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Utility of Geriatric Assessment to Predict Mortality in the Oldest Old: The Octabaix Study 3-Year Follow-Up

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Abstract

Objective: Few studies have prospectively evaluated the utility of geriatric assessment tools as predictors of mortality in the oldest population. We investigated predictors of death in an oldest-old cohort after 3 years of follow-up.

Methods: The Octabaix study is a prospective, community-based study with a follow-up period of 3 years involving 328 subjects aged 85 at baseline. Data were collected on functional and cognitive status, co-morbidity, nutritional and falls risk, quality of life, social risk, and long-term drug prescription. Vital status for the total cohort was evaluated after 3 years of follow-up.

Results: Mortality after 3 years was 17.3%. Patients who did not survive had significantly poorer baseline functional status for basic and instrumental activities of daily living (Barthel and Lawton Index), higher co-morbidity (Charlson), higher nutritional risk (Mini Nutritional Assessment), higher risk of falls (Tinetti Gait Scale), poor quality of life (visual analog scale of the Quality of Life Test), and higher number of chronic drugs prescribed. Cox regression analysis identified the Lawton Index (hazard ratio [HR] 0.82, 95% confidence interval [CI] 0.73–0.89) and the number of chronic drugs prescribed (HR 1.09, 95% CI 1.01–1.18) as independent predictors of mortality at 3 years.

Conclusions: Among the variables studied, the ability to perform instrumental activities of daily living and using few drugs on a chronic basis at baseline are the best predictors of which oldest-old community-dwelling subjects survive after a 3-year follow-up period.

Introduction

Life expectancy is increasing rapidly throughout the developed world, leading to more people surviving to very old ages. In almost all developed countries, the average life span of men and women continues to increase. Consequently, the oldest old is a growing population segment.[1] Nevertheless, few studies have prospectively evaluated predictors of mortality exclusively in older adults,[2,3] and even less information exists on the group of oldest old.[4–6]

This subject has been addressed in a comprehensive manner with long-term follow-up registries such as the Leiden 85-plus study,[6] which found blood pressure[7] or erythropoietin[8] levels to predict long-term mortality in the cohort. Recently, Taekema et al.[6] reported that gait speed in the oldest old is a useful tool to assess survival prognosis in this population.

Chronic conditions are a strong predictor of mortality among younger elderly subjects. In addition, functional limitation has been found to strongly predict mortality among the oldest old.[9] Our group evaluated a cohort of nonagenarians living in our area (the Nonasantfeliu study) and found that general geriatric assessment tools were valuable in the prediction of short- and long-term mortality.[10,11]

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In the present study, we prospectively followed a broad sample of subjects aged 85 years old in our geographical area and assessed mortality within a 3-year period. Due to the importance of general geriatric assessment of the oldest-old subjects, the main objective was to examine whether any of the tools that are regularly used in community geriatric assessment would be useful to detect the group of patients among this cohort with a high risk of mortality within these 3 years of follow-up.

Methods

The Octabaix study is a prospective cohort study incorporating a double-blind, parallel-group, randomized clinical trial on falls and nutritional risk. A total of 328 community-dwelling persons born in 1924 (85 years old at the time of inclusion) who were registered with one of seven primary care teams in the geographical area of Baix Llobregat, Barcelona, Spain, were included; this sample is described in more detail elsewhere.[12,13] In brief, every old inhabitant was interviewed at their home or their health center by a research team with a training in geriatrics. The institutional ethics committee of the local health system approved the design of the study, and all patients, or the caregivers of cognitively impaired subjects, gave their written informed consent before enrollment. No criteria related to baseline health or cognitive status were applied to exclude patients. Sociodemographic data (gender, marital status, place of residence, studies, and living alone) and a comprehensive geriatric evaluation (functional, cognitive and nutritional status, social risk, gait, and risk of falls) based on tools currently used in geriatric practice were included in this evaluation.

