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

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Abstract

The population is aging throughout the world. Preserving physical and cognitive functions is crucial to successful aging. The aim of this study was to determine the proportion of 85-year-old community-dwelling subjects aging successfully, applying a quantitative approach, and assessing the association of successful aging with sociodemographic data, global geriatric assessment, and co-morbidity. This was a community-based survey of inhabitants aged 85 years, with 328 out of 487 subjects born in 1924 assigned to seven primary health-care teams, representing a participation rate of 67.5%. Sociodemographic variables, Barthel index (BI), the Spanish version of the Mini-Mental State Examination (MEC), Mini Nutritional Assessment (MNA), Charlson Index, Gait Rating Scale, social risk, quality of life (QoL), and prevalent chronic diseases were assessed. Subjects scoring higher than 90 on the BI and higher than 24 on the MEC were compared with the rest. Multiple regression analysis was performed. Using these criteria, successful aging status was defined in 162 (49.3%) subjects. Using multiple logistic regression analysis, successful agers had significantly lower co-morbidity scores ($p < 0.02$, odds ratio [OR] = 0.791, 95% confidence interval [CI] 0.657–0.952), higher scores on the Gait Rating Scale identifying lower risk of falls ($p < 0.0001$, OR = 1.753, 95% CI 1.501–2.046), and higher scores on the MNA, indicating lower risk of malnutrition ($p < 0.0001$, OR = 1.190, 95% CI 1.090–01.299). Regarding QoL, successful agers had significantly higher values than their unsuccessful aging counterparts ($p > 0.0001$). Almost half of the individuals presented successful aging. Successful agers had less co-morbidity and a lower risk of falls or malnutrition, and they had higher scores on the QoL scale.

Introduction

IN SPAIN, AS IN OTHER developed countries, old-old individuals are making up an increasingly large segment of the population.[1] The goal is to reach old age with the best possible health status and quality of life (QoL). Thus, the challenge is to obtain an increase in life expectancy, if possible without incapacity.[2,3] Nevertheless, disability, frailty, and co-morbidity are clinical conditions that frequently interfere with successful aging.[2]

Increasing rates of successful aging is a worldwide aim in public health. Four decades of literature have defined the concept in various ways, encompassing physical, functional, psychological, and social health.[4–9] Early research defined successful aging using a one-dimensional approach, describing it as the avoidance of disease and disability. However, a multidimensional concept of successful aging has been used increasingly.[7] The definition proposed for the present study incorporates three important aspects—the physiological component (good functional status), the psychological function (good cognitive status), and of a particular region of the social component (no need for institutionalization). The definition does not include the absence of depression, details regarding social aspects (high scores on social and leisure activities scales), nor well-being according to QoL scales, although this latter aspect is evaluated in the study.

It is important to understand the distinctive characteristics associated with successful aging in the oldest old

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subjects.[10,11] In the oldest old, a particular behavior characterized by progressive phenomena of adaptation[11] has been reported to favor certain aspects of successful aging. The gender differences in incapacity percentages reported in very old subjects suggest that the percentage of successful aging is higher in men than in women.[12,13] In previous work, we evaluated a nonagenarian cohort in our area (the Nonasantfeliu study) using the same definition of successful aging (function, cognition, and noninstitutionalization), and found that male nonagenarians with low co-morbidity are more likely to be considered nondisabled (successful agers) than males with high co-morbidity and females.[14] Furthermore, after 2 years of follow-up, male nonagenarians who were successful agers were more likely to maintain this status than females.[15]

The aim of the present study was to evaluate a cohort of community-living subjects aged 85 years, in a Mediterranean area, to assess differences that might identify the group with better successful aging using a quantitative approach to test function and cognition. The second objective was to establish whether there are gender differences. We also explored possible differences between successful and unsuccessful aging groups according to their responses on a QoL scale.

Methods

This study was conducted as part of the Octabaix project, a prospective population-based study of 328 community-dwelling inhabitants born in 1924 (aged 85 at the time of inclusion) from 487 eligible subjects assigned to seven primary health-care teams of the 33 teams existing in the geographical area of Baix Llobregat, Barcelona, Spain. The participation rate was 67.5%; there were no differences between respondents in terms of gender. The combined population served includes approximately 210,000 of the total of nearly 800,000 inhabitants of the Baix Llobregat. At the time of the start of the study, the referral hospital was the Hospital Universitari de Bellvitge. Geriatric assessment and sociodemographic data (gender, marital status, and educational level) were recorded in the study.

