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Original Article

Living alone as an independent predictor of prolonged length of hospital stay and non-home discharge in older patients

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1. Introduction

In-hospital mortality, prolonged length of hospital stay and institutionalization at discharge of older adults are widely discussed in the medical literature, because of their implications on clinical practice and health care costs. In older patients a prolonged hospitalization might worsen their vulnerability, enhancing the risk of functional loss, institutionalization and death [1]. Early identification of patients at higher risk of in-hospital mortality, longer length of hospital stay and non-home discharge is recommended in order to make more appropriate and early choices regarding hospital care and discharge. However, despite the availability of some predictive tools on these outcomes, only in a few cases they have been implemented in routine clinical practice. Perhaps this occurs because most of the available tools are disease-oriented, validated only in specific settings of care, and owing to the difficulty to objectively and comprehensively assess the complex relationship of the biomedical and psychosocial variables in the elderly [2–10]. The portion of community-dwelling older adults who live in a state of social isolation has been increasing. Moreover, after hospital discharge, they become even more vulnerable, because they lack the support needed at home.

However, social isolation is not easily definable as an epidemiologic variable and its prognostic meaning is not clear. Although subjective (the feeling of isolation) and objective measures (living alone, marital status, availability of a caregiver, number of social contacts and engagements) have been proposed, they are not necessarily related [11, 12]. Pertaining to living alone, it seems to be a stronger predictor of mortality in ages other than in the older ones [11, 13]. On one hand, in older adults living alone has been associated with a higher risk of lower medical and medication adherence, malnutrition, impaired mobility, depression and poor quality of life. On the other hand, older people who live alone might be more resilient and independent in the basic and instrumental activities of daily living, might have better cognition performances and lower burden of comorbidity [14, 15]. In addition, a stronger impact of living arrangements on health outcomes has been reported for men than for women [16, 17].

All in all, the effect of the cohabitation status on mortality in older adults is controversial. In particular, there is no evidence about its predictive role on in-hospital mortality in older patients with multimorbidity and polypharmacy. Older hospitalized adults who live alone may have a higher risk of non-home discharge for assistance needs in the activities of daily living or medication administration rather than rehabilitation needs [18]. Furthermore, non-home discharge may prolong length of hospital stay in order to wait for discharge solutions or social assistance-related problems [19–21]. Therefore, it is controversial in literature whether or not there is a direct relation between living status and length of hospital stay or the latter is only secondary to a non-home discharge. With this background and gaps of knowledge, we chose to examine the data of the REPOSI register in order to evaluate whether or not there was an association between the cohabitation status (living alone vs not living alone) and the risks of in-hospital mortality, prolonged length of hospital stay and non-home discharge.

2. Materials and methods

2.1. Data collection

The Registro Politerapie SIMI (REPOSI) is a collaborative and independent initiative of the Italian Society of Internal Medicine (SIMI), the IRCCS Istituto di Ricerche Farmacologiche Mario Negri and the IRCCS Ca' Granda Maggiore Policlinico Hospital Foundation. The register was set up in 2008 from a network of internal medicine and geriatric wards in order to collect information on acutely hospitalized elderly patients. The first data collection was run between January and December 2008, the second, third and fourth and the ongoing one were run between January and December 2010, 2012, 2014 and 2016. Since 2014, few Spanish hospitals also participated in data collection. To ensure an unselected population of elderly patients admitted to internal

