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Complete List of Authors:	Hartley, Peter; Cambridge University Hospitals NHS Foundation Trust, Physiotherapy Department Alexander, Kerry; Cambridge University Hospitals NHS Foundation Trust, Physiotherapy Department Adamson, Jennifer; Cambridge University Hospitals NHS Foundation Trust, Physiotherapy Department Cunningham, Carol; Cambridge University Hospitals NHS Foundation Trust Embleton, Georgina; Luton and Dunstable Hospital NHS Foundation Trust, Physiotherapy Department Romero-Ortuno, Roman; Cambridge University Hospitals NHS Foundation Trust, Department of Medicine for the Elderly; University of Cambridge Institute of Public Health, Clinical Gerontology Unit
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The Association of Cognition with Functional Trajectories in Patients Admitted to Geriatric Wards: a Retrospective Observational Study

Peter Hartley,[1] Kerry Alexander,[1] Jennifer Adamson,[1] Carol Cunningham,[1] Georgina Embleton[2] and Roman Romero-Ortuno[3,4]

[1] Department of Physiotherapy, Addenbrooke's Hospital, Cambridge, United Kingdom; [2] Department of Physiotherapy, Luton and Dunstable Hospital, Luton, United Kingdom; [3] Department of Medicine for the Elderly, Addenbrooke's Hospital, Cambridge, United Kingdom; [4] Clinical Gerontology Unit, Department of Public Health and Primary Care, University of Cambridge, United Kingdom

Address correspondence to Peter Hartley, Department of Physiotherapy, Box 185, Addenbrooke's Hospital, Cambridge University Hospitals NHS Foundation Trust, Hills Road, Cambridge, CB2 0QQ, United Kingdom. Email: peter.hartley@addenbrookes.nhs.uk; Telephone: +44 1223 274 438

Short running title: Cognition and Functional Trajectories

Authors' contributions: Peter Hartley conceived the study, collected and interpreted data, performed statistical analyses, and prepared the manuscript. Kerry Alexander, Jennifer Adamson, Carol Cunningham, Georgina Embleton and Roman Romero-Ortuno collected and interpreted data and revised the manuscript critically for important intellectual content. All authors read and approved the final manuscript before submission.

Abstract

Aim: impaired cognition is common among older patients admitted to acute hospitals, but its association with functional trajectories has not been well studied.

Methods: retrospective observational study in an English tertiary university hospital. We analysed all first episodes of county residents aged ≥75 admitted to the Department of Medicine for the Elderly (DME) wards between December 2014 and May 2015. History of dementia or a cognitive concern in the absence of a known diagnosis of dementia were recorded on admission. A cognitive concern included possible undiagnosed dementia or delirium. Function was retrospectively measured with the modified Rankin Scale (mRS) at preadmission baseline, admission and discharge.

Results: There were 663 first hospital episodes over the period, of which 590 patients survived. Among the latter, 244 had no cognitive impairment, 134 a diagnosis of dementia, 66 a cognitive concern in the absence of a known dementia, and 146 had missing cognitive data. When frailty, acuity, age and comorbidity were controlled for, people with known dementia had a similar functional recovery compared to those with no cognitive impairment. People with a cognitive concern but no known dementia had lesser functional recovery, and greater disability at discharge than those with no cognitive impairment (mean discharge mRS 3.4 compared to 3.1, p=0.011).

Conclusions: Dementia *per se* may not be a marker of poor rehabilitation potential. Older people with acute cognitive concerns may be more vulnerable to poor functional recovery. Our cognitive variables are not gold standard and further research is needed to clarify this relationship.

Key words

Cognition

Disability

Frail Elderly

Functional trajectory

Length of Stay

Introduction

Impaired cognition is common among older patients admitted to acute hospitals,[1-4] and is associated with a range of adverse outcomes including prolonged length of stay, impaired functional recovery and higher risk of institutionalization.[5-8] With an ever-increasing population of older people,[9] the prevalence of cognitive impairments in the hospital is expected to rise.

