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Impaired cognition is associated with adverse outcome in older patients in the Emergency Department; the Acutely Presenting Older Patients (APOP) study

J. A. Lucke[1,2], J. de Gelder[1], C. Heringhaus[2], R. C. van der Mast[3,4], A. J. Fogteloo[5], S. Anten[6], G. J. Blauw[1], B. de Groot[2], S. P. Mooijaart[1,7]

[1]Department of Gerontology and Geriatrics, Leiden University Medical Center, Leiden, The Netherlands
[2]Department of Emergency Medicine, Leiden University Medical Center, Leiden, The Netherlands
[3]Department of Psychiatry, Leiden University Medical Center, Leiden, The Netherlands.
[4]Collaborative Antwerp Psychiatric Research Institute (CAPRI), University of Antwerp, Antwerp, Belgium
[5]Department of Internal Medicine, section of Acute Care, Leiden University Medical Center, Leiden, The Netherlands
[6]Department of Internal Medicine, section acute care, Alrijne Hospital, the Netherlands
[7]Institute for Evidence-based Medicine in Old Age (IEMO), Leiden, The Netherlands

Address Correspondence to Jacinta A. Lucke, Department of Gerontology and Geriatrics, Leiden University Medical Center, PO Box 9600, 2300 RC Leiden, The Netherlands. Tel: +31 (0)715262025. Email: j.a.lucke@lumc.nl

Abstract

Objective: to investigate whether cognitive impairment, measured early after Emergency Department (ED) arrival and irrespective of its cause, is independently associated with functional decline or mortality after 3 and 12 months in older ED patients.
Design and setting: a prospective multi-centre cohort study in all Acutely Presenting Older Patients visiting the Emergency Department (APOP study) of three hospitals in the Netherlands.
Participants: 2,130 patients, ≥70 years.
Measurements: data on demographics, disease severity and geriatric characteristics were collected during the first hour of the ED visit. Cognition was measured using the 6-Item-Cognitive-Impairment-Test ('6CIT'). Cognitive impairment was defined as 6CIT ≥11, self-reported dementia or the inability to perform the cognition test. The composite adverse outcome after 3 and 12 months was defined as a 1-point decrease in Katz Activities of Daily Living (ADL), new institutionalisation or mortality. Multivariable regression analysis was used to assess whether cognitive impairment independently associates with adverse outcome.
Results: of 2,130 included patients, 588 (27.6%) had cognitive impairment at baseline and 654 patients (30.7%) suffered from adverse outcome after 3 months. Cognitive impairment associated with increased risk for adverse outcome (adjusted odds ratio (OR) 1.72, 95%CI 1.37–2.17). After 12 months, 787 patients (36.9%) suffered from adverse outcome. Again, cognitive impairment independently associated with increased risk for adverse outcome (adjusted OR 1.89, 95%CI 1.46–2.46). ORs were similar for patients who were discharged home versus hospitalised patients.
Conclusion: cognitive impairment measured during the early stages of ED visit, irrespective of the cause, is independently associated with adverse outcome after 3 and 12 months in older patients.

Keywords: *geriatric emergency medicine, cognition, adverse outcome, functional decline, acute care, older people*

Introduction

Background

The prevalence of impaired cognition in older Emergency Department (ED) patients ranges from 20% to 40% [1, 2]. Irrespective of its cause, impaired cognition is an important indicator that a patient has a vulnerable brain and may suffer from other comorbidities or previously unrecognised frailty [3] and may be at risk for developing delirium. However, impaired cognition is frequently underdiagnosed in the ED [4].

Importance

Impaired cognition can have numerous causes, either transient or pre-existing, such as dementia, delirium and circulatory failure as a result of severe disease causing hypoperfusion of the brain. Cognitive impaired patients have a higher chance of adverse outcome, such as functional decline [5], decreased quality of life [6], moving to a nursing home after being hospitalised [7] and revisits to the ED [8]. Emphasis in research in the ED has been on diagnosing delirium, for which multiple screeners exist [9, 10]. However, these screening tools are specific for delirium, for instance because they score the acute onset or fluctuation of symptoms, or inattention, which may not be present in a patient with pre-existing cognitive impairment. Arguably, also these patients may benefit from early recognition, for instance by implementing delirium prevention measures prior to the delirium occurring or because of communication needs of the cognitively impaired older patient. It is, however, unclear impaired cognition measured shortly (<1 h) after the start of the ED visit, associates with adverse outcomes.

Goals of this investigation

The goal of this investigation is to assess whether there is an independent association between impaired cognition, measured early during the ED visit, and functional decline or mortality after 3 and 12 months in older ED patients. We performed a large prospective, multi-centre study in the Netherlands.

