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The Aging Profile of the Portuguese Population: A Principal Component Analysis

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Abstract In the last 5 years the resident population of Portugal has increased 2.3 %, along with a progressive ageing. This study aims assessing the social dependence and frailty, as well as social and familial support needs of the elderly. In an observational, cross-sectional community based study (EPEPP study), a total of 2,672 people, aged 55 or more, were submitted to an enquiry and several variables were studied among three age groups: 55–64 years old (37 %), 65–74 years old (37 %) and ≥75 years old (26 %), encompassing a total of 57 % women and 43 % men. A questionnaire including items such as physical autonomy, locomotion, falls, health/medical complaints, instrumental autonomy, physical activity, health self-evaluation and emotional status was applied. The strong correlations among the studied scores allowed the identification of people groups with common characteristics when a principal component analysis was used: "autonomy" (scores of instrumental autonomy, locomotion and physical autonomy) and "perception of health and emotional status" (scores of health self-evaluation and emotional status), were present in the three age groups. The component analysis evidences that a good autonomy, a good perception of health and emotional status are determinant to a good quality of life in elderly. Although health status and self-rated health have a propensity to deteriorate with aging, older Portuguese consider their state of health satisfactory and tend to underestimate their decline. In what concerns the analysis of gender with the same age and in contrast to what has been reported, older women alike to men, experience a good mobility and health self-evaluation.

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Introduction

Portugal is a European country with a total of 10.5 million inhabitants, including the mainland and the two archipelagos (Madeira and Azores). Within the last 5 years the resident population on mainland Portugal has increased 2.3 % [1].

This quantitative evolution of the Portuguese population has been accompanied by a progressive ageing of the population, due to lower fertility and to the increase of life expectancy. According to official demographic data [2] life expectancy rose 2.44 years for both genders from 1999 to 2001, and between 2007 and 2009 this increase was

2.77 years for men and 2.11 for women. Life expectancy was 81.8 years for women and 75.9 years for men in 2009, with a ratio distribution of 15.2 % for young people (below 15 years old), 17.9 % for older people (above 64 years). Furthermore, global mortality rate has stabilised at around 9.4 deaths per thousand inhabitants, which is in line with the European average (UE25 = 9.6 ‰ in 2005).

It has been reported that gender has a profound impact on quality of life (QoL) among old-aged people. In several studies worse results have been found in women, regardless the studied instruments (e.g., self-rated health, census data or self-reported health judgments). Nevertheless, a controversy still exists as women evidence a distinct advantage in survival in nearly all populations worldwide. The determinants of these gender differences in QoL are still unclear in particular the impact of social and biological factors [3].

The unprecedented growth of the elderly population during the past century, will create unavoidable changes in society and in the policy of health over the next decades. Despite worldwide interest in the increasing human "health span", scarce experimental attention has been dedicated to identifying differences in life-style, psychological and social factors, health status and health perception that can influence successful aging.

Accordingly, to evaluate the process of aging in the Portuguese population, it is mandatory to study social dependence and frailty, as well as social and familial support needs of the elderly. This study is crucial for implementing a suitable response in order to improve the quality of life and minimize the economic impact of aging on health and wellbeing of the aged population.

Materials and Methods

The EPEPP study ("Profile of the Aging of the Portuguese Population") had two main goals: a descriptive study of socio-demographic characteristics of the Portuguese elderly population, and the identification of large group characteristics (patterns) according to a range of functionality variables and to age and gender.

This was a community-based observational study from a representative sample of the Portuguese population. The sample was drawn from the list of Health Centres of the 5 regions of the mainland Portugal: North (22 %), Centre (20 %), Lisbon and the Tagus Valley (LVT) (19 %), Alentejo (20 %) and Algarve (19 %) using a proportional clustering method of trends made by region ("nuts II").

A total of 2,672 people, aged 55 or more, were submitted to an enquiry at the previously selected 26 Health Centres [4]. The survey was performed on 2,516 individuals, in order to obtain a maximum error of 2 % with a 95 % interval of confidence.

The questionnaire, previously validated in the Portuguese population [5], was conducted by trained interviewers.

The study was cross-sectional and compared several variables among three age groups: 55–64 years old (37 %), 65–74 years old (37 %) and ≥75 years old (26 %), 57 % were women and 43 % were men.