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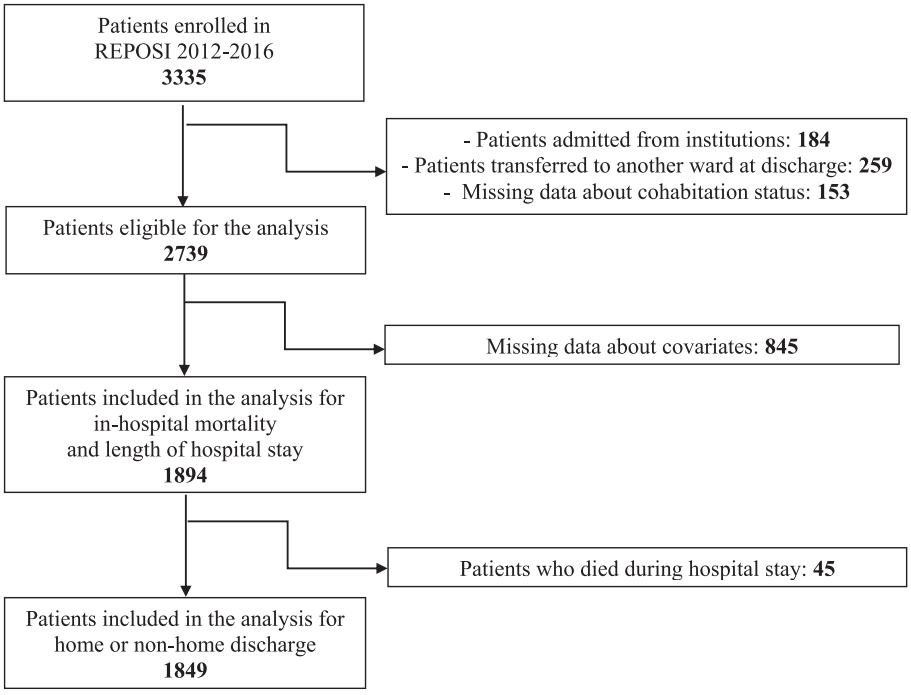

Fig. 1. Study flow chart.

medicine and geriatric wards, the first five patients acutely admitted to the wards participating in the register during four week periods three months apart were consecutively recruited if they were 65 years old or older. The principal data collected include sociodemographic factors, clinical and laboratory data and pharmacological therapies. After discharge, additional follow-up data were collected via telephone calls at 3 months. Participation was voluntary, and all patient participants signed an informed consent. More detailed description of the data set is available [22]. Data collection complied fully with the Italian law on personal data protection and the ethical committees of each ward participating in REPOSI approved the study.

2.2. Study design and measures of outcome

To study the predictive value of living alone on in-hospital mortality, length of hospital stay and non-home discharge we considered all the patients recruited in the REPOSI Register from 2012. Patients enrolled in the 2008 and 2010 REPOSI runs were excluded because the place of hospital discharge was not collected in the data set. Patients admitted from nursing homes or long-term care were excluded because cohabitation status was not evaluable, and those transferred to another ward because data on discharge was not available. Length of hospital stay was defined as the difference between date of discharge or in-hospital death and date of admission. Place of discharge was categorized in two classes as home discharge and non-home discharge, the latter including nursing homes, physical therapy/rehabilitation or palliative care institutes. Patients who died during hospital stay were excluded from sample analysis for the non-home discharge endpoint.