Despite reports of the prevalence of dementia in acute hospitals being approximately 40%,[4] the National Audit of Intermediate care in the United Kingdom reported in 2012 that just 12% of patients in intermediate care had dementia.[10] This may reflect an under-diagnosis of dementia in intermediate care, or that patients with dementia are either not being referred for or accepted for intermediate care. Even though national intermediate care guidance has been produced aiming at not excluding older people with mental health problems,[11] part of the apparent underrepresentation may be due to clinical decision-making. Decisions to refer to intermediate care services such as inpatient rehabilitation are made by the acute hospital's multi-disciplinary team in conjunction with the patient, based on whether they feel the patient has the potential to recover further on discharge from hospital and would benefit from the service. The intermediate care service then decides if they agree with the recommendation and can accept the referral. The data from the National Audit of Intermediate care raises the question as to whether there is a difference in functional trajectories of older patients admitted to hospital with dementia or other cognitive impairments compared to patients with no diagnosed cognitive impairment.

The aim of this study was to retrospectively compare the functional trajectories of patients with cognitive impairment and those with no documented cognitive concern in a cohort of patients admitted to Department of Medicine for the Elderly (DME) wards.

Methods

Study design and setting. We conducted a retrospective observational study in a large tertiary university National Health Service (NHS) acute hospital in the United Kingdom.

Measures. The following measures were extracted from the hospital's electronic information systems:

- Age (years) and gender.
- Total length of stay (LOS, days).
- Emergency Department Modified Early Warning Score (ED-MEWS, highest recorded in the ED). MEWS scores are considered a measure of acute illness severity.[12,13] Our ED-MEWS and its scoring protocol are shown in Table 1.
- Inpatient mortality (yes or no).
- Readmission within 30 days of discharge.
- Place of residence before admission and discharge destination (own home versus others: extra sheltered accommodation, residential home, nursing home, or another inpatient facility).
- Existence of a formal care package, prior to admission and on discharge (yes or no).
- Clinical Frailty Score (CFS).[14] A local Commissioning for Quality and Innovation (CQUIN) hospital payment incentive scheme (http://www.institute.nhs.uk/commissioning/pct_portal/cquin.html) implemented in 2013 mandated that all patients aged 75 years or over admitted to the Trust via the emergency pathway be screened for frailty using the CFS within 72 hours of admission.

- Charlson Co-morbidity Index (CCI) (without age adjustment).[15]
- Known history of dementia, or a cognitive concern recorded on admission in the absence of a known diagnosis of dementia (yes or no). The admitting team collected this information under a parallel CQUIN scheme. The cognitive CQUIN assessment does not intend to diagnose dementia, it tries to separate the dementias that General Practitioners (GPs) already know about from hospital-identified acute cognitive concerns that GPs may need to assess or investigate further after discharge. In the latter cases, the discharge summaries include information on the clinical evolution of the confusional state (e.g. resolved or not), formal assessments made while in hospital, or recommendations/plans for further assessments in the community. It is possible that some of those with a history of dementia had a superadded delirium, and those with acute cognitive concern may have had an underlying undiagnosed dementia. We do not think that our cognitive variables are 'gold standard' for the diagnosis of dementia or delirium, they should be seen as surrogates.
- The modified Rankin Scale (mRS) was used as a measure of function.[16] Scores were retrospectively calculated for preadmission baseline, admission, and discharge.[17]
- Average physiotherapy frequency defined as LOS divided by number of physiotherapy contacts.

Participants. We analyzed all first admission episodes of people aged ≥75 years admitted to the Department of Medicine for the Elderly (DME) wards between 1st December 2014 and 30th May 2015. Patients from outside the county boundaries were excluded because of differences in the social care service delivery, which we believed might introduce bias in outcomes, particularly LOS. Patients with a CFS score of 9 were

also excluded, as it was felt that terminal illness could be independent of frailty and could therefore bias results. We also excluded patients who died during the hospital admission, as this would be rated as a mRS of 6 and would bias the analysis of the functional trajectories.

