapy area, (4) bathroom, and (5) off ward (doctor's room, radiologic imaging, Doppler/echo, and other).

Five main categories of people present were registered; (1) alone, or with (2) nurse (nurse and/or nurse assistant), (3) PT, (4) family, and (5) others.

Hospital Characteristics

At each day of observation, the total number of patients admitted to the ward, the number of stroke patients, and the nurse:patient ratio (number of nurses/nurse assistants at work divided on the number of patients admitted) were recorded. We also registered whether the hospital had a policy of serving meals in communal areas.

Baseline Assessment

Demographic information including age, gender, pre-morbid function assessed by modified Rankin Scale (mRS),¹⁶ stroke severity obtained by National Institutes of Health Stroke Scale,¹⁷ stroke type (infarction or intracerebral hemorrhage),¹⁸ and mRS at inclusion.

Data Processing and Analysis

The highest level of activity in every 10-minute interval was recorded in the database (Microsoft Access 2007). The recorded activity levels were put into 1 of the 3 predefined categories, and the proportion of time spent in each category was calculated as a percentage of the 55 observations per person.

When patients were not able to be observed for 1-2 observations because of privacy, missing activity data were imputed as "sitting out of bed." If more than 2 observations were missing, it was maintained as not observed. Missing activity data because of computed tomography/magnetic resonance scan or ultrasound were imputed as "in bed." All other occasions of "not observed" were recorded as missing.

Means and standard deviations (SDs) were used for descriptive purposes and the proportion of baseline variables, whereas the mean and 95% confidence intervals (CIs) were used to present time in each activity category.

All variables were tested for normality. The Kruskal-Wallis nonparametric test was used to compare differences in variables between hospitals.

A mixed logistic regression model was used to determine which of the independent variables were associated with activity levels. The independent variables we wanted to test were (1) nurse:patient ratio (the number of nurses divided by the total number of patients admitted at the day of observation); (2) number of stroke patients treated per year in each hospital; (3) if the meals

were served in communal areas or not; and the amount of time spent with (4) a nurse/nurse assistant, (5) a PT, and (6) a family member. Because of repeated measurements for each patient and a potential cluster effect of hospital, patient id and hospital id were included as random effects in the mixed logistic regression model. Three models were tested with time spent in upright activity, sitting out of bed, and in bed as dependent variables. All analyses were adjusted for age and stroke severity.

Results

A total of 547 patients were screened for inclusion from December 2011 to June 2013. Out of these, 137 patients did not meet the inclusion criteria because of palliative treatment ($n = 9$), early discharge ($n = 60$), not Norwegian speaking ($n = 3$), more than 14 days since stroke onset ($n = 39$), and did not want to participate ($n = 26$), giving a total of 410 observed patients.

Furthermore, 17 patients were excluded because the final diagnostic evaluation revealed no stroke diagnosis ($n = 16$) or the patient withdrew from the study ($n = 1$). Hence, 393 patients were included in the final data analysis. All hospitals were visited from 5 to 36 times.

Patients' characteristics at baseline showed no significant differences in age, National Institutes of Health Stroke Scale, pre-morbid mRS, mRS at inclusion, or days since stroke onset between hospitals (Table 1).

Amount of Activity

Figure 1 shows that the mean (95% CI) proportion of daytime spent in upright activities was 8.3% (7.4-9.2) for all hospitals, varying from 4.5% (4-8.6) to 13.4% (9.4-17.3), P less than .05. The proportion of daytime spent

Table 1. Baseline patient characteristics

Characteristics	N = 393
Age, y, mean (SD)	76.8 (11.2)
Male, n (%)	189 (48.1)
First-ever stroke, n (%)	284 (72.3)
Time since stroke, d, mean (SD)	5.2 (2.9)
NIHSS score, mean (SD)	7.9 (7.7)
Severity groups, n (%)	
Mild stroke (NIHSS <8)	250 (63.6)
Moderate stroke (NIHSS 8-16)	78 (19.9)
Severe stroke (NIHSS >16)	65 (16.5)
Stroke type, n (%)	
Infarction	338 (86.0)
Intracerebral hemorrhage	55 (14.0)
Prestroke mRS, n (%)	
0-1	204 (51.9)
2-3	150 (38.2)
4-5	39 (9.9)

Abbreviations: mRS, modified Rankin Scale; NIHSS, National Institutes of Health Stroke Scale; SD, standard deviation.