Methods

Study design and setting

A detailed description of the of the Acutely Presenting Older Patients (APOP) study was previously published [11]. In short, during 3 consecutive months all patients aged 70 years and older visiting the ED were included in this multicenter prospective cohort study. One tertiary care hospital (Leiden University Medical Center) and two secondary care hospital (Alrijne Hospital and HMC Bronovo Hospital) participated.

Selection of participants

All patients were included consecutively. Inclusion criteria were age 70 years and older. Patients who were triaged for a need of immediate care (Manchester Triage category Red), patients with an unstable medical condition, due to denied permission of the nurse or physician to enter the room and patients with a disturbed mental status without a proxy to provide informed consent were excluded. Also patients with a language barrier were not eligible. See Appendix 1 in the Supplementary data on the journal website (http://www.ageing.oxfordjournals.org) for more information about the selection of participants. Written informed consent was obtained before inclusion from all participants. The medical ethics committee of the LUMC, Alrijne Hospital and HMC Bronovo Hospital approved the study.

Methods and measurements

For extended methods and measurements, see Appendix 1. Cognition was measured using the 6-Item-Cognitive-Impairment-test (6CIT) [12]. Patients were stratified for analyses: those with a 6CIT < 10 were considered to have normal cognition, 6CIT ≥ 11 was considered cognitive impairment [13]. Also patients with self-reported dementia, or those unable to perform the 6CIT were categorised as 'impaired cognition'.

Outcome

The main outcome of the study was composite adverse outcome, a composite of functional decline or mortality at 3 months follow-up. Functional decline was defined as at least one point increase in Katz Activities of Daily Living (ADL) score or new institutionalisation, defined as moving to a nursing- or residential care home within 3 months after ED visit. Three months after the ED visit the patient was contacted by telephone. In case of no response after three attempts in three consecutive days, the general practitioner (GP) was contacted to verify phone number and living status and a letter was sent. Data concerning mortality were derived from the municipal records at 3 months follow-up. If a patient did not decease within 3 months but no data on functional status was available, the patient was considered to have no composite adverse outcome. A similar endpoint was available at 12 months.

Analysis

Baseline characteristics are presented as mean with standard deviation (SD) in case of normal distribution, median with interquartile range (IQR) in case of skewed distribution or as numbers with percentages (%). Using univariable and multivariable regression analysis with endpoint 'cognitive impairment' the independent predictors of cognitive impairment in older ED patients were assessed. Chi-square test was used to assess crude associations between cognitive impairment and functional decline or mortality. Univariable and multivariable logistic regression was used to assess the association between cognition and functional decline or mortality after 3 months. See Appendix 1 for a more detailed description of used models and sensitivity analysis. The level of significance was set at $P < 0.05$. Statistical analyses were performed using IBM SPSS Statistics package (version 23).

Results

A total of 2,130 patients participated in this study, which is a 83.4% inclusion rate of all eligible patients (see the figure in Appendix 2 in the Supplementary data on the journal website http://www.ageing.oxfordjournals.org/).

Baseline characteristics

Table 1 shows the baseline characteristics of the study population. Of all included patients 588 (27.6%) had cognitive