Statistical analyses. Anonymized data was analyzed with IBM SPSS Statistics (version 22) software. Descriptive statistics were given as number (with percentage) or mean (with standard deviation [SD]). For testing for differences between categories Independent samples Mann-Whitney U tests were used for continuous variables and Chi-squared tests for categorical variables. A repeated measures analysis of variance (ANOVA) design was used to assess whether there were differences in change in mRS from baseline to discharge when patients were stratified by cognitive category. Age, CFS, CCI and ED-MEWS were controlled for.

Ethics approval. This Service Evaluation Audit was registered with our center's Safety and Quality Support Department (Project Register Number 4803). Formal confirmation was received that approval from the Ethics Committee was not required.

Declaration of sources of funding. Permission to use the CFS was obtained from the principal investigator at Geriatric Medicine Research, Dalhousie University, Halifax, Canada. Funding was not required for this study.

Results

There were 663 first hospital episodes over the period, of which 590 patients survived. Among the latter, 244 had no cognitive impairment, 134 had a diagnosis of dementia, 66 had a cognitive concern in the absence of a known of dementia, and 146 had missing cognitive data. Baseline characteristics and hospital outcomes are summarized in Table 2.

The repeated measures ANOVA model showed significant differences in mRS change from baseline to discharge (interaction between cognitive categories and time: F=4.884, p=0.002, partial eta^2=0.030). Post hoc analysis of least squared differences revealed that there was no statistically significant difference between groups other than between those with a new cognitive impairment in the absence of a diagnosis of dementia and those with no cognitive impairment.

The estimated marginal means (with 95% confidence intervals) of the cognitive categories for baseline, admission, and discharge mRS are summarized in Figure 1 and Table 3. The difference between the change in mRS from baseline to discharge between those with a new cognitive impairment in the absence of a diagnosis of dementia and those with no cognitive impairment appear to be due to lack of functional recovery during hospital admission rather than a difference between the two groups at baseline or on admission (Table 2).

Discussion

This study retrospectively examined the association of cognitive impairment with inpatient functional trajectories in acutely hospitalized older adults. Our results suggest that the presence of a cognitive impairment on admission to hospital is associated with higher frailty, increased disability and longer LOS (Table 2), however there was an equal degree of functional loss (as measured by the mRS) associated with admission to hospital and functional recovery by discharge (Table 2). When frailty, ED MEWS, age and CCI were controlled for people with a known dementia continued to be associated with equal functional recovery compared to those with no cognitive impairment, but also equal LOS (Table 3, Figure 1). However, with the same variables being controlled for people with a cognitive concern without a known dementia had less functional recovery, and greater disability at discharge than those with no cognitive impairment (Table 3, Figure 1).

Our results need to be interpreted in the light of the way our cognitive variables were defined. A cognitive concern without a history of dementia can be due to either undiagnosed dementia or delirium, and the latter is often associated with higher acute illness severity. Previous studies have shown that delirium in acutely admitted patients may not recover in a proportion of patients, and that is often associated with functional decline.[7,18-22] Some studies have shown that delirium has an adverse impact on rehabilitation outcomes from both short- and long-term perspectives,[23,24] and this could impair their rehabilitation potential. On the other hand, our results are also consistent with the fact that older patients with dementia recovering from delirium have comparable potential for functional recovery as their cognitively intact counterparts.[25-26]

Our study has limitations, including a retrospective design and a single center perspective. A further limitation of our study is investigating cognition as a dichotomous variable. We cannot make any assumptions about the impact of severity of cognitive impairment on functional trajectories. Another important limitation is clinical experience would suggest that despite our data being in line with prevalence reported in acute hospitals,[1-4] it is still un under-estimate. Previous studies have suggested only 35-50% of patients with dementia in hospital have a diagnosis on admission to hospital.[2,4] Furthermore, approximately 25% of patients in our cohort had missing data regarding their cognitive status. In addition we have not included 'admission diagnosis' as a variable within this study as this data was not available.