Functional status was measured using the Barthel Index (BI)[14] for basic activities of daily living (ADL) and the Lawton Index[15] (LI) for instrumental ADL. The LI is an easy-to-administer assessment instrument that provides self-reported information about functional skills necessary to live in the community. LI scores range from 0 (low function, dependent) to 8 (high function, independent). Historically, women were scored on all eight areas of function; men were not scored in the domains of food preparation, housekeeping, and laundering. However, we applied the current recommendations to assess all domains for both genders.[16] A limitation of the instrument includes the self-report or surrogate report method of administration rather than a demonstration of the functional task. BI measures include questions about seven areas: Feeding, bathing, personal hygiene, dressing, bowel/bladder control, getting on/off the toilet, and locomotion. A maximum score of 100 indicates that the subject is independent in physical function and the lowest score of 0 indicates a totally dependent state. Cognitive function was measured by the Spanish version of the Mini-Mental State Examination (MEC), which has a total score of 35; as recommended, we considered scores below or equal to 23 to indicate the presence of cognitive impairment.[17] Nutritional status was assessed using the Mini Nutritional Assessment (MNA).[18] The MNA score is based on 18 items covering four component sub-scores. The MNA score incorporates 18 items sub-divided in four components: MNA-1 (four items), anthropometric measurement (0–8 points); MNA-2 (six items), overall evaluation (0–9 points); MNA-3 (six items), assessment of dietary habits (0–9 points); and MNA-4 (two items), subjective assessment of self-perceived quality of health and nutrition (0–4 points). The score obtained (maximum 30 points) classifies the subjects assessed into three categories: 24–30, well-nourished; 17–23.5, at risk of malnutrition; and <17, malnourished. Gait was evaluated with the Gait Rating Scale from the Tinetti Performance-Oriented Mobility Assessment. The gait component of this scale evaluates seven items: Initiation of gait, step height and length, step symmetry and continuity, path deviation, trunk stability, walking stance, and turning while walking. The scale provides a final score that ranges from 0 to 12, with a higher score indicating better gait performance.[19] A fall was defined as any incident in which the patient ends up on the ground or at a lower level against his/her will (and not due to an intentional movement).[20] Patients and/or caregivers were asked about the number of falls in the last year. The Gijon scale was used for the social assessment.[21] This scale is scored on a maximum of 24 points. Social risk scores are those between 10 and 14 and social problems exist with scores >15. Quality of life was assessed using the visual analog scale of the Quality of Life Test (EQ-VAS) of perceived health.[22] The EQ VAS records the respondent's self-rated health on a 20-cm vertical, visual analog scale with end points labeled "the best health you can imagine" (100) and "the worst health you can imagine" (0).

The Charlson score (CS) was used to measure overall co-morbidity.[23] It ranges from 0 to a theoretical maximum of 33, depending on the presence of certain diseases with assigned values. Age-adjusted CS was not used because all participants were 85 year olds. Cardiovascular risk factors such as treatment for high blood pressure (HBP) above 140/90 (clinical measurement of blood pressure is calculated using the average of two morning measures in upright position), diabetes mellitus (DM), and dyslipidemia were also recorded. Disease prevalence for stroke and dementia was determined on the basis of data review from general practice records. The number of drugs used by prescription on a chronic basis was also recorded. In most cases, the physician who obtained the information was at the same time the one who usually cared for the patient; co-morbidity data were therefore not only derived from self-report but also from chart reviews, test results, and prescription drug indications.

Intervention

During the first and second year, an intervention to reduce the risk of falls and malnutrition was implemented in a randomized fashion. The intervention was administered to 164 subjects (136 completed the 2-year program) and consisted of a community-based multifactorial program that links participants to existing medical care and service networks. The control participants (164) received their usual health care. The baseline characteristics of the two groups were similar in terms of age, sex, living alone, co-morbidity, and most health-related variables, including functional and cognitive status.[13]

Outcome events

Mortality, mesured as time-to-event data, is the main outcome of this study. For that purpose, the vital status of the participants was intermittently evaluated during the 3 years of follow-up; participants were categorized as alive after 36 months of follow-up, or censored when they died,