The sample has been described in more detail elsewhere.[16,17] Subjects were examined at their place of residence by trained teams (medical doctors and nurses) skilled in interviewing the elderly. An interview was performed in all cases in which the individual was able to participate. A geriatric assessment and sociodemographic data (recording gender, marital status, place of residence, studies, and living alone) were included in the interview. Functional, cognitive, and nutritional status was assessed by instruments currently used in geriatric practice. Social risk, gait, and falls and QoL were also assessed.

The study was approved by the institutional ethics committee. All patients, or their caregivers in cases of cognitive impairment, gave written informed consent before enrollment. We assessed all patients and no exclusion criteria (such as impaired health or cognitive status) were applied.

Global geriatric assessment

Functional status was measured using the Barthel Index (BI)[18] for the basic activities of daily living (ADL). The total score of the BI ranges from 0 to 100 points (from "help needed in all activities" to "total independence"). Cognitive function was measured by the modified Spanish version of the Mini-Mental State Examination (MEC)[19]; on this scale, the maximum score is 35.

Nutritional status was assessed using the Mini Nutritional Assessment (MNA). The MNA score is based on 18 items covering four component subscores: MNA-1 (4 items), anthropometric measurement (0–8 points); MNA-2 (6 items), global evaluation (0–9 points); MNA-3 (6 items), assessment of dietary habits (0–9 points); and MNA-4 (2 items), subjective assessment of self-perceived quality of health and nutrition (0–4 points).[20] The score obtained (maximum 30 points) allowed classification of the elderly subjects into three categories: 24–30, well-nourished; 17–23.5, at risk of malnutrition; and <17, malnourished.

Gait was evaluated using the Gait Rating Scale from the Tinetti Performance-Oriented Mobility Assessment. Gait consists of nine components: Initiation, step height and length, step symmetry and continuity, path deviation, trunk stability, walking stance, and turning while walking.[21] Each component was scored as 1 (normal) or 0 (abnormal), providing a final score that ranged from 0 to 12, with higher scores indicating a better gait performance. 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).[22] Patients and/or caregivers were asked about any previous falls in the last year.

The Gijon scale was used for social risk assessment.[23] This scale has a maximum of 24 points: Scores between 10 and 14 represent social risk, and scores > 15 indicate social problems.

QoL was assessed using the Quality of Life Test (EuroQol-5D) with the visual analog scale (EQ-VAS) of perceived health, from 0 to 100: 0 represents the worst state of health imaginable, and 100 the best).[24]

Co-morbidity and cardiovascular risk factors

The Charlson score (CS) was used to measure global co-morbidity.[25] This score ranges from 0 to a theoretical maximum of 33, depending on the presence of certain diseases with assigned values. Cardiovascular risk factors such as treatment for high blood pressure (HBP) of values above 140/90, and diabetes mellitus (DM) and dyslipidemia were recorded. For most diseases, prevalence was determined on the basis of a review of data from general practice records alone: Ischemic cardiopathy, heart failure, stroke, chronic obstructive lung disease, and atrial fibrillation. Chronic drug prescription was also recorded.

Procedure: Successful aging

In accordance with the quantitative model, we defined nondisabled subjects as those with a better health status (successful aging), who, in addition to being noninstitutionalized (local social criteria), had scores of 91 or higher on the BI (subjects with total independence for basic ADL or minimal dependence) and 24 or higher on the MEC (scores of 23 or below indicate cognitive impairment). We had already used these criteria in our assessment of the population of nonagenarians in our area.[14,15]

We assessed whether there were differences between the successful and unsuccessful aging groups according to their responses on the EuroQol-5D and EQ-VAS.