Table 1. Baseline characteristics of APOP, stratified by cognition status

Characteristics	All patients *n* = 2130	Normal cognition[a] *n* = 1542	Impaired cognition[b] *n* = 588	*P*-value between groups
Demographics				
Age (years), median (IQR)	79 (74–85)	78 (74–83)	83 (77–88)	<0.001
Male, *n* (%)	953 (44.7)	691 (44.8)	262 (44.7)	0.916
High education, *n* (%)	466 (22.0)	389 (25.3)	77 (13.2)	<0.001
Living in a residential care/nursing home, *n* (%)	191 (9.0)	69 (4.5)	122 (20.7)	<0.001
Hospital				0.185
LUMC	751 (35.3)	561 (36.4)	190 (32.3)	
Alrijne	881 (41.4)	631 (40.9)	250 (42.5)	
Bronovo	498 (23.4)	350 (22.7)	148 (25.2)	
ED presentation characteristics				
Arrival by ambulance, *n* (%)	1093 (51.3)	704 (45.7)	389 (66.2)	<0.001
Triage urgency, *n* (%)				<0.001
>1 h	616 (28.9)	488 (31.7)	128 (21.8)	
<1 h	1207 (56.7)	842 (54.6)	365 (62.1)	
<10 min	306 (14.4)	211 (13.7)	95 (16.2)	
Blood tests performed, *n* (%)	1696 (79.6)	1216 (78.9)	480 (81.6)	0.155
Fall-related ED visit, *n* (%)	582 (27.3)	375 (24.3)	207 (35.2)	<0.001
Main complaint, *n* (%)				<0.001
Minor trauma	669 (31.6)	475 (31.0)	194 (33.2)	
Malaise	398 (18.8)	260 (17.0)	138 (23.6)	
Chest pain	334 (15.8)	292 (19.1)	42 (7.2)	
Abdominal pain	214 (10.0)	167 (10.9)	47 (8.0)	
Dyspnoea	240 (11.8)	157 (10.3)	93 (15.9)	
Other	112 (5.3)	88 (5.8)	24 (4.1)	
Syncope	101 (4.8)	72 (4.7)	29 (5.0)	
Major trauma	16 (0.8)	12 (0.8)	4 (0.7)	
Psychiatric complaint	21 (1.0)	7 (0.5)	14 (2.4)	
Geriatric characteristics				
Hours of home-care, median (IQR)	0 (0–3)	0 (0–3)	2.5 (0–7)	<0.001
Use of walking device, *n* (%)	923 (43.5)	555 (36.1)	386 (63.0)	<0.001
Number of medications, median (IQR)	5 (3–8)	5 (3–7)	5 (3–8)	1.00
Katz index of ADL, median (IQR)[c]	0 (0–1)	0 (0–1)	1 (0–3)	<0.001
6CIT score, median (IQR)[d]	4 (2–9)	3 (0–6)	16 (13–21)	–

n, number; IQR, interquartile range; ED, Emergency Department; 6CIT, 6 Item Cognitive-Impairment-Test; ADL, activities of daily living.
Data are complete, except for use of walking device (*n* = 8), level of education (*n* = 10), triage category (*n* = 1), main complaint (*n* = 15), Katz ADL score (*n* = 31), hours of home-care (*n* = 63), number of medications (*n* = 1), and 6CIT score (*n* = 202).
[a]6CIT score 0–10.
[b]6CIT ≥11, dementia or missing cognition.
[c]Higher scores indicate higher dependency (range 0–6).
[d]Higher scores indicate more cognitive impairment, cut-off ≥11.

impairment according to a 6CIT-score ≥11, of which 122 (5.7% of the total cohort) reported to be diagnosed with dementia (Supplemental Table S1). Compared to patients with normal cognition, patients with cognitive impairment were older (median 83 years vs. median 78 years), less frequently high educated (13.2% vs. 25.3%) and more often living in residential care or nursing home (20.7% vs. 4.5%). Cognitively impaired patients arrived by ambulance more frequently (66.2% vs. 45.7%), suffered from more urgent problems (triage urgency <1 h, 62.1 vs. 54.6%), more often had a fall-related visit (35.2% vs. 24.3%), had more impairment on the other geriatric characteristics tests because they used a walking device more frequently (63.0% vs. 36.1%), had a higher Katz ADL score (median 1 vs. median 0) and had more hours of home-care (median 2.5 vs. median 0). See Appendix 3 for a baseline characteristics of patients, stratified by cognition status.

Characteristics of impaired cognition

Appendix 4 shows which predictors independently associated with the risk of having impaired cognition. Demographic characteristics like higher age and higher level of education, triage urgency, fall-related ED visit and main complaint 'malaise', 'dyspnea' or 'psychiatric complaint' were independent predictors of having impaired cognition. Finally, a higher Katz ADL at baseline was independently associated with risk of having impaired cognition.

Association between impaired cognition and functional decline or mortality

In total 654 (30.7%) patients suffered from functional decline or mortality after 3 months. Older patients with impaired cognition had an increased risk (odds ratio (OR) 2.81, 95%CI 2.30–3.43) for functional decline or mortality

after 3 months (Table 2, Figure 1). After adjustment for age, sex and education and additionally for disease severity, comorbidities and baseline functional status patients with impaired cognition had increased risk of functional decline or mortality (OR 1.72, 95% CI 1.37–2.17).

Table 2 also shows the association between impaired cognition and functional decline or mortality after 12 months. A number of 787 patients (36.9%) suffered from functional decline or mortality after 12 months. The risk of functional decline or mortality in patients with impaired cognition after 12 months was 3-fold higher when compared to those with normal cognition (OR 3.13, 95%CI 2.57–3.81, fully corrected model OR 1.91, 95%CI 1.52–2.39).