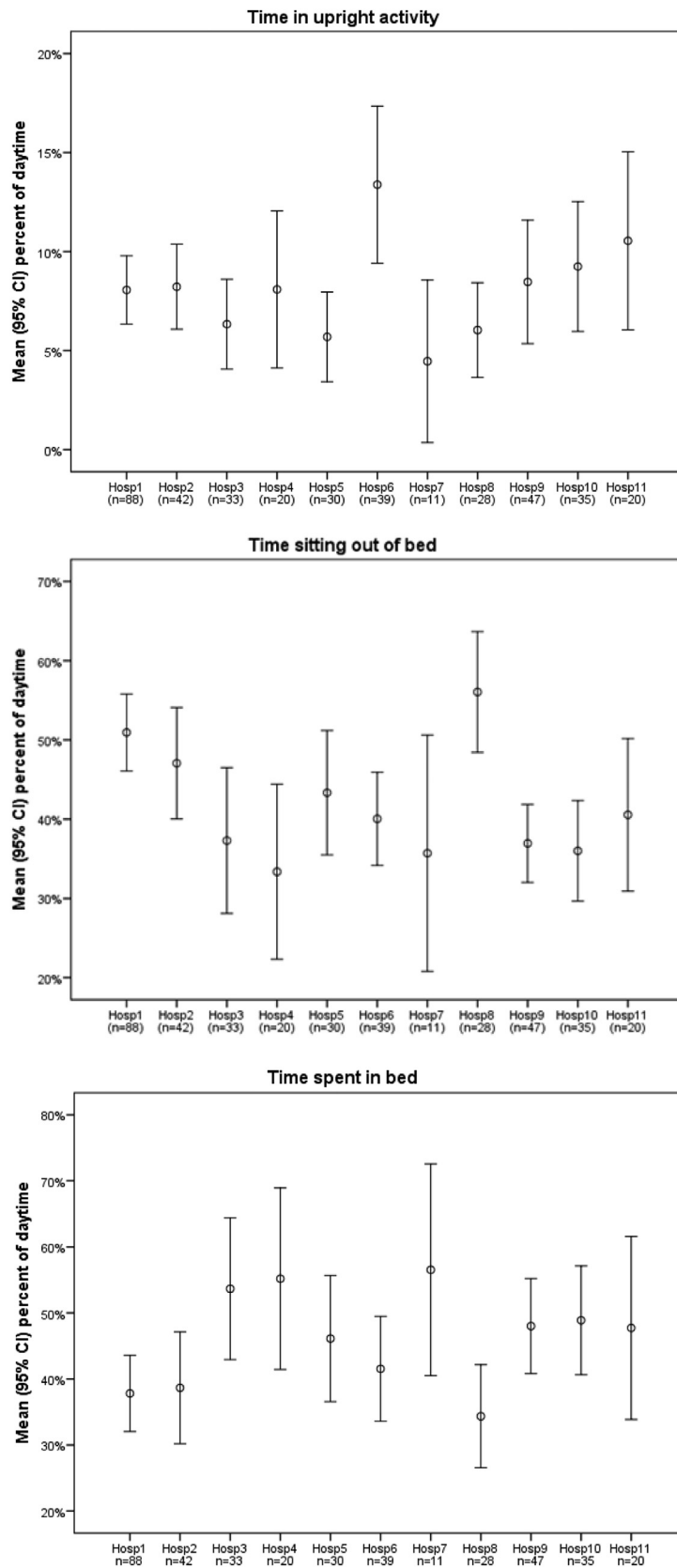


Figure 1. Time spent in different motor activity levels. Abbreviations: CI, confidence interval; Hosp, hospital.