Data analysis

Normally distributed continuous variables are reported as means ± standard deviation (SD). Categorical variables are reported as proportions. Normal or nonnormal distributions of continuous variables were assessed using the Kolmogorov–Smirnov test. The Student *t*-test was used to compare continuous variables, following performance of a Levene test for equality of variances, whereas either the chi-squared statistic or Fisher exact test was used for the comparison of categorical or dichotomous variables. A logistic regression analysis was performed to determine the variables associated with successful aging, entering the variables that were previously significant in bivariate analysis into the regression model—gender, marital status, level of studies, MNA, Tinetti gait scale, Charlson Index, Gijon Index, previous diagnosis of diabetes, history of stroke, and number of chronic drug prescriptions. We did not enter either functional or cognitive results in the multivariate analysis; these results were closely related and were both included in the definition of successful aging, the variable that was the aim of the study. An adjusted odds ratio (OR) 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 sample included 202 women (61.6%) and 126 men. Most were widowed (174, 53%), 134 (40.9%) married, and 20 (6.1%) unmarried. Sixty two (19%) had a university degree or had reached high school, and the remaining 81% had primary studies or had not completed any studies at all. One hundred participants were living alone and the rest with family members; none of them lived in assisted living facilities.

Geriatric assessment

Functional and cognitive assessment at baseline produced the following values. For basic ADL, BI mean score was 87.6 ± 19; 197 (60%) subjects had BI scores > 90, including 139 (42%) with a BI of 100. For cognition, MEC mean score was 26.7 ± 6.8; 238 (72.5%) individuals scored 24 or higher on the MEC, including 21 (6.4%) with the maximum score of 35. The rest of the tests performed for the geriatric assessment showed the following means: 24.5 ± 3.7 on the MNA for risk of malnutrition, 6.6 ± 2.9 on the Tinetti Gait Scale for risk of falls, and finally 9.8 ± 2.6 on the Gijon test for social risk. The mean quality of life score assessed using the EuroQol-5D and EQ-VAS was 62 ± 21.

Co-morbidity evaluation

The mean Charlson Index value was 1.45 ± 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%). Twenty subjects had previous clinical histories of ischemic cardiomiopathy (6.1%), 42 heart failure (12.8%), 34 chronic obstructive pulmonary disease (10.4%), 41 atrial fibrillation (12.5%), and 49 stroke (14.9%). Patients were taking an average of 6.09 ± 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 more than once. A total of 137 falls were recorded, with a mean of 0.4 ± 0.9 falls per subject.

Successful aging

With the quantitative criteria selected to evaluate function and cognition, 162 (49.3%; 95% CI 43.8–54.9%) subjects were considered to have successful aging status: 74 out of 126 men (58.7%) and 88 out of 202 women (43.5%) ($p < 0.008$).

Table 1 shows the differences between successful and unsuccessful aging. Successful agers were more likely to be male, widows/widowers, with a higher level of studies, and to have better scores on the MNA and the Tinetti gait scale. Lower overall co-morbidity, lower social risk, absence of previous diabetes or stroke, and a lower number of chronic drug prescriptions were also related with better aging.

Using multiple logistic regression analysis, successful aging was significantly associated with lower values on the Charlson Index (lower co-morbidity) and higher scores on the Tinetti gait and MNA scales (lower risk of falls and malnutrition; Table 2).

With regard to QoL, successful agers had significantly higher values on the EuroQol-5D and EQ-VAS than the rest of the sample (68.34 vs. 55.94; $p < 0.0001$).

Discussion

Longevity in the developed world is increasing, but the subgroup of oldest adults may present impairments in their functional and cognitive status and diminished QoL. This study focuses on successful aging in community-dwelling subjects who do not present age-associated functional and cognitive decline. We chose these two aspects because physical and cognitive dysfunctions are two of the most feared conditions among the elderly and frequently lead to dependency and social isolation.[26] Interestingly, almost half of the subjects evaluated (49.3%) presented a successful aging profile, a figure substantially higher than that reported in a sample of older subjects in the same area (16.7%; mean age 93.1 years old).[14] Our ongoing monitoring of this population group will tell us whether the group who reach the age of 90 with a successful aging profile is on the increase, or whether the possible occurrence of future health problems related to functional or behavioral cognitive loss during the study will reduce the proportion of successfully aging nonagenarians. The nonparticipation rate (32.5%), which is higher than that reported in the evaluation of the 85 year olds in the Leiden study,[27] may have contributed to the high percentage of successful aging reported because it is likely that subjects with more severe health disorders are underrepresented. Unfortunately we have no information on the health status of people who declined to participate.

