Experimental Gerontology 174 (2023) 112129

Contents lists available at ScienceDirect

Experimental Gerontology

journal homepage: www.elsevier.com/locate/expgero

Clinical Risk Group as a predictor of mortality in delirious older adults in the emergency department

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ARTICLE INFO

Section Editor: Tibor Hortobagyl

Keywords:
Aged
Delirium
Emergency department
Survival
Chronicity

ABSTRACT

Background: In older people, chronicity is associated with delirium, which in turn increases the risk of developing poor clinical outcomes like nursing home admission and death. The aim is to determine whether chronicity, as assessed by Clinical Risk Groups (CRG), is an independent predictor of mortality in older adults with delirium seen in the emergency department (ED).

Methods: Prospective study with 18-month follow-up. Included patients were aged 65 years or older, admitted from 1 January to 31 December 2020, and diagnosed and coded for delirium in the ED of a secondary hospital. Patients were followed for 18 months. A survival analysis was performed using the Kaplan-Meier method and a multivariate Cox proportional hazards model.

Results: The study included 125 patients (56 % men, mean age 81.2 years, standard deviation [SD] 7.5). At baseline, level 0 chronicity was present in 4.7 % of the patients; level 1, 23.4 %; level 2, 32.8 %; and level 3, 39.1 %. By study end, 29.68 % (n = 38) had died. Mean survival in the total sample was 176.6 (standard error 25.8) days. Level 3 chronicity was associated with a significantly higher risk of mortality (hazard ratio 3.41, 95 % confidence interval 1.31–8.96).

Conclusions: Level 3 chronicity, as assessed by Clinical Risk Groups, is an independent predictor of mortality in older ED patients with delirium. Delirium leads to an increased level of chronicity over the following months.

1. Introduction

Delirium is a multifactorial, neuropsychiatric syndrome that usually presents as a symptom of acute pathologies in older people. Its development depends on predisposing factors such as dementia or advanced age and precipitating factors such as infection or hospital admission (Inouye et al., 2014). While associated with poor health outcomes, its consequences are closely tied to its duration and severity. Delirium can be completely reversed, although its resolution can lead to a worsening of the initial health state depending on the underlying disease (Iglseder et al., 1946. 2022).

Delirium has important consequences for older people, including cognitive impairment, longer hospital stays, increased need for institutionalization, and increased mortality (Inouye et al., 2014). It is associated with a 62 % greater risk of mortality within one year of discharge and a significant increase in health care costs (Smallheer, 2021).

In the acute phase, approximately 25 % to 33 % of patients die, a similar rate to that of acute myocardial infarction or sepsis. Another 25 % of hospitalized older people with delirium die within 3–4 months. These high rates must be considered in the context of underlying diseases (Charlson et al., 2016).

Poor health status, the presence of comorbidity, and sensory and neurocognitive deficits increase the likelihood of delirium in older people. Chronic kidney, liver, cardiac, pulmonary and central nervous system diseases play an important role as risk factors in the context of multimorbidity (Ahmed et al., 2019), increasing both vulnerability to delirium and recovery from it (Smallheer, 2021).

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https://doi.org/10.1016/j.exger.2023.112129
Received 4 September 2022; Received in revised form 16 February 2023; Accepted 17 February 2023
Available online 25 February 2023

Risk assessment systems have been developed to quantify multimorbidity. The most widely used worldwide is the Clinical Risk Group (CRG) system (Hughes et al., 2004), which classifies patients into one of several mutually exclusive CRGs according to the International Classification of Diseases codes (ICD.9.MC and/or ICD.10) (ICD-10 Version, 2019) assigned to them over the course of a year. The most aggregated level comprises nine main health states: 1) Healthy; 2) history of significant acute disease; 3) single minor chronic disease; 4) minor chronic diseases in multiple organ systems; 5) significant chronic disease; 6) significant chronic diseases in multiple organ systems; 7) dominant chronic disease in three organ systems or more; 8) dominant/metastatic malignancy; and 9) catastrophic status. The CRG system considers demographic characteristics, clinical morbidity data from electronic medical records (EMR), and primary care and hospital procedures, but others, such as drugs prescription, can be added (Caballer Tarazona et al., 2016; Monterde et al., 2019; Vivas-Consuelo et al., 2014).