Table 1. Comparison of Variables Associated with 3-Year Survival: Proportions and Mean (Standard Deviation) Are Shown

	All (n = 328)	*Survivors* (n = 271)	*Non-survivors* (n = 57)	p
Gender				0.67
Female	202 (61.6%)	173 (63.8%)	29 (50.9%)	
Male	126 (38.4%)	98 (36.2%)	28 (49.1%)	
Marital status				0.45
Widowed	174 (53%)	140 (51.7%)	34 (59.6%)	
Married	134 (40.9%)	113 (41.7%)	21 (36.8%)	
Unmarried	20 (6.1%)	18 (6.6%)	2 (3.5%)	
Studies				0.44
No studies	113 (34.5%)	89 (32.8%)	24 (42.1%)	
Primary studies	153 (46.6%)	129 (47.6%)	24 (42.1%)	
High school	47 (14.3%)	39 (14.4%)	8 (14%)	
University degree	15 (4.6%)	14 (5.2%)	1 (1.8%)	
Living alone	100 (30.5%)	87 (32.1%)	13 (22.8%)	0.16
Barthel Index	87.6 ± 19	88.8 ± 18	81.8 ± 25	0.01
Barthel Index > 90	131 (39.9%)	98 (36.2%)	33 (57.9%)	0.02
MEC	26.7 ± 6.8	26.9 ± 6.6	25.4 ± 7.4	0.12
MEC < 24	90 (27.4%)	71 (26.2%)	19 (33.3%)	0.27
Lawton IADL Index	5.3 ± 2.5	5.6 ± 2.7	4.2 ± 2.2	0.0001
Gijon	9.8 ± 2.6	9.7 ± 2.8	9.9 ± 2.6	0.57
EQ-VAS	62 ± 21	63.3 ± 21.3	56.2 ± 19.5	0.02
Charlson Index	1.4 ± 1.6	1.3 ± 1.4	2.0 ± 2.1	0.001
MNA-SF	24.5 ± 3.7	24.8 ± 3.6	23.0 ± 3,7	0.001
Tinetti	6.6 ± 2.9	6.8 ± 2.8	5.7 ± 2.8	0.01
Hypertension	249 (75.9%)	208 (76.8%)	41 (71.9%)	0.43
Diabetes mellitus	58 (17.7%)	48 (17.7%)	10 (17.5%)	0.97
Dyslipidemia	168 (51.2%)	140 (51.7%)	28 (49.1%)	0.72
Medical history of stroke	49 (14.9%)	42 (15.5%)	7 (12.3%	0.53
Dementia	31 (9.5%)	25 (9.2%)	6 (10.5%)	0.76
Number of drugs taken	6 ± 3	5.8 ± 3.2	7.4 ± 3.2	0.001
Falls	0.4 ± 0.9	0.4 ± 0.9	0.4 ± 0.7	0.97

MEC, Spanish version of the Mini-Mental State Examination; IADL, Instrumental Activities of Daily Living; EQ-VAS, Quality of life with the visual analog scale; MNA-SF, Mini Nutritional Assessment questionnaire (short form).

whichever occurred first. We chose a 3-year follow-up period because it represents about 50% of the years of life expectancy in the 85 year olds in our area (6.5 years).[24]

Mortality status and causes were determined by trained physician adjudicators on the basis of medical records from hospitalizations, emergency room visits, death certificates, and autopsy and coroner's reports, when available. We compared the patients who had survived with those deceased.

Data analysis

Normally distributed continuous variables are reported as mean ± standard deviation (SD). Categorical variables are reported as proportions. Normal or non-normal distributions of continuous variables were assessed using the Kolmogorov–Smirnov test. The Student *t*-test was used to compare continuous variables, with a previous Levene test for equality of variances, while either the chi-squared statistic or Fisher exact test was used to compare categorical or dichotomous variables. Cox models were adjusted between main outcome variable and predictors. The semi-parametric Cox proportional hazards model analyzes the relationship between a time-to-event response variable and adjusted baseline covariates. Proportional hazards and linearity (on continuous variables) assumptions were evaluated for the Cox models to determine the variables associated with 3-year mortality.