Our results cannot be compared with those of the Leiden study, which recorded successful aging in only 10% of subjects, because those authors used more selective criteria,[27] classifying subjects as successful or not successful based on optimal scores in a complete evaluation for physical (Groningen Activity Restriction Scale including instrumental and basic ADL), social (Time Spending Pattern Questionnaire) and psychocognitive functioning (MMSE and a short Geriatric Depression Scale), and on feeling of well-being (Cantril

TABLE 1. DIFFERENCES BETWEEN GROUPS ACCORDING TO SUCCESSFUL AGING STATUS.

	Successful aging (n = 162)	Non successful aging (n = 166)	p value
Gender			0.008
Male, n (%)	74 (45.7%)	52 (31.3%)	
Female, n (%)	88 (54.3%)	114 (68.7%)	
Marital status			0.01
Widowed	79 (48.8%)	55 (33.1%)	
Married	75 (46.3%)	99 (59.6%)	
Single	8 (4.9%)	12 (7.2%)	
Studies			0.02
No education or only primary	123 (76%)	143 (86.1%)	
studies Secondary or university studies	39 (24%)	23 (13.9%)	
Living alone	52 (32.1%)	48 (28.9%)	0.53
Barthel Index, mean ± SD	98.6 ± 2.2	76.8 ± 22	0.0001
MEC, mean ± SD	30.5 ± 3	22.9 ± 7.4	0.001
MNA, mean ± SD	26.1 ± 2	22.9 ± 4	0.0001
Gijon questionnaire, mean ± SD	9.1 ± 0.4	10.4 ± 2.7	0.0001
Falls, mean ± SD	0.3 ± 0.7	0.4 ± 1.1	0.26
Tinetti Gait Scale, mean ± SD	8.2 ± 5.1	5.1 ± 3	0.001
Charlson comorbidity Index, mean ± SD	1.07 ± 1.3	1.8 ± 1.7	0.001
Hypertension, n (%)	122 (75.3%)	127 (75.9%)	0.89
Diabetes mellitus, n (%)	20 (12.3%)	38 (22.9%)	0.01
Dyslipidemia, n (%)	83 (51.2%)	85 (51.2%)	0.99
Previous stroke, n (%)	17 (10.5%)	32 (19.3%)	0.02
Chronic obstructive lung disease, n (%)	12 (7.4%)	22 (13.3%)	0.08
Heart failure, n (%)	17 (10.5%)	25 (15.1%)	0.21
Atrial fibrillation, n (%)	17 (10.5%)	24 (14.5%)	0.27
Isquemic cardiopathy, n (%)	7 (4.3%)	13 (7.8%)	0.18
Number of drugs taken, mean ± SD	5.2 ± 2.9	6.9 ± 3.4	0.001

SD, Standard deviation; MEC, Spanish version of the Mini-Mental State Examination score; MNA, Nutritional Assessment questionnaire score.

ladder). The diversity of the scales used in the different studies makes it difficult to compare the populations selected as successful agers. Perhaps the choice of less selective criteria, such as those used in the Octabaix study, will make it easier to replicate future studies using the same successful aging definition. In our study, multivariate analysis showed an association between unsuccessful aging in oldest Spanish community-dwelling subjects with higher co-morbidity, high malnutrition, and risk of falls.

Young et al.[7] recently postulated that successful aging is a state wherein an individual is able to invoke psychological and social mechanisms to compensate for physiological limitations to achieve a sense of well-being, high self-assessed QoL, and a sense of personal fulfillment, even in the context of illness and disability. Our results, however, show that the higher presence of disease decreases the proportion of successful agers. The loss of physical or cognitive functions is often due to, or associated with, a health problem. Consequently, global co-morbidity, evaluated by the Charlson Index, was higher in the group with poorer functional and cognitive performance. As expected, the group of unsuccessful agers presented a higher prevalence of diabetes mellitus and also of previous stroke, but these data were not significant in the multivariate analysis. The findings of the bivariate analysis associating a higher chronic use of drugs with less successful aging also reflect the high level of co-morbidity.

MNA is a simple tool used in clinical practice to measure nutritional status in elderly persons and to detect malnutrition risk. Malnutrition risk has been associated with lower performance,[28] although malnutrition is not an inevitable corollary of the aging process. Therefore, the finding that aged subjects in poor health have a higher risk of malnutrition is to be expected and should help us to identify individuals who require special strategies to prevent the onset of malnutrition.