Research on delirium in the emergency department (ED) has increased in recent years (Eagles, 2018; Lee et al., 2020), although studies analyzing associated health and mortality outcomes are scarce (Anand et al., 2022; Han et al., 2010; Han et al., 2017; Kakuma et al., 2003). Older people with multimorbidity and polypharmacy have a higher risk of delirium and a worse prognosis, with a higher probability of returning to a more impaired state and increased mortality. To our knowledge, no study has analyzed the relationship between CRGs and mortality after episodes of delirium. The aim of this study was to assess survival in older people presenting to the ED and diagnosed with delirium according to chronicity level, as classified using the CRG system.

2. Methods

2.1. Study design and setting

This was a cohort study with a follow-up of 18 months. The cohort was drawn from a previous case-control study (Soler-Sanchis et al., 2022) that analyzed the flow charts and main predictors of delirium in older people, according to the Manchester triage system.

2.2. Sample size

A total of 17,852 people aged 65 years or older presented to the ED during the one-year study period (Soler-Sanchis et al., 2022). Assuming an incidence of delirium of 0.7 %, a sample size of 96 patients was needed to obtain a confidence level of 95 % and a margin of error of 5 %.

2.3. Study participants

We included all patients aged 65 years and over who presented to the ED of the Hospital Francesc de Borja (Gandia, Spain), between 1 January and 31 December 2020 and who had a primary or secondary diagnosis of delirium at ED discharge according to the ICD-9 codes documented in the EMR. The attending physician determined the presence of delirium based on criteria from the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-V): (i) disturbance in attention and awareness; (ii) develops over a short period of time; (iii) additional disturbance in cognition; (iv) attention and cognition are not from a pre-existing or evolving neurocognitive disorder, and not from severely reduced arousal (coma) (European Delirium Association and American Delirium Society, 2014). Cases of delirium due to alcoholism or toxic substances were excluded.

The possible effect of the COVID-19 pandemic was analyzed, and no differences were found with respect to the year 2019 in terms of the distribution of emergencies in older people (Soler-Sanchis et al., 2022).

2.4. Data collection

Data from the EMR were collected on age, sex, ED discharge outcome, mortality during the 18-month follow-up period, and place and cause of death. In addition, we collected the level of chronicity at the time of the ED episode and at 540 days of follow-up or death, according to the EMR.

2.5. Chronicity level

Chronicity was assessed on the basis of the EMRs, managed by the Valencian Regional Health Council. This records each person's level of chronicity based on their CRG (Hughes et al., 2004), a system developed and maintained by 3M. The aim of this system is mainly cost adjustment, rather than risk adjustment; it assigns each individual to one of nine mutually exclusive risk groups based on historical clinical and demographic characteristics, as described above. To facilitate clinical use of the nine CRGs, the Valencian Regional Health Council consolidates the classification into four levels of chronicity (level 0 to level 3; Table 1) (Sánchez Mollá et al., 2017).

The levels of chronicity based on the CRGs account for social variables such as income, educational level, cohabitation, and environment. The system has been in operation for years and is constantly updated, allowing comparisons at national and international level. Accuracy is high, and the system includes data on admissions and emergency visits (recalibrating them in time windows of one year), pharmacological prescriptions, primary care services, and home care. It is updated monthly and can be consulted through the patient's EMR, both from the hospital record and from the primary care center (Hughes et al., 2004; Sánchez Mollá et al., 2017).

2.6. Ethical considerations and data confidentiality

The Hospital Francesc de Borja Ethics Committee approved the study. Data confidentiality was maintained, in line with Spanish legislation (Organic Law 3/2018, of 5 December) on the protection of personal data and the guarantee of digital rights. The study was carried out in accordance with the principles of the Declaration of Helsinki.

2.7. Statistical analysis

Categorical variables were expressed as counts and percentages (%) and continuous variables as mean and standard deviation (SD) or median and interquartile range (IQR), according to their distribution. Normality of the continuous data was checked using the Kolmogorov–Smirnov test.

Survival was assessed using the Kaplan-Meier method, and groups were compared using the log-rank test. Moreover, univariate and multivariate Cox proportional regression analyses were performed,

Table 1
Chronicity level and their correspondence with Clinical Risk Groups (CRGs).