Our study implies that people with a noted cognitive impairment on admission without a known dementia are particularly vulnerable to a long length of stay, greater disability, slow functional recovery and inpatient mortality. Reasons for this are not known, but we wonder if as a 'new diagnosis of dementia' was one reason why a person may have been categorized into this group whether this group had had less contact with medical professionals in recent years increasing their vulnerability to illness. That is, had they regularly visited their GP we would imagine their dementia would have been diagnosed. It could follow that they had other undiagnosed medical conditions or presented to hospital at a later stage in their illness than those with a known diagnosis of dementia. In this regard, it is known that people with dementia who are undiagnosed are older, have fewer years in education, are more likely to be unmarried, male and have less severe dementia than those with a diagnosis.[27]

Reasons for the underrepresentation in intermediate care of those with a diagnosis of dementia are not explained by the functional trajectories following acute hospitalization. If patients with dementia do indeed have a slower functional recovery (Table 2) it would appear logical that they above others would benefit from services designed to bridge the gap between secondary and primary care services. Yet in our study also, there were significantly few patients with dementia than without who were discharged to inpatient rehabilitation (Table 2). The data may hint at a more risk averse approach to those with dementia, that is, clinicians may be more likely to keep those with dementia rehabilitating in the acute hospital as oppose to with intermediate care. Another potential factor is the common belief that patients should have the opportunity to demonstrate rehabilitation potential by participation in therapy and being able to "carry over".[28] Our study may help provide a better understanding of inpatient functional trajectories of patients with cognitive impairments and may provide a foundation to challenge preconceptions of whether a diagnosis of dementia effects rehabilitation potential.

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Disclosure statement

The authors declare no conflict of interest.

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Figure Legend

Figure 1: Estimated marginal means (95% Confidence Intervals) of Functional Trajectories of Patients Stratified by Cognitive Categories.

Table 1. ED-MEWS: components, scoring and escalation protocol. HR: heart rate (beats per minute); RR: respiratory rate (per minute); SBP: systolic blood pressure (mmHg); AVPU: **A**lert, responds to **V**oice, responds to **P**ain, **U**nresponsive; GCS: Glasgow Coma Scale; Temp: body temperature (degrees Celsius); minimum score = 0 points; maximum score = 15 points. The usual trigger for escalation (i.e. immediate referral to doctor for clinical review) is 4 or more points.

	3	**2**	**1**	**0**	**1**	**2**	**3**
HR	<40	41-50	51-60	61-90	91-110	111-129	≥130
RR	≤6	7-8	-	9-14	15-20	21-29	≥30
SBP	≤70	71-80	81-100	101-180	-	≥181	-
AVPU	U	P	V	A			
GCS				15	14	9-13	≤8
Temp	-	<35·0	-	35·0-38·4	-	38·5-39·0	≥39·0

Table 2: Patient Characteristics and Outcomes.

	No cognitive impairment (N)	Previous diagnosis of dementia (D)	Cognitive concern in absence of a previous diagnosis of dementia (C)	Group comparison	P for difference
Numbers	244 (41.3)	134 (22.7)	66 (11.2)		
Age	84.6 (5.62)	87.0 (5.43)	88.1 (6.09)	**N vs. D**	**<0.001**
				N vs. C	**<0.001**
Female	160 (65.6)	98 (73.1)	40 (60.6)	N vs. D	0.131
				N vs. C	0.454
CFS	5.0 (1.53)	6.5 (0.81)	6.0 (1.27)	**N vs. D**	**<0.001**
				N vs. C	**<0.001**
Patients with CFS ≥7 (Severely Frail)	33 (13.5)	58 (43.3)	19 (28.8)	**N vs. D**	**<0.001**
				N vs. C	**0.014**
CCI	3.2 (3.19)	4.6 (2.61)	2.9 (2.46)	**N vs. D**	**<0.001**
				N vs. C	0.363
Patients with CCI ≥ 3	91 (37.3)	79 (59.0)	27 (40.9)	N vs. D	**<0.001**
				N vs. C	0.592
ED MEWS	2.9 (1.61)	3.3 (1.62)	3.4 (1.91)	**N vs. D**	**0.033**
				N vs. C	0.050
Patients with ED MEWS > 3	72 (30.6)	50 (39.7)	27 (40.9)	N vs. D	0.083
				N vs. C	0.117
Length of stay	12.9 (10.57)	17.2 (18.62)	20.1 (16.92)	**N vs. D**	**0.004**
				N vs. C	**<0.001**
Physiotherapy frequency	0.6 (0.29)	0.5 (0.30)	0.5 (0.26)	**N vs. D**	**0.002**
				N vs. C	0.490
New Institutionalization	17 (7)	10 (7.5)	3 (4.5)	N vs. D	0.858
				N vs. C	0.477
New package of care on discharge	50 (20.5)	15 (11.2)	10 (15.2)	**N vs. D**	**0.022**
				N vs. C	0.330
Discharged to inpatient rehabilitation hospital	19 (7.8)	3 (2.2)	10 (15.2)	**N vs. D**	**0.028**
				N vs. C	0.068
Readmission within 30 days	43 (17.6)	20 (14.9)	13 (19.7)	N vs. D	0.501
				N vs. C	0.698
Inpatient Mortality	19 (7.2)	20 (13)	15 (18.5)	N vs. D	0.051
				N vs. C	**0.003**