The variables entered into the model using a backward stepwise approach were gender and all the variables with significant differences in the bivariate analysis, such as the BI and LI, Charlson Comorbidity Index, MNA, Tinetti Gait Scale, EQ-VAS, and chronic drugs prescription. The significance level was fixed at 5%. Because this is mainly an exploratory analysis and covariates associated with the main outcome variable are unknown or not fully understood, we performed an algorithm variable selection based solely on a backward-stepwise approach. The variable selection process was supervised by clinical criterion to ensure the result's reliability and meaningfulness. We repeated the model with BI as categorical scores (BI > 90) and the results did not change. Finally, we analyzed a third model that excluded polypharmacy to evaluate the co-morbidity contributions with the Charlson Index alone. The analyses were repeated to explore associations by 1- and 2-year survival. An adjusted hazard ratio (HR) with a 95% confidence interval (CI) was used. The results were considered significant when $p < 0.05$. All analyses were performed using SPSS 15.0 statistical software (SPSS Inc., Chicago, IL).

Results

The characteristics of the 328 participants are summarized in Table 1. In brief, the sample included 202 women (61.6%)

and 126 men. Geriatric assessment tools at baseline showed the following mean values: BI 87.6 ± 19 for basic ADL, Lawton 5.3 ± 2.5 for instrumental ADL, MEC 26.7 ± 6.8, MNA 24.5 ± 3.7 for malnutrition risk, Tinetti Gait Scale 6.6 ± 2.9 for risk of falls, and Gijon test 9.8 ± 2.6 for social risk. The mean quality of life score assessed using the EQ-VAS was 62 ± 21. The mean Charlson Index value was 1.4 ± 1.6. Among major cardiovascular risk factors, hypertension was found in 249 (75.9%) subjects, diabetes in 58 (17.8%), and dyslipidemia in 168 (51.2%). Forty-nine subjects had a previous history of stroke (14.9%) and 31 of dementia (9.5%). Patients were taking an average of 6.1 ± 3 chronic drugs, with 253 patients (77.1%) taking three or more. Ninety-four (28.6%) subjects had suffered at least one fall during the previous year, and 25 (7.6%) had fallen two or more times. A total of 137 falls were recorded during follow-up, a mean of 0.4 ± 0.9 falls per subject.

Evaluation after 3-year follow-up

Fifty-seven subjects died during the 36 months of the follow-up period (17.3%). Hence, the annual average mortality rate was 5.7%, and was distributed as follows: 4.9% within the first year, 5.8% within the second, and 6.7% within the third. Deaths were in absolute figures; the distribution between females (29, 14.3% of women) and males (28, 22.2%) was not even.

Predictors of mortality

Thirty-six (22.2%) of the control subjects died during the follow-up period, versus 21 (12.8%) ($p = 0.03$) of the intervention group participants. The bivariate analysis of baseline variables associated with 3-year survival is shown in Table 1. Patients who did not survive had significantly poorer baseline functional status for both basic and instrumental activities of daily living, higher co-morbidity, higher nutritional risk, higher risk of falls, worse quality of life, and were taking more chronic prescription drugs.

Cox regression analysis identified two significant clinical variables (LI values and number of chronic drugs used) among those significant at the bivariate level as independent predictors of 3-year risk of mortality for this cohort of octogenarians (Table 2). When we applied the Cox model to evaluate mortality after the first and second year of follow-up, lower LI Index scores were the only significant predictors of higher mortally, with a HR of 0.72, 95% CI 0.60–0.87 ($p < 0.001$) and 0.81, 95% CI 0.71–0.91 ($p < 0.001$), respectively.

When we excluded the polypharmacy of the model, the Cox regression analysis identified the LI (HR 0.83, 95% CI 0.75–0.91) and the Charlson Index values (HR 1.17, 95% CI 1.01–1.36) as independent predictors of mortality after 3 years. However, only the LI remained significant when the follow-up was restricted to 1 or 2 years.