Chronicity level	Correspondence with CRGs
Level 0	CRG 1 (healthy)
	CRG 2 (history of significant acute disease)
Level 1	CRG 3 (single minor chronic disease)
Mild chronicity	CRG 4 (minor chronic diseases in multiple organ systems)
	CRG 5 (significant chronic disease)
Level 2	CRG 6 (significant chronic diseases in multiple organ systems,
Moderate chronicity	at severity level 1–4)
Level 3	CRG 6 (significant chronic diseases in multiple organ systems,
High chronicity	at severity level 5 and 6)
	CRG 7 (dominant chronic disease in three organ systems or more)
	CRG 8 (dominant/metastatic malignancy)
	CRG 9 (catastrophic status)

using the forward stepwise method, where we included age, sex, chronicity level, and place of death. p values of <0.05 were considered significant. All data were analyzed with SPSS Statistics version 26.0 (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp).

3. Results

We included 125 participants with delirium over the study period, with a mean age of >80 years and a predominance of men. At baseline, a plurality of patients were classified as presenting level 3 chronicity, followed by levels, 2 and 1; very few patients had level 0 chronicity. The outcome of the ED encounter was admission in 60 % (n = 75) of the patients, with no significant differences according to chronicity (p = 0.68). Mortality at 18 months' follow-up was 29.7 % (n = 38), and most (76.3 %, n = 29) died during a hospital admission. No differences were found according to age, sex, ED discharge outcome, place of death, or levels of chronicity and mortality (Table 2).

Table 2
Baseline participant characteristics and associated risk of mortality at 18 months (N = 125).

Variable	Died (N = 38) n (%)	Survivors (N = 87) n (%)	Total (N = 125) n (%)	HR (95 % CI)	p
Age in years, mean (SD)	82.6 (8.2)	80.6 (7.3)	81.2 (7.5)	–	0.19
Aged ≥ 80 years	23 (60.5)	48 (55.2)	71 (56.8)	1.35 (0.59–3.04)	0.47
Sex					
Female	17 (44.7)	38 (43.7)	55 (44.0)	–	
Male	21 (55.3)	49 (56.3)	70 (56.0)	1.24 (0.54–2.87)	0.61
Chronicity					
Level 0	0 (0)	6 (6.9)	6 (4.8)	–	
Level 1	11 (29.0)	18 (20.7)	29 (23.2)	–	
Level 2	16 (42.1)	26 (29.9)	42 (33.6)	2 (0.72–5.53)	0.18
Level 3	11 (29.0)	37 (42.5)	48 (38.4)	2.09 (0.81–5.37)	0.13
Admitted after ED encounter	25 (65.8)	49 (56.3)	74 (59.2)	1.51 (0.66–3.42)	0.33
Cumulative mortality		–	–	–	–
30 days (1 month)	9 (7.0)	–	–	–	–
180 days (6 months)	22 (17.2)	–	–	–	–
365 days (12 months)	33 (25.8)	–	–	–	–
540 days (18 months)	38 (29.7)	–	–	–	–
Place of death (n = 38)		–	–	–	–
In-hospital	29 (76.3)	–	–	–	–
Home	9 (23.7)	–	–	–	–
Cause of death					
Delirium	21 (55.3)				
Cardiovascular	3 (7.9)				
Renal problems	5 (13.2)				
Respiratory problems	4 (10.5)				
Traumatological problems	1 (2.6)				
Digestive problems	3 (7.9)				
Sepsis	1 (2.6)				

CI: confidence interval; HR: hazard ratio; SD: standard deviation.

In deceased patients, chronicity at last follow-up before death was recorded. The sharp decrease in both level 1 (from 28.9 % to 7.9 %) and level 2 chronicity (from 42.1 % to 18.4 %) from baseline to death contrasts with the dramatic rise in level 3 (from 28.9 % to 73.7 %) (Fig. 1a). In survivors, chronicity was assessed at 18 months. Level 0 chronicity disappeared over the study period, and the prevalence of level 1 decreased (from 20.7 % to 12.6 %) in favor of an increase in levels 2 (from 29.9 % to 37.9 %) and 3 (from 42.5 % to 49.4 %) (Fig. 1b).