The association between functional and/or cognitive decline and falls is well known.[29] We expected 85 year olds with better cognition and functionality to have a lower risk of falls. In fact, the percentage of reported falls was low throughout the sample: The percentage of subjects who reported at least one fall in the previous year was below the figure of 38.3% reported in a sample of 85 year olds in England.[30]

Interestingly, better aging was associated with male gender and more years of schooling in the bivariate analysis, although the associations lost significance in the multivariate analysis. In our sample, the percentage of men who survived to age 85 with successful aging status was higher than the percentage of wo-

TABLE 2. ODDS RATIO OF VARIABLES IN MULTIPLE LOGISTIC REGRESSION ANALYSIS MODEL

	p value	Odds ratio	95% Confidence interval
Tinetti Gait Scale	0.0001	1.753	1.501–2.046
MNA	0.0001	1.190	1.090–1.299
Charlson Index	0.013	0.791	0.657–0.952

MNA, Nutritional Assessment questionnaire score.

men. In most previous analyses of patients over the age of 84, the majority of subjects are women.[27] The greater survival rate of women with severe disability is probably due to their higher prevalence of disability rather than differences in incidence between the sexes.[12] Men born in 1924 would have been 12 at the outbreak of the Spanish Civil War in 1936, which could not have contributed to differences in survival. With regard to the importance of education, a high educational level has also been noted as a predictive factor of successful aging.[4,31] In our study, 19% of participants had a university degree or had reached high school. This percentage is higher than that previously reported in the general Spanish population of oldest-old subjects.[14,31] This high proportion of highly educated individuals in the study sample may have contributed to the high prevalence of successful aging found, although the percentage is lower than that reported in the Leiden study (35% of subjects with higher education[27]) and the association was not confirmed in the multivariate analysis. Although marital status does not generally relate to successful aging,[32] we found a predominance of widows in the successful aging group in the bivariate analysis in this study, but this association did not remain statistically significant in the multivariate analysis. Finally, unsuccessful aging is often associated with lack of social support.[33]

Another concept considered as part of successful aging is the individual's ability to adapt to changes during the aging process, resulting in a feeling of well-being.[4,5] We decided to compare the results of a semiquantitative QoL scale in our two groups. The results showed that people defined as successful agers using quantitative criteria had better QoL scores. A recent study of 85 year olds in Newcastle in northeastern England with a participation rate of eligible population (71%) similar to ours found frequent morbidity, but low levels of disability or poor QoL.[30] In that study, women outnumbered men in the same proportion as the Octabaix study (1.6:1), but in the Newcastle study 10% of subjects were in institutional care and 12.7% in sheltered accommodation (an uncommon resource in our area). Perhaps for this reason, only one fifth of the Newcastle cohort had no difficulty with any ADLs, whereas in our study the percentage of the participants who were independent for all basic ADL assesses was above 40%. Interestingly, disability was also higher in women in the Newcastle 85 + cohort study.[30]

The main strength of the Octabaix study is the use of a community-based sample of the same age. The sample provides a representative range of the socioeconomic characteristics of the older residents in our area, all of whom are registered in a general clinical practice and benefit from a full range of health facilities. However, this strength might also constitute a weakness as it limits the generalizability of the health survey findings to other populations.

This study has several limitations that we should point out. We examined the association between current geriatric evaluation scale values and certain diseases and disabilities (unsuccessful aging), but we did not evaluate previous disability; the direction of the effect is not clear. Another limitation is the failure to assess psychological aspects, such as depression, that might have interfered with the answers to the questionnaire on QoL, although the results support an association between better physical and cognitive performance and QoL.

Healthy life expectancy is influenced by a substantial number of avoidable or subordinate causes. Prevention of the risk factors causing high levels of disability, functional limitations, and cognitive decline such as stroke or ischemic cardiopathy is particularly important.[2] The risk of malnutrition and falls is potentially modifiable. Encouraging physical and cognitive training in the oldest old is positively related to a feeling of well-being.

This study is important because it is the first report from Spain to present the results of an age cohort as homogeneous as the ones from Leiden and Newcastle. Almost half of the 85 year olds in this population were aging successfully according to the quantitative definition chosen, and the group of successful agers reported better QoL and well-being. Low co-morbidity, as measured by the Charlson Index, lower risk of malnutrition (high MNA scores), and lower risk of falls (high Tinetti Gait Scale scores) were associated with successful aging in our oldest-old subjects.

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Author Disclosure Statement

The authors have no conflicts of interest to report.

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