Table 2. Proportion of daytime spent in different motor activities according to stroke severity

Activity categories	Mild stroke NIHSS <8 (n = 250)	Moderate stroke NIHSS 8-16 (n = 78)	Severe stroke NIHSS >16 (n = 65)	P value
Time in upright activity, mean % (95% CI)	11.8 (10.7-56.4)	3.2 (2.3-4.1)	.9 (.5-2.6)	.000
Time sitting out of bed, mean % (95% CI)	48.9 (46.5-51.4)	39.5 (34.4-44.5)	25.7 (20.9-30.6)	.000
Time in bed, mean % (95% CI)	33.9 (31.2-36.7)	53.5 (47.9-59.1)	72.0 (67.0-77.0)	.000

Abbreviations: CI, confidence interval; NIHSS, National Institutes of Health Stroke Scale.

sitting out of bed was 43.2% (41.0-45.4), varying from 33.4% (22.3-44.4) to 56.0% (48.4-63.6), $P = .01$. While, the proportion of daytime spent in bed was 44.1% (41.5-46.8), varying from 37.8% (32.0-43.6) to 56.5% (40.5-72.6), P less than .001. Total time not observed was 4.4% (3.6-5.1) of the day, $P = .081$. There were significant differences in activity levels between stroke severity groups (Table 2).

People Present

Overall patients spent mean (SD) are 55.9% (18.6) of the daytime alone, 3.3% (4.1) with a PT, 14.9% (9.8) with a nurse/nurse assistant, and 11.4% (9.8) with a family member (Table 3). The remaining observations (14.5% [21.2]) were with other people (team members, patient transport, other patients, and unknown) or not observed.

The mean (SD) nurse:patient ratio at the day of observation was .56 (.15) ranging from .44 (.11) to .65 (.11). Out of all observations with PT present, the patient spent 42% of the time in upright, 42% in sitting, and 16% of the time in bed.

Patient Location

For all hospitals, patients spent mean (SD) 74.4% (22.4) of their day in the bedroom, 14.0% (17.6) of their day in communal areas on the ward, 2.7% (5.5) of their day at the therapy area, and 2.7% (3.0) in the bathroom. For location off ward, the mean time was 6.2% (8.9) of the day. Time spent in the different locations on the ward except the bathroom varied significantly between hospitals with bedroom location from 57.6% (29.3) to 88.4% (11.8), ($P < .001$), communal areas from 4.0% (5.7) to 29.4% (24.5), ($P < .001$), and time spent in therapy area varied from .0% (.0) to 5.5% (8.9), ($P < .001$), (Fig 2).

The 5 hospitals with less time spent in bedroom corresponded with those serving meals in communal areas (Fig 2 and Table 3).

Factors Associated with the Activity Levels

Patients spending more time with a PT, odds ratio (OR), 1.05 (95% CI, 1.03-1.08, $P < .001$) and patients admitted to hospitals serving the meals in communal areas, OR, 1.46 (95% CI, 1.09-1.95, $P = .011$) were more likely to have an increased activity level, whereas time spent with a nurse,

OR, .98 (95% CI, .97-1.00, $P = .007$) decreased the odds for upright activity. All analyses were adjusting for age and stroke severity (Table 4).

Discussion

The present study explored factors associated with activity across a broad range of CSUs in Norway. This is the largest study of its kind. Our goal was to determine factors that may help explain interhospital variability in activity (and inactivity) in acute stroke patients.

The main findings were that the activity levels varied significantly between the hospitals and that the amount of time spent with a nurse and a PT and whether the meals were served in communal areas or not, explained most of the observed differences after adjusting for stroke severity and age. Not surprisingly, time spent with a PT and serving the meals in a dining area was positively associated with upright activity. However, time spent with a nurse was negatively associated with upright activity.

Motor Activity

Our results showed that physical therapy promotes upright activity, despite the fact that PTs only spent 42% of their therapy time targeted at walking recovery. The interpretation of our results reveals that every percent increase in time spent with a PT, that is, for every 5 minutes, the odds for being upright increased by 5%. Translated into a 20-minute additional bout of physical therapy, the odds for being upright will increase by 22% at any given time point. However, in a recent study, the authors found that increasing the dosage of therapy did not always translate into meaningful increases in physical activity across the day for patients undergoing rehabilitation after stroke.¹⁹ So although PTs have an important role to play in promoting activity and walking recovery after stroke, they need to be mindful of the actual proportion of their treatment time devoted to these important tasks. It may be possible to further increase patient activity through changes to current training programs that emphasize activity not just in therapy time but more broadly throughout the day.