Regarding the place of death, in-hospital deaths were more common than deaths at home in all patients, regardless of chronicity level, but this difference was more pronounced in patients with level 1 (81.8 %, n = 11) and 2 (87.5 %, n = 6) chronicity compared to level 3 (54.5 %, n = 6).

Of the 29 patients who died during a hospital admission, 27.6 % (n = 8) died during the first hospital admission after their ED encounter. The primary cause of death was delirium in three patients, and other causes (respiratory, cardiac, and neurological problems) with a secondary diagnosis of delirium in the other five. The remaining 72.4 % (n = 21) died during a recurrent admission after the initial ED encounter, one with delirium as the primary cause of death. Nine others had a secondary diagnosis of delirium. In contrast, delirium was the primary cause of death in all nine patients who died at home.

Mean survival in the cohort was 176.6 days and ranged from 218.2 days in the level 1 group to 94 days at level 3 (p = 0.003) (Table 3 and Fig. 2).

In the multivariate Cox model, the people at the highest risk of death after an ED episode due to delirium were those classified as presenting chronicity level 3 (hazard ratio [HR] 3.41, 95 % CI 1.3–8.96; p = 0.031). There was no significant difference in mortality between patients with level 1 and level 2 chronicity (HR 1.37, 95 % CI 0.60–3.16; p = 0.46).

4. Discussion

The onset of a delirium episode in older people is associated with poor health outcomes, including higher mortality. This study investigated the relationship between chronicity and survival in delirious older people presenting to the ED. In our cohort, the severity of chronicity increased markedly over the follow-up period, and the overall mortality rate at 18 months was 29.7 %.

The level of chronicity in our patients was higher than that reported in other studies (Monterde et al., 2019; Briongos-Figuero et al., 2020; Lozano-Vidal et al., 2014). However, our sample was drawn from older people with delirium diagnosed in the ED, without any specific follow-up protocol other than usual care, so compared to other descriptive studies in the general population of older people, a higher prevalence of multimorbidity would make sense, as this increases the susceptibility to delirium.

Mortality rates following delirium in older people vary in the literature, ranging from 20 % at 18 months (observed in older people with delirium in the ED and discharged home (Kakuma et al., 2003)) to 27.2 % (Han et al., 2017) and 37 % (Han et al., 2010) at 6 months in older patients seen in the ED. Mortality rates in older people with delirium are as high as 41 % in the year after hospital discharge (McCusker et al., 2002), with the greatest risk of death occurring in the first few months.

To our knowledge, there are no studies that analyze chronicity levels and their relationship with delirium and mortality. However, some studies have analyzed the relationship that mortality in older people has with morbidity, polypharmacy and vulnerability (Iglseder et al., 1946. 2022; Dasgupta and Brymer, 2015; McAvay et al., 2006). Mortality in our sample is among the highest in the literature and may be due to the higher percentage of people with chronicity levels 2 and 3, which would increase the vulnerability to the risk of delirium. This chronicity indicator encompasses medical and nursing procedures performed, polypharmacy, and diseases (Caballer Tarazona et al., 2016; Monterde et al., 2019; Vivas-Consuelo et al., 2014). Bowman et al. (Bowman et al., 2020) concluded that multimorbidity and polypharmacy, as collected from the