The questionnaire included questions that were grouped into scores ("physical autonomy": capability in dress, lie down and out to bed, wash, use the bathroom, eat, urine and stool control; "locomotion": capability to walk in house or in the street, use stairs; "falls": history of falls, reasons and sequels; "health/medical complaints": locomotion, vision and audition complaints, medical consultations; "instrumental autonomy": capability of performing daily domestic and non-domestic tasks; "physical activity": experience of various types of physical activities; "health self-evaluation": subjective quantification and comparison with other age populations; "emotional status": depression, anxiety, nervousness, energy feelings and subjective emotional evaluation). The total value of each score was obtained summing all the items values included in the score. For each a "favourable" or "unfavourable" assumption (using the median of the questionnaire score) was calculated according to the values of each variable used to build the item. A high score value means a better performance and a higher favourable status.

The study protocol was approved by the Ethics Committee of the Faculty of Medicine of the University of Coimbra.

Statistical Analysis

The statistical analysis was performed with the help of IBM SPSS 20.0. The distribution properties of the scores regarding instrumental autonomy, locomotion, physical autonomy, falls, health self-evaluation, emotional status, physical activity and health/medical complaints scores were assessed by calculating the range, mean, standard deviation, median, mode and the skewness of their distribution. Due to the asymmetric distribution of some of the scores, Principal Component Analysis for Categorical Data was applied, with the criteria of eigenvalue being greater than one and a maximum of two dimensions, in order to determine the dimensions underlying the pattern of inter-relationships among the scores considered. Thus, reducing the number of the original variables and increasing interpretability of the summary components.

Results

The scores were the first empirical indicator of the patterns underlying the studied population. Their distribution

Table 1 Descriptive statistics of the scores of the evaluated items in the total population (n = 2,672)

Scores (%)	Possible range	Observed range	Mean ± SD	Median	Mode	Skewness
Physical autonomy	0–24	8–24	22.7 ± 2.0	24	24	−2.02
Locomotion	0–9	3–9	8.3 ± 1.0	8	9	−2.04
Instrumental autonomy	0–24	1–24	19.6 ± 4.5	21	24	−1.13
Health self-evaluation	0–6	0–6	3.6 ± 1.6	4	4	−0.23
Emotional status	0–12	0–12	7.6 ± 2.9	8	8	−0.54
Falls	0–9	0–9	5.9 ± 2.1	6	6	0.24
Physical activity	0–9	0–9		4	6	−0.03
Health/medical complaints	0–7	0–6	2.6 ± 1.3	3	2	0.34

Table 2 Analysis of the studied scores association—correlation matrix

	Falls	Instrumental autonomy	Emotional status	Physical autonomy	Health/medical complaints	Health self-evaluation	Physical activity
Locomotion	0.330	0.298	0.189	**0.533**	0.367	0.113	−0.050
Falls		0.105	0.205	0.336	0.295	0.107	−0.082
Instrumental autonomy			0.049	0.039	0.124	0.082	0.038
Emotional status				0.289	0.324	**0.424**	0.083
Physical autonomy					0.369	0.191	−0.106
Health/medical complaints						0.286	−0.102
Health self-evaluation							0.186

Correlations above 0.400 (positive or negative) are in bold

(Table 1) shows some skewness mainly at physical autonomy, locomotion and instrumental autonomy scores.

The highest favourable scores were found for physical autonomy (98.9 % of the individuals), locomotion (98.6 % of the individuals), and instrumental autonomy (79.4 % of the individuals), followed by health self-evaluation (58.1 % of the individuals), emotional status (56.4 % of the individuals) and falls (56.2 % of the individuals). Physical activity (31.6 % of the individuals) and health/medical complaints (27.3 % of the individuals) showed the highest unfavourable scores.

The correlation matrix of the transformed variables is presented in Table 2. Strongest associations were observed between locomotion and physical autonomy (0.533) and between emotional status and health self-evaluation (0.424). The majority of the bivariate correlations presented some correlation, but physical activity score showed a lack of correlation with all the other scores.

The study of the correlation of the transformed variables among the scores allowed the identification of groups with common characteristics when a principal component analysis was used.

The results concerning the component loading of each item, as well as the eigenvalues and the Cronbach's alpha (a coefficient of internal consistency), for both genders and age groups, are summarized in Table 3.

For the youngest age group of males a Cronbach's alpha of 0.70 and 0.37 for the first and second components were found. The first component includes the scores of instrumental autonomy, locomotion, physical autonomy, falls and health/medical complaints. The second component includes the scores of health self-evaluation, emotional status and physical activity, this one with a lower component loading.