2.3. Statistical analysis

Covariates used to estimate the effect of living alone on the study outcomes were age, sex, education level, caregiver availability, Cumulative Illness Rating Scale (CIRS) Index of Comorbidity (IC) [23], hemoglobin levels, Short Blessed Test (SBT), Geriatric Depression Scale (GDS) and the Barthel index (BI). Patients were grouped in three pre-established age classes, as 65–74, 75–84 and ≥85 years. Education level was categorized in two classes according to the median value (< or ≥5 years). The CIRS IC and hemoglobin were evaluated at admission. Hemoglobin levels were categorized according to the levels diagnosing for anemia in the elderly (< 12 g/dl vs ≥12 g/dl). As a measure of cognitive impairment the SBT was used according to the following standard cut-off points: normal cognition (score 0–4), possible cognitive deficit (score 5–9), probable cognitive deficit (score ≥ 10) [24]. For depression the GDS short form 4 items was used, rating patient mood as no probable depression (0), minor [1] and probable depression (≥2) [25]. Both SBT and GDS were recorded during the hospital stay within two days of admission or when patients were considered stable. For measuring functional dependence in the basic activities of daily living the BI was used, scoring five levels of dependence: total (scores 0–24), severe (scores 25–49), moderate (scores 50–74), mild (scores 75–90) and minimal (scores 91–100) [26]. Characteristics of the two subgroups of patients, those living alone and those living together with someone, were compared using univariate analysis by means of the chi-squared test for categorical variables and *t*-test for continuous variables. The relation between living alone and in-hospital mortality and non-home discharge were analyzed using logistic regression in four hierarchically related models. The first model included such sociodemographic variables as age, sex, education level and availability of a caregiver. The second model was also adjusted for clinical covariates: CIRS IC and hemoglobin. In the third model SBT, GDS, BI were added to the first model and the fourth model included all the covariates. Models two and three enabled us to evaluate the association of living alone in different contexts (clinical status vs neuropsychological and functional scales), in view of the possible correlations among the several variables. The same covariates were used to evaluate by means of linear regression the association between length of stay and living alone. Statistical analyses were done using JMP Pro 10 (SAS Institute Inc. Cary. NC. USA). *P* values < .05 were considered statistically significant. In a sensitivity analysis for all the three endpoints, the fourth model was evaluated in the enlarged sample also including patients with missing data on education, GDS and SBT covariates, which accounted for 88.6% of the missing data on covariates included in models. As concerns the length of hospital stay, the fourth model was also evaluated specifically in the sample of patients discharged at home.

3. Results

Of the 3335 in-patients enrolled in REPOSI 2012–2016, 1894 were included in the analysis for in-hospital mortality and length of hospital stay. Concerning the non-home discharge outcome, 45 patients were excluded since they died during the hospital stay (Fig. 1). Table 1 shows the main characteristics of patients included in the analysis. Of 1894 patients, 456 (24.1%) lived alone, whereas most of those not living alone lived with a partner. Age, sex, marital status, presence of a caregiver, number of drugs, BI and the SBT score showed statistically significant differences between the two groups. Patients living alone were more likely to be older, females, unmarried, with no caregiver, to use a lower number of drugs and to have lower functional dependence and better cognitive status. Characteristics were very similar in the sample of 2739 patients, obtained including subjects with missing data about covariates ("eligible sample") (Fig. 1 and supplementary table 1). In all models, the condition of living alone was associated with a prolonged length of hospital stay ($p = 0.0089$ in the fourth model) and non-home discharge ($p < 0.0001$ in the fourth model), whereas the condition was not significantly associated with in-hospital mortality (Table 2). These findings were confirmed also in the sensitivity analysis (length of stay: $p = 0.0007$; non-home discharge: $p < 0.0001$; in-hospital mortality: $p = 0.61$).With regards to the length of hospital stay, the significance of correlation between living status and this endpoint was confirmed in the sample of patients who were discharged at home. Patients living alone showed a length of hospital stay 0.64 days longer than others ($p = 0.0180$). Only male sex and probable cognitive deficit correlated with a higher risk of in-hospital mortality. In addition to living alone, the only variables significantly related to length of hospital stay and non-home discharge were the hemoglobin level and functional dependence (see supplementary table 2).

Table 1
Main characteristics of 1894 patients includedMain characteristics of 1894 patients included in the analysis.[a]