In contrast, time spent with nurses was negatively associated with upright activity. This finding might mirror the

Table 3. Hospital characteristics and people present

Variables	Hosp1 (n = 88)	Hosp2 (n = 42)	Hosp3 (n = 33)	Hosp4 (n = 20)	Hosp5 (n = 30)	Hosp6 (n = 39)	Hosp7 (n = 11)	Hosp8 (n = 28)	Hosp9 (n = 47)	Hosp10 (n = 35)	Hosp11 (n = 20)	Total (n = 393)
Hosp size*	536	203	112	87	137	141	65	200	301	283	285	
Communal meals	Yes	Yes	No	No	No	Yes	No	No	Yes	No	Yes	
Mean (SD), nurse:	.65 (.11)	.54 (.12)	.51 (.21)	.48 (.12)	.64 (.14)	.44 (.11)	.56 (.19)	.54 (.08)	.55 (.17)	.62 (.22)	.59 (.09)	.56 (.15)
patient ratio												
Mean (SD) amount of daytime												
Patient alone	52.9 (17.5)	49.6 (21.2)	66.4 (18.5)	60.3 (18.5)	52.1 (19.9)	59.9 (16.5)	60.5 (18.1)	56.4 (20.4)	51.0 (16.0)	61.0 (18.2)	58.0 (14.5)	55.9 (18.6)
With nurse	18.0 (10.4)	12.3 (7.8)	10.9 (5.9)	7.9 (4.7)	16.5 (10.1)	14.2 (13.2)	19.2 (9.2)	16.0 (8.5)	16.5 (9.5)	13.1 (9.9)	15.0 (8.9)	14.9 (9.8)
With PT	2.7 (4.6)	4.1 (4.3)	3.2 (2.7)	4.0 (3.8)	4.9 (5.7)	2.2 (3.6)	2.3 (2.5)	3.4 (3.8)	3.1 (3.9)	3.3 (4.2)	2.9 (2.5)	3.3 (4.1)
With family	15.2 (16.6)	10.5 (14.8)	11.5 (20.0)	9.8 (7.6)	10.2 (11.9)	7.8 (8.2)	9.9 (14.7)	7.9 (19.2)	13.6 (13.1)	10.1 (13.3)	8.9 (14.0)	11.4 (14.8)

Abbreviations: Hosp, hospital; PT, physical therapist; SD, standard deviation.

*Stroke patients treated annually. Data from the Norwegian Stroke Registry, average for 2012 and 2013.

fact that nurses usually spend time with the patient in nursing and grooming. However, one of the core elements of stroke unit care is the multidisciplinary approach including joint work practice with nurses taking part in mobilization and training of independence in activities of daily living throughout the day.^{15,20} Our results indicate that this part of the guidelines is not yet fully implemented.

An important finding was that serving meals in a communal area was strongly associated with more time in upright activity. This is in line with the findings from a recent study from rehabilitation centers, showing higher activity levels in the hall.²¹ Spending time outside the bedroom might also represent an enriched environment, inducing more social activity.¹³ As shown in Table 2 and also confirmed by others,¹⁵ patients with the most severe strokes spent most time in bed, indicating that, the need for help in mobilization probably represents a barrier to initiate transfer to the communal areas.²²

People Present

In all hospitals, except hospital 2, patients spent most of the day (>50% of daytime) alone, while nurses were the profession who were most frequently present. This is in line with previous findings from mapping studies both in hospital and rehabilitation institutions.^{11,14,23} Our results did not reveal any association between the nurse:patient ratio and activity levels. However, nurses are a key factor in increasing the activity during most of the daytime, evenings, and weekends when PTs are not present, but finding ways to release time from other duties might be difficult. The increasing call for documentation is a significant barrier to such a change in working culture. On the other hand, increasing the staffing ratio for PTs, and also request PTs to work out of core time could be a facilitator to induce higher activity.

Although family spent more than 11% of the daytime with the patient, this did not have an impact on their activity levels. Family should also be regarded as a resource for activating patients; however, they may feel uncertain about how to take part in rehabilitation and stimulate the patient, and simple information might help promote their participation.²⁴ Because living with a family member is associated with returning home, involving family in early rehabilitation might be important.²⁵

Strengths and Limitations

A major strength of the present study was the large number of patients included from an unselected stroke population admitted to multiple Norwegian hospitals and assessment by 4 well-trained observers. However, the study has some limitations. Two of the participating hospitals were small, and the few patients included from these hospitals might represent a bias in activity data. Although the amount of missing data was very