For the youngest age group of females a Cronbach's alpha of 0.73 and 0.32 for the first and second components were found. The first component includes the scores instrumental autonomy, locomotion, physical autonomy, falls, emotional status and health/medical complaints. The second component includes the scores of health self-evaluation, emotional status and physical activity. The emotional status score has similar loadings in both components.

For the 65–74 years old male age group, a Cronbach's alpha of 0.70 and 0.37 for the first and second components were found. The first component includes the scores of instrumental autonomy, locomotion, physical autonomy, falls, emotional status and health/medical complaints. The second component includes the scores of health self-evaluation, emotional status and physical activity. The emotional status has similar loadings in both components.

Females in the same age group showed three components with a Cronbach's alpha of 0.72 and 0.35 for the first and

Table 3 Principal component structure for male and female and for the age groups studied

	55–64 age group		65–74 age group		≥75 years old	
	Component 1	Component 2	Component 1	Component 2	Component 1	Component 2
Male gender score						
Instrumental autonomy	**0.54**	−0.26	**0.60**	0.10	**0.78**	−0.21
Locomotion	**0.76**	−0.22	**0.72**	−0.16	**0.80**	−0.24
Physical autonomy	**0.78**	−0.09	**0.78**	−0.10	**0.85**	−0.16
Falls	**0.52**	−0.13	**0.51**	−0.37	0.49	−0.31
Health self-evaluation	0.32	**0.77**	0.33	**0.73**	0.30	**0.75**
Emotional status	0.31	**0.69**	**0.51**	0.47	**0.55**	**0.55**
Physical activity	−0.37	0.46	−0.18	**0.72**	0.03	**0.57**
Health/medical complaints	**0.70**	0.23	**0.68**	0.13	**0.55**	0.15
Eigenvalue	2.58	1.48	2.61	1.48	2.90	1.43
Cronbach's alpha	0.70	0.37	0.70	0.37	0.75	0.35
Female gender score						
Instrumental autonomy	**0.65**	−0.10	**0.63**	0.03	**0.76**	−0.39
Locomotion	**0.69**	−0.25	**0.69**	−0.27	**0.72**	−0.38
Physical autonomy	**0.79**	−0.16	**0.76**	−0.24	**0.83**	−0.37
Falls	**0.55**	−0.24	**0.50**	−0.46	**0.50**	0.06
Health self-evaluation	0.48	**0.69**	**0.51**	**0.61**	**0.50**	**0.65**
Emotional status	**0.54**	**0.57**	**0.57**	0.40	0.48	**0.67**
Physical activity	−0.17	**0.66**	0.09	**0.76**	0.24	0.37
Health/medical complaints	**0.65**	−0.03	**0.62**	−0.04	**0.58**	0.29
Eigenvalue	2.78	1.38	2.68	1.44	2.91	1.52
Explained variance (%)	0.73	0.32	0.72	0.35	0.75	0.39

Factor loadings above 0.50 (positive or negative) are in bold

second components. The first component encompasses scores of instrumental autonomy, locomotion, physical autonomy, falls, health self-evaluation, emotional status and health/medical complaints. The second component includes the scores of health self-evaluation and physical activity. The health self-evaluation and the emotional status cores had similar loadings in both components. The falls scores has also similar loadings but with an inverse behaviour.

For males with 75 or more years old, a Cronbach's alpha of 0.75 and 0.35 for the first and second components were found. The first component includes the scores of instrumental autonomy, locomotion, physical autonomy, falls, emotional status and health/medical complaints. The second component includes the scores of health self-evaluation, emotional status and physical activity. The emotional status score had similar loadings in both components.

For females with 75 or more years, a Cronbach's alpha of 0.75 and 0.39 for the first and second components were found. The first component includes the scores of instrumental autonomy, locomotion, physical autonomy, falls, health self-evaluation and health/medical complaints. The second component includes the scores of health self-evaluation, emotional status. The health self-evaluation and the

emotional status scores have similar loadings in both components. The physical activity is distributed, with a low loading, in both components.

Discussion

The variables studied are part of the EPEPP questionnaire which assesses the prevalent characteristics of several variables in a representative sample of the Portuguese population aged 55 years old and over, according to gender. From these variables, scores of physical autonomy, locomotion, falls, health/medical complaints, instrumental autonomy, physical activity, health self-evaluation and emotional status were calculated. After an initial evaluation of their distribution, the scores were modulated with a statistical analysis procedure, in order to identify groups of people with shared characteristics (components), which allowed defining several profiles of the studied population.

It must be stressed that the EPEPP population is non-dependent, generally having a good health status average. Also, the questionnaire tried to analyse aging trends and

subsequently it had a low sensitivity for individual or population details.