Variables	Living alone	Not living alone	p
	N = 456	*N* = 1438	
Age, mean ± SD	80.3 ± 7.0	78.4 ± 7.3	< **0.0001**
Age classes, n (%)			
65–75 y	107 (23.5)	464 (32.3)	**0.0009**
75–85 y	222 (48.7)	650 (45.2)	
≥85 y	127 (27.9)	324 (22.5)	
Male, n (%)	138 (30.3)	782 (54.4)	< **0.0001**
Education level ≥ 5 years, n (%)	399 (87.5)	1237 (86.0)	0.4228
Married, n (%)	27 (6.0)	1035 (72.4)	< **0.0001**
Living with partner, n (%)		904 (62.9)	
Living with children, n (%)		273 (19.0)	
Living with partner and children, n (%)		137 (9.5)	
Having a caregiver, n (%)	184 (40.4)	716 (49.8)	**0.0004**
CIRS IS, mean ± SD	1.7 ± 0.3	1.7 ± 0.3	0.5266
CIRS IC, mean ± SD	3.1 ± 1.9	3.1 ± 1.9	0.8749
Drug number, mean ± SD	5.4 ± 2.9	6.0 ± 3.1	**0.0013**
Previous hospitalizations, n (%)	146 (32.0)	505 (35.1)	0.2245
Albumin, mean ± SD	3.4 ± 0.5	3.4 ± 0.6	0.7440
Hemoglobin < 12, n (%)	242 (53.1)	711 (49.4)	0.1772
[a] eGFR classes, n (%)			
Class I	40 (8.8)	142 (9.9)	0.8611
Class II	186 (40.8)	589 (41.0)	
Class III	171 (37.5)	515 (35.8)	
Class IV	49 (10.8)	150 (10.4)	
Class V	10 (2.2)	41 (2.9)	
GDS classes, n (%)			
Not probably depressed	132 (29.0)	436 (30.3)	0.7941
Minor depressed	143 (31.4)	430 (29.9)	
Probably depressed	181 (39.7)	572 (39.8)	
Barthel classes, n (%)			
Completely dependent	10 (2.2)	67 (4.7)	**0.0004**
Severely dependent	11 (2.4)	87 (6.1)	
Moderately dependent	47 (10.3)	176 (12.2)	
Mildly dependent	110 (24.1)	269 (18.7)	
No or minimally dependent	278 (61.0)	839 (58.3)	
SBT classes, n (%)			
Normal cognition	187 (41.0)	599 (41.7)	**0.0202**
Possible cognitive deficit	99 (21.7)	234 (16.3)	
Probable cognitive deficit	170 (37.3)	605 (42.1)	
In-hospital mortality, n (%)	11 (2.4)	34 (2.4)	0.9533
[b] Length of stay, mean ± SD	13.1 ± 11.6	11.6 ± 9.3	**0.0156**
[c] Place of discharge, n (%)			
Home	398 (89.8)	1324 (94.8)	**0.0015**
Nursing home	17 (3.8)	21 (1.5)	
Physical therapy/rehabilitation institute	22 (5.0)	41 (2.9)	
Palliative care	6 (1.4)	10 (0.7)	

Notes: SD = Standard Deviation; CIRS IS = Cumulative Illness Rating Scale Index Severity; CIRS IC = Cumulative Illness Rating Scale Index Comorbidity; eGFR = Estimated Glomerular Filtration Rate; GDS = Geriatric Depression Scale; SBT = Short Blessed Test.
$p < 0.05$

[a] eGFR was calculated according to the CKD-EPI equation, expressed as a single equation [40].

[b] 2 missing.

[c] 10 missing and 45 patients excluded since deceased.

4. Discussion

Our results show that living alone was significantly associated with a longer hospital stay and a higher risk of non-home discharge. This in agreement with previous observations [3–5, 18, 22, 27–36]. Living alone was correlated with a longer hospital stay also in patients discharged at home, thus excluding a possible influencing effect of a non-home discharge on this outcome. It is interesting to note that we found these results even though patients living alone had a better functional and cognitive status before hospitalization: however, older patients living alone need a higher level of autonomy than other ones to be discharged at home because they have no home assistance even just after discharge. Therefore, their social frailty makes them more vulnerable to hospitalization-related consequences.

In the present study, no significant association with in-hospital mortality was found, probably because of the small number of events or the complex interrelation between the different covariates strongly influencing this outcome in REPOSI patients.