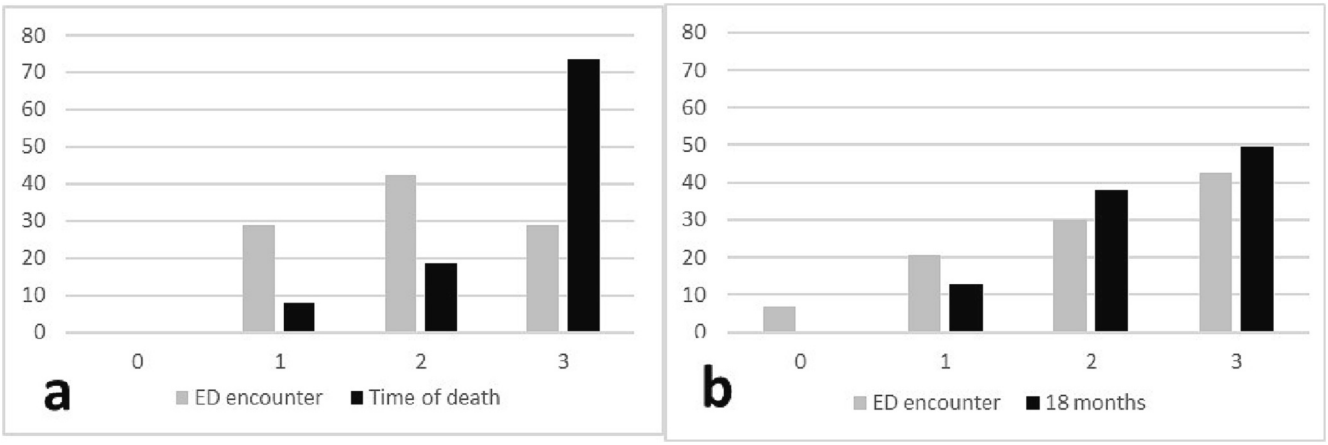

Fig. 1. Percentage of patients classified at each level of chronicity at baseline and (a) death or (b) end of study (18 months).

Table 3
Mean and median survival (days) by chronicity levels.

Chronicity	Mean survival, days	SE	95 % CI	Median survival, days	SE	95 % CI
Level 1	218.2	58.6	103.27–333.09	155	111.8	0.00–374.03
Level 2	204.4	38.6	128.71–280.16	135	168	0.00–464.28
Level 3	94.6	29.7	36.41–152.86	62	24.8	13.45–110.55
Total	176.6	25.8	125.99–227.28	93	38.5	17.49–168.51

SE: standard error; CI: confidence interval.

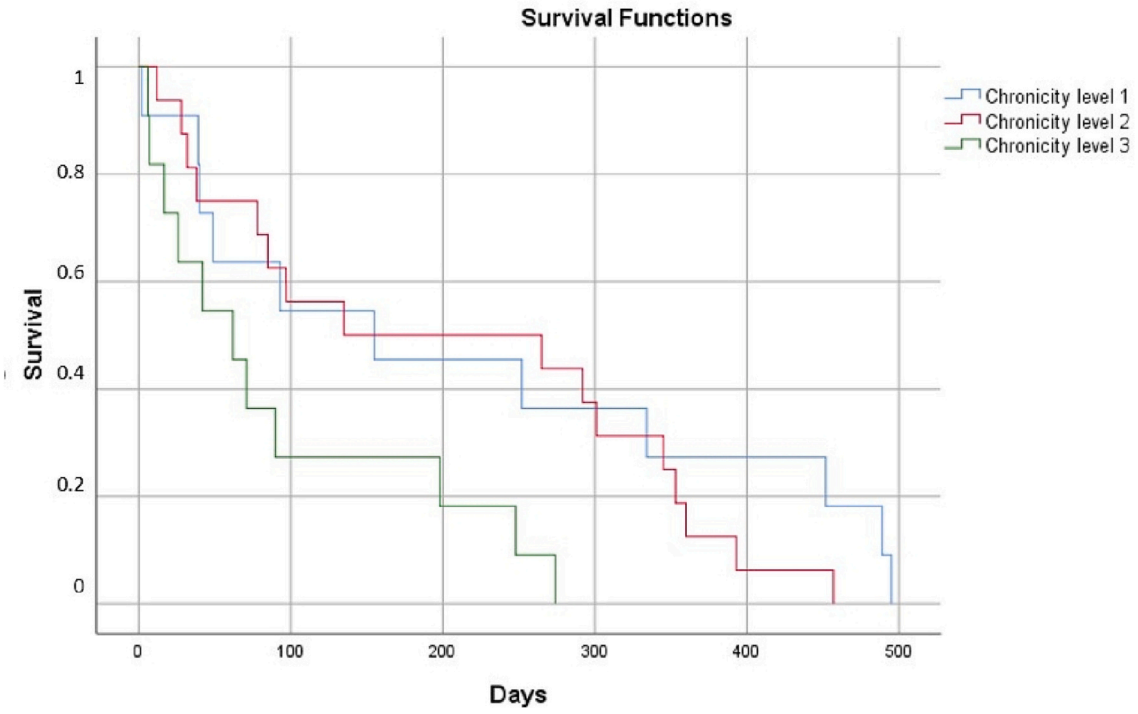

Fig. 2. Survival in delirium patients according to chronicity level.