The correlation matrix of the transformed variables (Table 2) is a first indication of some multicollinearity among the studied scores, as the majority of the scores have some correlation. The most important correlations are between the scores of physical autonomy and locomotion and between the scores of self-evaluation and emotional status, predicting the results of the principal component analysis (PCA).

The two component extracted have a common trait of association which may be called "autonomy" (scores of instrumental autonomy, locomotion, physical autonomy, falls, together with health/medical complaints) and "perception of health and emotional status" (scores of health self-evaluation and emotional status). The physical activity score showed a variable behaviour, according to gender and age groups. It may be considered that the prevention of the deterioration of these scores may lead to a better quality of life in a high percentage of the elderly population. This principal component analysis evidences that the elderly are associated in distinct groups, thus assuming that a good autonomy, a good perception of health and emotional status are determinant to a good quality of life.

This study also demonstrated the presence of common traits in all the age groups and in both genders, particularly in the scores of instrumental and physical autonomy, usually associated with favourable characteristics of locomotion and absence of falls. It has been demonstrated that people ageing with an early onset disability often have fewer basic living skills and therefore require higher levels of assistance mainly due to an increased physical frailty and diminished levels of functional skills [6]. The aged Portuguese population does not seem to follow this trend since that in the three age groups a segment of the population remains with an independent activity and a good autonomy.

It is also evident that the component of perceived health and emotional status, which includes the scores of health self-evaluation and emotional status, leads to a feeling of wellbeing. The scores of health/medical complaints and falls are scattered through these components. An unexpected feature is the lack of adequacy of the physical activity score regarding the components identified. The variability observed could result from a lack of specificity, and/or of homogeneity of this score, as it includes sports, recreational and domestic activities.

The physical activity score showed an intermittent association with the two components extracted, "autonomy" and "perception of health and emotional status" component. In male, the physical activity score has its maximum association with the "perception of health and emotional status" component at the age group of 65–74 years old, probably meaning that at this age most of

the men are retired, having more facility and availability to socialize. This score is also important for emotional wellbeing in female, but seems that it loses its significance in the older group. The emotional status shows a more quantitative insert in the second component, but also an important loading at the first component.

Several authors have attempted to summarize the evidence of correlations among parameters such as physical activity, emotional status and health self-evaluation [7, 8]. In the elderly, a consistent association between regular physical exercise, enhanced psychological wellbeing, cognitive efficacy and a favourable health perception was also described [9, 10]. Routine physical activity has been shown to be associated with the prevention and management of cardiovascular disease and contributes to the primary and secondary prevention of chronic diseases such as diabetes, osteoporosis, hypertension, obesity, cancer and depression reducing the risk of premature death [7]. Increasing evidence shows that with age, a decrease in muscle quality occurs and exercise has been suggested to provide the stimulus and substrates for tissue remodelling [11]. Interestingly, the greatest improvements from regular physical exercise in health status are observed when least fit individuals become physically active, particularly in elderly women [7, 10]. Our data highlight the presence of groups with common characteristics that were considered as differentiator elements of distinctive traits or behaviours.

Really, the influence of chronic diseases, socioeconomic status, education and cognitive impairment on quality of life, wellbeing and self-control can't be ruled out [12–15].

Postural control efficiency in the elderly is diminished, which makes them more unstable and with a higher tendency to fall. The fact that falls are being associated with female remains undetermined, although lifestyle, longevity, frailty, genetic factors and the absence of physical activity can be potential reasons for this increase. A consensus exists concerning the association between the regular practice of physical activity and health benefits, such as increased longevity, reduced mortality, improved control of chronic diseases, decreased medication consumption, functional maintenance and psychological benefits. Therefore, the practice of exercise may be considered a "protective component" against conditions that predispose the elderly to falls [16].

Conclusions

Although health status and self-rated health tend to decline with aging, many older Portuguese people consider their state of health satisfactory and have a tendency to underestimate its decline, as demonstrated by the two components "autonomy" and "perception of health and

emotional status". In what concerns gender and in contrast to what has been reported by other authors for several health indicators and health-related behaviour, we found that older women experience a good mobility and health self-evaluation similar to men of the same age.

Across the world all data suggest that the ageing of the population, together with changes in the family support, raised expectations on the quality of health services and support of the elderly population, may increase the challenges for policy-makers of health care. A more specific evaluation of the various determinants of aging profile is required in order to promote a healthier aging and quality of life.

Conflict of interest The authors have no conflict of interest to declare.

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