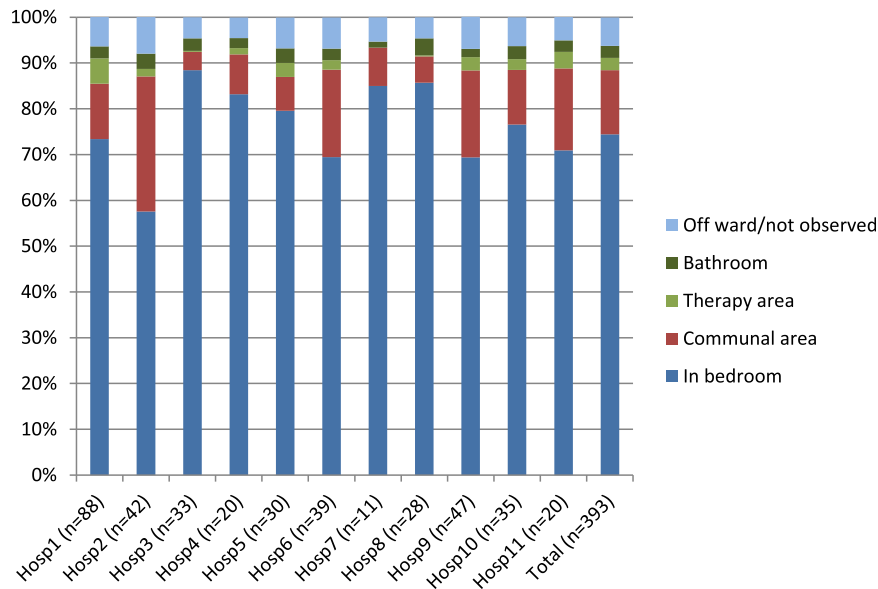


Figure 2. Patient location during the day at different hospitals. Abbreviation: Hosp, hospital.

small, the most common reason for missing was off-ward activity. Because off-ward activity like home visits is likely to be upright activity, this limitation represents a risk of underestimation of upright activities. Another limitation was the very short time for hospital stay in Norwegian stroke units, which might lead to a selection bias toward more severe stroke patients.

As we have pointed out in this article, environmental factors and staffs' ability to promote activity in acute stroke patients seems important. Activity levels peak in the morning and decline during the day.²⁶ In future research, the cost benefit of an intervention facilitating patients to more activity together with nurses and family, and promoting activity in communal areas throughout

the waking hours should be designed and tested in a randomized controlled trial.

Conclusions

Despite significant differences between the hospitals, this study has shown that patients admitted to Norwegian stroke units spend most of their daytime out of bed. Differences in time spent with PT and nurses in addition to a policy of serving meals in a communal area at the ward contributed significantly to explain the observed differences in activity levels. Minor changes in daily routines such as facilitating patients to be more active while with nurses and family, and promote activity in

Table 4. Association between independent variables and motor activity

Fixed effects (covariates)	Upright activity			Sitting out of bed			In bed		
	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
PT with patient	1.05	1.03-1.08	.000	1.03	1.00-1.06	.021	.96	.93-.99	.006
Nurse with patient	.98	.97-1.00	.007	1.02	1.00-1.03	.018	1.00	.98-1.01	.724
Family with patient	.99	.99-1.00	.156	1.00	1.00-1.01	.536	1.00	.99-1.01	.960
Nurse:patient ratio	.89	.46-1.70	.722	1.08	.52-2.23	.845	1.01	.40-2.54	.981
Communal meals	1.46	1.09-1.95	.011	.92	.67-1.26	.610	.84	.61-1.16	.284
Hospital size	1.00	1.00-1.00	.846	1.00	1.00-1.00	.088	1.00	1.00-1.00	.102
NIHSS	.88	.86-.89	.000	.92	.91-.94	.000	1.12	1.10-1.14	.000
Age, y	.98	.98-.99	.000	1.01	1.00-1.02	.006	1.00	1.00-1.01	.681
Random effect	SD			SD			SD		
Hospital ID	0.128			0.132			0.000		
Patient ID	0.654			0.961			1.240		

Abbreviations: CI, confidence interval; NIHSS, National Institutes of Stroke Scale; OR, odds ratio; PT, physical therapist; SD, standard deviation.

communal areas might encourage higher activity levels early after stroke.

Acknowledgment: The authors want to thank Jan Chamberlain and Li Chun Quang for preparing the data and medical student Martina Reiten Bovim, nurse/MSc Christine Sandø Lundemo and PT/MSc Mari Gunnes for collecting data.

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