Table 2. Adjusted Cox Regression Analysis Model of Baseline Variables for the Death of Oldest-Old Subjects after a 3-Year Follow-Up

	Hazard ratio	*95% Confidence interval*
Lawton IADL Index	0.82	0.73–0.89
Number of chronic drug prescriptions	1.09	1.01–1.18

IADL, Instrumental Activities of Daily Living.

Discussion

In our cohort of octogenarians, the mortality rate after 36 months of follow-up was 17.3% (4.9% after 12 months and 10.7% after 24 months). This 2-year mortality rate is very similar to that reported for Jerusalem residents[5] (9.8%), but lower than that of the Leiden Study participants[6] (16%).

Besides crude mortality rates, our main finding was that the only predictors of mortality, among the variables studied, for a cohort of community-dwelling octogenarians at 3-year follow-up were the inability to perform instrumental activities of daily living and the use of higher numbers of prescription drugs on a long-term basis.

Over the past two decades, there has been growing recognition of functional status assessment as a key factor in the evaluation of older persons to help predict future mortality.[25] Similar to our results, the Leiden 85+ study has reported that instrumental activities of daily living dependence (assessed using the Groningen Activity Restriction Scale) was associated with an increased risk of mortality after 2 years. This association persisted as far as 12 years after the baseline evaluation.[6] Spector et al.[26] suggested that disability in instrumental ADL was a more sensitive predictor of functional decline than disability in basic ADL alone. That is in concordance with the results of our study and probably relates to the very high proportion of individuals with normal or almost normal baseline BI values. It is also important to note that the LI was the only predictor of survival at 1- and 2-year follow-up.

Regarding the second factor associated with mortality, it remains unclear whether polypharmacy is a marker for poor health or an independent risk factor, and conflicting results have been reported on this association.[27] This is perhaps related to the different definitions of polypharmacy used; we chose to analyze it as a continuous variable defined by the total number of drugs taken. Recently, Richardson et al.[28] have reported a variation over time in this association; a strong independent association between polypharmacy and mortality can be found in the short term (first 2 years) for both men and women. The association remained, although to a lesser degree, in the mid to long term (2–18 years of follow-up) in women, but became non-significant in men. In contrast, our study showed this association to be present in the mid-term (3 years), but not within the 2 first years of follow-up. This association persisted when the diseases behind the prescription were included in the multivariate analysis via the Charlson Comorbidity Index, which itself does not show statistical predictive value for mortality in this study. However, when we exclude polypharmacy from the regression analyses, the Charlson Index was indeed predictive of mortality in the mid-term.

Three other variables predicted mortality in the univariate analysis but lost significance in the multi-variable model—high nutritional risk, high risk of falls, and poor reported quality of life. All of them have been found to predict morbimortality in the elderly. MNA is the most frequently used screening test for malnutrition in elderly populations and can predict mortality in a general, community-dwelling elderly population.[29] Falls are the leading cause of injury-related visits to emergency departments and the primary etiology of accidental deaths in persons over the age of 65 years, and the mortality rate for falls increases dramatically with age.[30] Finally, quality of life evaluations, which take into account the patient's perceived health status, have also been shown to predict mortality in elderly people.[31]

This study has several strengths, including its prospective design, comprehensive set of measurements, and completeness of follow-up. An important strength of the Octabaix study is the use of a community-based sample of patients of the same age. This sample is representative of the socioeconomic characteristics of the older residents in our area, with a full range of co-morbidities. All subjects were registered with a general practitioner and benefitted from a full range of public health facilities. However, the same-age restriction might limit the value of the findings of our study when applied to an elderly population with a broader age range. Also, this is a small sample size study and its findings cannot probably be generalized to larger populations. A factor to take into account is the potential gender bias of the LI as we mentioned in the Methods section. Other limitations should be acknowledged. Geriatric measurements were taken only at baseline, so it remains unknown whether age declines in these test results might better predict mortality. Another important limitation is the lack of biological data and the clinical characteristics of the chronic diseases present among the population included in the study. Moreover, the prevalence of diseases or syndromes without straightforward diagnostic criteria, such as dementia, may be underestimated. Also, the backward data analysis method for the models variable selection is not based in clinical criterion, it is a hypothesis generation one, so results must be confirmed in new specific studies. Finally, the analysis did not take into account the possible beneficial effect of the study intervention or the patients' follow-up on the occurrence of adverse events such as hospital admission episodes. However, it must be noted that no differences in basal LI values between individuals in the control group and the intervention subgroups (data not shown) exist.