Sensitivity analysis

We performed three sensitivity analyses. First, we studied the association between cognition and functional decline or mortality, using a lower cut-off point of ≥8 for the 6CIT (Appendix 5). The total number of patients with impaired cognition in these analyses increased from 588 (27.6%) to 847 (39.7%). Impaired cognition was still independently associated, yet the associated risk was lower (OR 1.39, 95% CI 1.12–1.73) Predictors of impaired cognition and its association with functional decline or mortality were similar to the main analysis. In a second sensitivity analysis, patients without dementia but in whom cognition could not be measured in the ED were excluded (Appendix 6). The results were comparable to the main analysis. The third sensitivity analysis showed the association between cognitive impairment and functional decline or mortality, stratified for disposition (discharged home vs. hospitalised, Appendix 7). Whereas the percentage of patients with cognitive impairment who suffered from functional decline or mortality after 3 months (38.2% vs. 54.5%) was higher in the hospitalised patient group, the odds ratios for functional decline or mortality were very similar. Also, even when correcting for disease severity, comorbidity and Katz ADL, the odds ratio for functional decline was similar for patients who were discharged home versus those who were hospitalised (OR 1.53, 95%CI 1.07–2.18 in discharged patients and OR 1.81, 95%CI 1.33–2.46 in hospitalised patients), indicating that cognitive impairment is evenly important to detect in patients discharged home from the ED. See the Tables from Appendix 4–7 in the Supplementary data on the journal website http://www.ageing.oxfordjournals.org/.

Discussion

Approximately a quarter of all older patients visiting the ED have impaired cognition. The main finding of this study is that cognitive impairment in older ED patients, irrespective of its cause, is associated with functional decline or mortality both after 3 months and 12 months, independent of demographic characteristics, disease severity, comorbidities and baseline functional status.

The results of a number of smaller studies in different populations and using different definitions of adverse outcome are in line with our finding that cognitive impairment is associated with functional decline or mortality. In one Canadian study including 1,114 older ED patients with minor injuries, frailty and cognitively impaired older patients had an adjusted risk ratio for functional decline of 1.89 (95%CI 1.38–2.59) after 3 months [5]. This is comparable to our findings in our unselected patient group, although in our study cognition was measured within 30 min to 1 h after ED arrival, while in the Canadian study cognition was assessed in the ED in 40% of the patients and within 7 days by telephone in approximately 60% of the patients. In another small study (n = 188), patients with impaired cognition were admitted to a nursing home more often after hospitalisation, which is similar to our results.

Table 2. The association between cognition and functional decline or mortality after 3 months in older ED patients

	Normal cognition[a] n = 1542	Cognitive impairment[b] n = 588	P-value
3 months functional decline or mortality, n (%)[c]	375 (24.3)	279 (47.4)	<0.001
		OR (95%CI)	
Crude	1 (ref)	2.81 (2.30–3.43)	<0.001
Model 1—corrected for age, sex and education	1 (ref)	2.18 (1.76–2.70)	<0.001
Model 2—corrected for age, sex, education, number of medications, ambulance arrival and triage	1 (ref)	1.99 (1.60–2.46)	<0.001
Model 3—corrected for age, sex, education, number of medications, KATZ ADL, ambulance arrival and triage	1 (ref)	1.72 (1.37–2.17)	<0.001
12 months functional decline or mortality, n (%)[c]	454 (29.4)	333 (56.6)	<0.001
		OR (95%CI)	
Crude	1 (ref)	3.13 (2.57–3.81)	<0.001
Model 1—corrected for age, sex and education	1 (ref)	2.37 (1.93–2.93)	<0.001
Model 2—corrected for age, sex, education, number of medications, ambulance arrival and triage	1 (ref)	2.24 (1.81–2.78)	<0.001
Model 3—age, sex, education, number of medications, KATZ ADL, corrected for ambulance arrival and triage	1 (ref)	1.91 (1.52–2.39)	<0.001

n, number; 95%CI, 95% Confidence Interval.
[a]6CIT score 0–10.
[b]6CIT score 11–28, known dementia or missing 6CIT.
[c]P-value calculated with chi-square test.

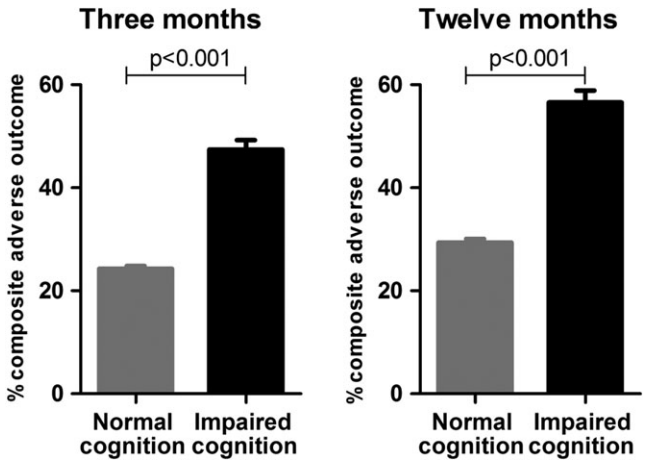

Figure 1. Incidence of functional decline or mortality for patients with normal and impaired cognition. *P* = *P*-value. 'Three months' shows the percentage of patients with composite adverse outcome after 3 months, comparing groups of patients with normal cognition and impaired cognition at baseline. 'Twelve months' shows the percentage of patients with composite adverse outcome after 12 months, comparing groups of patients with normal cognition and impaired cognition at baseline.