EMR, are predictors of delirium in older people. Our results add more granularity to previously published reports, with the added value conferred from using an international system for categorizing chronicity by level of complexity. Taken together, the evidence shows that in older people, the higher the level of chronicity, the more predisposing risk factors to delirium (Inouye et al., 2014).

The impact of delirium is apparent on chronicity levels as well as mortality (McCusker et al., 2002; Dasgupta and Brymer, 2015; McCusker et al., 2003; Richardson et al., 2022). In the case of surviving patients, level 0 chronicity disappeared, and the proportion of patients classified as having chronicity level 1 decreased in favor of an increase in chronicity levels 2 and 3. The literature highlights the great impact of delirium on health, increasing cognitive impairment and dependence while decreasing quality of life, with outcomes worsening with the duration and severity of the delirious episode (Iglseder et al., 1946. 2022; Anand et al., 2022; McCusker et al., 2002; Dasgupta and Brymer,

2015; McAvay et al., 2006; McCusker et al., 2003; Bellelli et al., 2021; MacLullich and Shenkin, 2019; Zhang et al., 2022).

In the case of patients who died during the study period, the dramatic increase in level 3 chronicity at the time of death was notable. Investments in social and health care resources are needed to meet the care demand in this population (de Lange et al., 2013). The place of death also varied according to chronicity levels: people with chronicity levels 1 and 2 were much more likely to die in the hospital compared to home than people with chronicity level 3. If an older person, after an episode of delirium, evolves to chronicity level 3, the care demands on primary care professionals are high, and a large share of end-of-life care will also fall to these professionals (Bowman et al., 2020; Gladman et al., 2015; Manni et al., 2021).

Few papers have studied older people diagnosed with delirium in the ED setting (Anand et al., 2022; Han et al., 2010; Han et al., 2017; Kakuma et al., 2003). The mean survival of the cohort was 176.6 days, less than that reported by Kakuma et al. (2003), although one of the study's limitations is that it did not analyze chronicity in an objective way. Han et al. (Han et al., 2010) found that Charlson's comorbidity index, dementia, the APACHE score, and polypharmacy were related to mortality in delirium. Our study highlights the low survival in people with high chronicity with respect to the rest, using an instrument that objectively synthesizes an international measure like the CRG without duplicating other possible assessment instruments such as Charlson's index, the APACHE, and dementia tools. Our results highlight the importance of delirium prevention in older people with high chronicity, since survival is limited and the demand for care by both primary care and hospital professionals in the months following the onset of delirium will be very high.

The present study is not without limitations. Some patients with delirium may not have been included, since the EMR may contain only the primary diagnosis, not the delirium arising from it. The same applies to the cause of death; most of the patients died of delirium, but a respiratory or septic cause could have led to a subsequent delirium, whereas only the former cause may have been recorded. The predisposing and precipitating factors for delirium, plus its duration, severity, or cause were not analyzed. The update of the chronicity level is monthly, so there may be a window of up to one month without an update in some cases of death. Finally, in grouping the chronicity levels, specific information on different levels and specifically level 9 (catastrophic status), which would indicate a short survival prognosis, was not available.

5. Conclusions

The level of chronicity, as assessed by Clinical Risk Groups, is an independent factor for mortality in older ED patients with delirium. The diagnosis of delirium in older people in the emergency department increases the level of chronicity in the following months.

CRediT authorship contribution statement

P.P.-R. and A.S.-S. conceived and designed the study; A.S.-S. acquired the data; P.P.-R. analyzed and interpreted the data, A.S.-S.; P.P.-R. and F.M.M.-A. drafted the manuscript.; J.S.-F. revised the manuscript for key intellectual content. P.P.-R. also supervised the study.

Conflict of interest

The authors have no conflicts of interest.

Data statement

The data has not been previously presented orally or by poster at scientific meetings.

Acknowledgements

The authors thank all participants and the Francesc de Borja Emergency Department Hospital.

Funding sources

The present study has received no external funding.

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