Table 3: Estimated marginal means (95% Confidence Intervals) for the cognitive categories at baseline and discharge. Age, CFS, CCI and ED-MEWS were controlled for.

	No cognitive impairment (N)	Previous diagnosis of dementia (D)	Cognitive concern in absence of a previous diagnosis of dementia (C)	Group Comparison	p for difference
Baseline mRS	2.7 (2.6-2.9)	2.9 (2.7-3.0)	2.9 (2.7-3.2)	N vs. D	0.273
				N vs. C	0.089
Admission mRS	4.0 (3.8-4.1)	3.9 (3.7-4.2)	4.1 (3.8-4.3)	N vs. D	0.789
				N vs. C	0.548
Discharge mRS	3.1 (2.9-3.2)	3.1 (2.9-3.3)	3.4 (3.2-3.6)	N vs. D	0.751
				N vs. C	**0.011**
LOS	14.6 (12.5-16.8)	16.8 (13.8-19.7)	20.2 (16.5-24.0)	N vs. D	0.273
				N vs. C	**0.012**

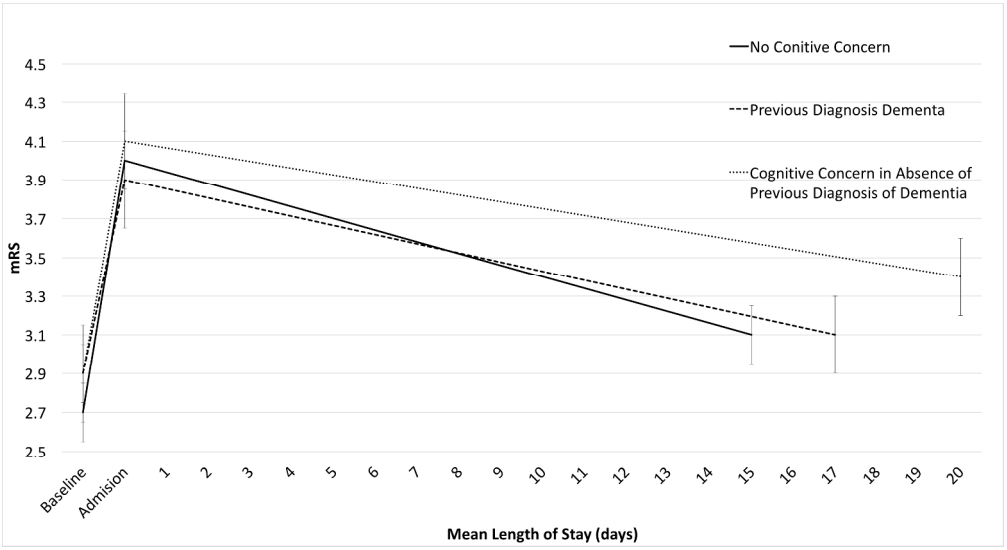

Figure 1
Estimated marginal means (95% Confidence Intervals) of Functional Trajectories of Patients Stratified by Cognitive Categories.
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