In conclusion, our study shows that an objective evaluation based on comprehensive geriatric assessment tools might be useful to predict mortality risk when performed on oldest-old, community-dwelling subjects. In particular, the ability to perform instrumental activities of daily living and taking fewer prescription drugs (two characteristics amenable to at least partial intervention) seem to predict a better chance of survival in this population.

Author Disclosure Statement

No competing financial interests exist.

References

1. Ferrer A, Formiga F, Ruiz D, Mascaró J, Olmedo C, Pujol R. Predictive items of functional decline and 2-year mortality in nonagenarians—the NonaSantfeliu study. Eur J Public Health 2008;18:406–409.
2. Yourman LC, Lee SJ, Schonberg MA, Widera EW, Smith AK. Prognostic indices for older adults: A systematic review. JAMA 2012;307:182–192.
3. Zhang Z, Xie D, Kurichi JE, Streim J, Zhang G, Stineman MG. Mortality predictive indexes for the community-dwelling elderly US population. J Gen Intern Med 2012;27: 901–910.
4. Lundman B, Forsberg KA, Jonsén E, Gustafson Y, Olofsson K, Strandberg G, Lövheim H. Sense of coherence (SOC) related to health and mortality among the very old: The Umeå 85+ study. Arch Gerontol Geriatr 2010;51:329–332.
5. Jacobs JM, Stessman J, Ein-Mor E, Bursztyn M. Hypertension and 5-year mortality among 85-year-olds: The Jerusalem Longitudinal Study. J Am Med Dir Assoc 2012;13:759.e1-6.
6. Taekema DG, Gussekloo J, Westendorp RG, de Craen AJ, Maier AB. Predicting survival in oldest old people. Am J Med 2012;125:1188–1194.
7. Boshuizen HC, Izaks GJ, van Buuren S, Ligthart GJ. Blood pressure and mortality in elderly people aged 85 and older: Community based study. BMJ 1998;316:1780–1784
8. den Elzen WP, Willems JM, Westendorp RG, de Craen AJ, Blauw GJ, Ferrucci L, Assendelft WJ, Gussekloo J. Effect of erythropoietin levels on mortality in old age: The Leiden 85-plus Study. CMAJ 2010;182:1953–1958.
9. Lee SJ, Go AS, Lindquist K, Bertenthal D, Covinsky KE. Chronic conditions and mortality among the oldest old. Am J Public Health 2008;98:1209–1214.
10. Formiga F, Ferrer A, Mascaró J, Ruiz D, Olmedo C, Pujol R. Predictive items of one-year mortality in nonagenarians. The NonaSantfeliu Study. Aging Clin Exp Res 2007;19:265–268.
11. Formiga F, Ferrer A, Chivite D, Rubio-Rivas M, Cuerpo S, Pujol R. Predictors of long-term survival in nonagenarians: The NonaSantfeliu study. Age Ageing 2011;40:111–116.
12. Formiga F, Ferrer A, Megido MJ, Chivite D, Badia T, Pujol R. Low co-morbidity, low levels of malnutrition, and low risk of falls in a community-dwelling sample of 85-year-olds are associated with successful aging: The Octabaix study. Rejuvenation Res 2011;14:309–314.
13. Ferrer A, Badia T, Formiga F, Gil A, Padrós G, Sarró M, Almeda J, Pujol R; Grupo de Estudio OCTABAIX. Ensayo aleatorizado de prevención de caídas y malnutrición en personas de 85 años en la comunidad. Estudio OCTABAIX. Rev Esp Geriatr Gerontol 2010;45:79–85.
14. Mahoney FI, Barthel DW. Functional evaluation: the Barthel Index. A simple index of independence useful in scoring improvement in the rehabilitation of the chronically ill. Md State Med J 1965;14:61–65.
15. Lawton MP, Brody EM. Assessment of older people: Self-maintaining and instrumental activities of daily living. Gerontologist 1969;9:179–186.
16. Vergara I, Bilbao A, Orive M, Garcia-Gutierrez S, Navarro G, Quintana JM. Validation of the Spanish version of the Lawton IADL Scale for its application in elderly people. Health Qual Life Outcomes 2012;10:130.
17. Lobo A, Saz P, Marcos G, Día JL, De la Cámara C, Ventura T, Morales Asín F, Fernando Pascual L, Montañés JA, Aznar S. Revalidación y normalización del Mini-Examen Cognoscitivo (primera versión en castellano del Mini-mental Status Examination) en la población general geriátrica. Med Clin (Barc) 1999;112:767–774.
18. Guigoz Y, Vellas B, Garry PJ. Assessing the nutritional status of the elderly: The Mini Nutritional Assessment as part of the geriatric evaluation. Nutr Rev 1996;54(Suppl);59–65.
19. Tinetti ME. Performance-oriented assessment of mobility problems in elderly patients. J Am Geriatr Soc 1986;34;119–126.
20. Buchner DM, Hornbrook MC, Kutner NG, Tinetti ME, Ory MG, Mulrow CD, Schechtman KB, Gerety MB, Fiatarone