Finally, several studies investigated the association between cognitive impairment and other endpoints, like falls, hospital visits [14] and quality of life [6], and are therefore difficult to compare with the results of our study. Taken together, our study is the first to show the association of cognitive impairment with functional decline or mortality in unselected older ED patients.

We a priori hypothesised that cognitive impairment indicates increased vulnerability of the patients' brain that should be recognised because of the large implications. Our study shows that cognitive impairment *per se* is associated with functional decline or mortality when measured within 1 h of ED arrival, irrespective of its cause, i.e. delirium, dementia, depression or hypoperfusion of the brain. Further, those with impaired cognition (e.g. dementia) and patients with hypoperfusion of the brain due to clinical illness are at increased risk of developing delirium. Finally, patients with pre-existing dementia can have superimposed delirium. Recognition of cognitive impairment *per se* may therefore may prevent delirium. Unfortunately, ED physicians frequently miss the presence of impaired cognition [4, 15–17], probably due to a lack of education, adequate screening tools and recognition of patterns associated with a diagnosis of impaired cognition. We showed in our study that the 6CIT is associated with functional decline and mortality and may therefore be a sensible screening tool.

Besides the higher probability of delirium, cognitive impairment has other implications for ED management of older patients which may help in preventing the associated adverse outcomes. For example, cognitive impairment complicates understanding of discharge instructions and may result in worse outcomes. Written discharge instruction is therefore especially important in cognitive impaired older patients. In addition, older patients often have impairments in multiple geriatric domains, such as the social network and mobility issues. cognitive impairment may further increases the risk of adverse events and calls for interventions. In a recent essay by Jackson *et al.* [3] there is a strong call for treating older patients with cognitive impairment on a 'need of care' basis, rather than on the basis of a diagnosis. There is a need for joined up care between professionals to improve detection, diagnostics and management, whatever the specific underlying diagnosis. In this light, the current study emphasises the importance of screening for cognitive impairment, shortly after arrival to the ED, because impaired cognition is associated with functional decline or mortality, irrespective of disease severity, comorbidities and geriatric factors. Currently, proper multi-domain screening tools for older ED patients are lacking [18] and when designing these, cognitive function, for example as measured by the 6CIT should be taken into account.

This study has several limitations. First, cognition was tested within 30 min to 1 h after arrival to the ED. This could have influenced the cognition score. A patient who is anxious or in pain may perform worse resulting in an overestimation of impaired cognition. Second, we did not perform a delirium screening test. We therefore have no information on whether impaired cognition was of 'acute onset' or not. However, we set out to study the association of cognitive impairment irrespective of the cause. A third limitation is the fact that 'known dementia' was a self-reported measurement and not confirmed by medical charts or by the general practitioner. Finally, we did not perform a cognition test at follow-up, so we do not know whether the impaired cognition had persisted for several months, or was a temporary problem. However, these limitations did not influence the validity of the study.

The strengths of this study are the broad, unselected inclusion and the high inclusion rate. Another strength is the multi-centre, prospective study design with a relatively large number of patients giving us the opportunity to draw conclusions about a broad patient group that made our results more generalisable. Third, the outcome measure is clinically relevant and collected with a low chance of bias. Mortality was checked with the municipality records and the Katz ADL is a well-validated measure. Finally, this is the first large, multi-centre study focussing on cognitive impairment and composite adverse outcome (functional decline and mortality) in unselected older ED patients.

To conclude, cognitive impairment is highly prevalent in older ED patients and is associated with functional decline or mortality, independent of the cause of cognitive impairment, baseline functional status, disease severity and comorbidities.

Key points

- Cognitive impairment is highly prevalent in the ED.
- Cognition can be measured with the 6CIT.
- Impaired cognition <1 h of arrival to the ED, irrespective of its cause, is associated with functional decline and mortality after 3 and 12 months.

- This association is independent of baseline functional status, disease severity and comorbidities.
- This association is similar for patients who were discharged home versus those who are hospitalised.

Supplementary Data

Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

Conflict of interest

None declared.

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