Based on the REPOSI caregiver definition, i.e. "someone who take care of", it is easily understandable that caregiver availability may be considered a marker of patients' clinical and functional severity. However, we found that caregiver availability, at variance with living alone, was not correlated with the length of hospital stay and non-home discharge.

In agreement with a previous study [15], at univariate analysis we found statistically significant differences between subjects living alone vs those not living alone, in relation to age, sex, cognitive and functional status since a higher functional and cognitive status makes it possible to live alone. Moreover, patients who lived with someone were found to take more drugs, probably as a consequence of a higher level of in-home assistance and care.

To our knowledge, no other studies have specifically evaluated the prognostic role of the status of living alone in older patients hospitalized in internal medicine and geriatric wards. This study confirms how important is to collect information on the cohabitation status as a key component of the comprehensive geriatric assessment: this gives the possibility to identify a vulnerable population that may require personalized approaches regarding more intensive and earlier discharge planning, post-discharge home services and closest medical monitoring in order to prevent institutionalization [37, 38]. Patient-centered care and early discharge planning are some of the main components of the Acute Care for Elders (ACE) model, which was shown to be effective in the setting of an acute geriatric care unit in reducing hospital-related functional decline, length of hospital stay and risk of non-home

Table 2
Clinical outcomes according to living alone in the frame of four logistic regression models.

	First model [a]		Second model [b]		Third model [c]		Fourth model [d]	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
In-hospital mortality	1.21 (0.57–2.40)	0.60	1.20 (0.57–2.38)	0.61	1.45 (0.67–2.91)	0.33	1.44 (0.67–2.89)	0.34
Non-home discharge	2.18 (1.44–3.28)	**0.0003**	2.16 (1.43–3.24)	**0.0003**	2.67 (1.73–4.09)	< **0.0001**	2.63 (1.71–4.04)	< **0.0001**

	First model [a]		Second model [b]		Third model [c]		Fourth model [d]	
	Mean difference (± SD)	p	Mean difference (± SD)	p	Mean difference (± SD)	p	Mean difference (± SD)	p
Lenght of stay	0.74 (± 0.27)	**0.0073**	0.71 (± 0.27)	**0.0095**	0.75 (± 0.28)	**0.0065**	0.72 (± 0.28)	**0.0089**

Notes: SD = Standard Deviation; OR = Odds Ratio; CI = Confidence Interval.
$p < 0.05$
[a] Multivariate adjusted for sex, age, education level and availability of caregiver.
[b] Multivariate adjusted for sex, age, education level, availability of caregiver, CIRS IC and serum hemoglobin.
[c] Multivariate adjusted for sex, age, education level, availability of caregiver, SBT, GDS and Barthel Index.
[d] Multivariate adjusted for sex, age, education level, availability of caregiver, CIRS IC, hemoglobin level, SBT, GDS and Barthel Index.

discharge [38].

For these patients an early in-hospital mobilization should be recommended in order to allow them to recover the previous functional and cognitive status as early as possible.

Furthermore, public health interventions are necessary to prevent institutionalization for patients lacking social support, including, for example, an early activation of home care services at the time of hospital discharge.

This study has some limitations. The REPOSI register was not specifically designed to evaluate the subjective and objective measures of living alone in older patients. Therefore, detailed data about some objective and subjective measures of social isolation were not collected in the data set. Patients transferred to another ward were excluded because we have no data about date of discharge for these patients. Other limitations include missing data in some covariates considered in the multivariate models, having as a consequence a sample size limitation.

5. Conclusions

The evidence stemming from our analyses provides data for planning further prospective studies specifically designed to assess whether or not the activation of personalized supports during hospital stay in socially frail older patients may have beneficial effects on these patients and on public health. Clinicians should not forget that many older adults living alone wish to be cared at home, also in the frame of dependence situations [39]. However, a limited social support often limits their freedom in care choices, making very difficult to express and realize their own wills and preferences. Only a patients-centered approach may overcome these barriers.

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Declarations of interest

None.

Appendix A

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Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejim.2018.06.014.

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