MA, Wolf SL, et al. Development of the Common Data Base for the FICSIT Trials. J Am Geriatr Soc 1993;41;297–308.

21. Alarcón MT, González JI. La escala sociofamiliar de Gijón, instrumento útil en el hospital general. Rev Esp Geriatr Gerontol 1998;33:178–180.
22. Herdman M, Badia X, Berra S. El EuroQol-5D: Una alternativa sencilla para medir calidad de vida relacionada con salud en atención primaria. Aten Primaria 2001;28:425–430.
23. Charlson ME, Pompei P, Ales KL, MacKenzie CR.A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation J Chronic Dis 1987;40:373–383.
24. Generalitat de Catalunya. Departament de Salut. Anàlisi de la mortalitat a Catalunya. 2008. Barcelona: Departament de Salut. Generalitat de Catalunya, 2010.
25. Cesari M, Onder G, Zamboni V, Manini T, Shorr RI, Russo A, Bernabei R, Pahor M, Landi F. Physical function and self-rated health status as predictors of mortality: Results from longitudinal analysis in the ilSIRENTE study. BMC Geriatr 2008;8:34.
26. Spector WD, Katz S, Murphy JB, Fulton JP. The hierarchical relationship between activities of daily living and instrumental activities of daily living. J Chronic Dis 1987;40:481–489.
27. Jyrkkä J, Enlund H, Korhonen MJ, Sulkava R, Hartikainen S. Polypharmacy status as an indicator of mortality in an elderly population. Drugs Aging 2009;26:1039–1048.
28. Richardson K, Ananou A, Lafortune L, Brayne C, Matthews FE. Variation over time in the association between polypharmacy and mortality in the older population. Drugs Aging 2011;28:547–560.
29. Lundin H, Sääf M, Strender LE, Mollasaraie HA, Salminen H. Mini nutritional assessment and 10-year mortality in free-living elderly women: A prospective cohort study with 10-year follow-up. Eur J Clin Nutr 2012;66:1050–1053.
30. Kannus P, Parkkari J, Niemi S, Palvanen M. Fall-induced deaths among elderly people. Am J Public Health 2005;95:422–424.
31. Cavrini G, Broccoli S, Puccini A, Zoli M. EQ-5D as a predictor of mortality and hospitalization in elderly people. Qual Life Res 2012;21:269–280.

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