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Authors: Daniela Brandão, Oscar Ribeiro, Rosa Marina Afonso, Constança Paúl

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Regional differences in morbidity profiles and health care use in the oldest old: Findings from two Centenarian Studies in Portugal

Daniela Brandão, MsC [1,2]

Oscar Ribeiro, PhD [1,3]

Rosa Marina Afonso, PhD [1,4]

Constança Paúl, Full Professor[1]

[1] Center for Health Technology and Services Research, Institute of Biomedical Sciences Abel Salazar (CINTESIS-ICBAS), University of Porto, Porto, Portugal

[2] Faculty of Medicine, University of Porto (FMUP-UP), Porto, Portugal

[3] Department of Education and Psychology, University of Aveiro (DEP.UA), Aveiro, Portugal

[4] Department of Psychology and Education, University of Beira Interior (UBI), Covilhã, Portugal

*** Corresponding author:**

Daniela Brandão at CINTESIS-UNIFAI (Research and Education Unit on Ageing), Institute of Biomedical Sciences Abel Salazar, University of Porto, Rua Jorge Viterbo Ferreira, 228, 4050-313 Porto, Portugal; Phone contact: + 351 220 428 161

E-mail: danielafsbrandao@gmail.com

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Highlights

- Environmental and contextual resources play an important contribution to aging well;
- Predominantly urban sample present an overall worst physical and mental status;
- Our data has implications for the provision of geographically sensitive health services;
- More studies on health disparities according to the geographical location are needed;

ABSTRACT

Background: The worldwide increase of human life expectancy and the rapid aging of the population will contribute to an increasing prevalence of chronic illness. Even so, individuals who reach very advanced ages often postpone or escape age-related diseases that are common causes of death. *Objective:* This article aims to examine health-related characteristics of two distinct samples of Portuguese centenarians (one predominantly rural – PR vs. one predominantly urban - PU), and explore potential dissimilarities in their morbidity profiles and use of health care services. *Methods:* A total of 241 centenarians were considered. Sociodemographic characteristics, health status, and use of health care services were assessed by semi-structured interviews with the centenarians and their proxies (family or formal caregiver). *Results:* A higher average of 4.80 self-reported illnesses (SD=2.01) were found in the PU sample (vs. 2.96; SD=1.77 in the PR sample); in overall the PR sample presented a better health condition with lower levels of physical and mental impairments, and a greater number of centenarians who did not succumb to the three most common lethal diseases (heart disease, non-skin cancer and stroke) in the elderly population (85.4% vs. 60% in the PU sample). *Conclusions:* Portuguese centenarians experienced a substantial number of illnesses, but an overall better health status was found in

centenarians from the PR area. By providing distinctive health-related profiles, our findings suggest the importance of contextual factors in shaping how very advanced ages may be achieved.

Keywords: Portugal; centenarians; health care services; functionality; diseases; morbidity

1. INTRODUCTION

In Portugal, one of the most aged countries in the world, according to the last census the number of centenarians almost tripled within a decade, from 589 centenarians in 2001 to 1526 in 2011 (INE, 2012). More recent estimates published in 2017 pointed to the existence of 4287 centenarians (INE, 2017).

Centenarians appear to "outlive" the risks for many of the conditions that are common causes of death, such as cancer and myocardial infarction (Gessert, Elliott, & Haller, 2002); nevertheless, they also present a wide range of clinical conditions, since there are healthy centenarians without any particular disease or cognitive disorders, as there are frail individuals with multimorbidity (Terry et al., 2008). Indeed, despite those living up to be 100 years have been often seen as models of successful aging, several studies have revealed that a significant number of these long-lived individuals do not reach advanced age free of age-related diseases or without functional or cognitive impairments (Cho, Martin, & Poon, 2012; Cimarolli & Jopp, 2014; Gondo et al., 2006). In Europe, for example, in a study with Greek centenarians, Darviri et al. (2008) found that centenarians had one health condition on average, and in a sample of Danish centenarians Andersen-Ranberg, Schroll, and Jeune (2001) found an average number of four acute or chronic conditions; a more recent study with German centenarians (Jopp, Boerner, & Rott, 2016) found an average number of five illnesses.

Recognizing the importance of better understanding the health trajectories and the prevalence of diseases in those achieving extreme longevity, Evert et al. (2003) explored the timing of most common age-related illnesses in a sample of centenarians. They established three distinct morbidity profiles: the ''escapers'', who did not succumb to any age-related illnesses; the ''delayers'', who experienced delayed onset of age-related illnesses until 80 years; and the ''survivors'', who outlived with disease. In their study they found that 38% of centenarians could be labeled as "survivors", 43% as "delayers", and 19% as "escapers". Using this morbidity classification in Australian centenarians, Richmond, Law, & KayLambkin (2012) found that 46% could be considered as "survivors", 34% as "delayers", and 19% as "escapers", and more recently, Brandão et al. (2017a) with a sample of Portuguese centenarians found that 27.1% could be labeled as "survivors", 26.5% as "delayers", and 46.4% as "escapers" based on 10 disease states: heart disease; non-skin cancer; stroke; skin cancer; hypertension; Parkinson's disease; COPD; diabetes; thyroid disorders; and osteoporosis.

Along with the importance of personal factors to aging well like genetics and healthy behaviors (Steverink et al., 2001), there is consensus within the gerontological literature that environmental and contextual resources (e.g. access to health care services and opportunities for preventive medicine) also play an important contribution (e.g. Gobbens & van Assen, 2017; Wahl, Iwarsson, & Oswald, 2012; Yabuwaki, Yamada, & Shigeta, 2008). Social and health services play a leading role in promoting active aging, and in this regard the availability of health promotion and disease prevention initiatives, equitable access to primary health care, and an easy access to curative and long-term care are of crucial importance (WHO, 2002; WHO, 2015). Yet, these may not be similarly available across regions.

Several studies, although not specifically focusing on centenarians, have shown the existence of better health behaviors in urban than in rural older dwellers, which can contribute to their better health status (e.g. Araújo, 2008; Fogelholm et al., 2006; Parks, Housemann, & Brownson, 2003). Indeed, available literature has pointed to an increased risk of poor health for individuals in rural areas (Bull et al., 2001; Goins et al., 2005; Greiner et al., 2004) despite contradictory findings can be found: Zimmer and Kwong (2004), for instance, studied a sample of rural and urban Chinese older adults and found these last ones to be more likely to report poor health than their rural counterparts. Even so, Eberhardt and Pamuk (2004) found that on key measures of health (e.g. premature mortality) residents of rural areas fare worse than residents of more urbanized areas, and this higher premature mortality in rural old individuals may end up in rural centenarians in better health and functional conditions than their urban counterparts.

Specifically for Portugal, Santana (2000) reviewed some macro level indicators of regional differences in the health status of elderly people, and verified that despite remarkable improvements in health outcomes, health services accessibility inequities still persist. Older persons from the Central Region of Portugal and from Alentejo (Southern Region) demonstrate a different set of health behaviors compared to the other regions or the country as a whole, being the two geographical areas with the lowest health care usage (Santana, 2000). More recently, the same researcher (Santana, 2015) studied the evolution of the Portuguese health between 1991 and 2011 according to a holistic measure - the population health index - which includes two components of assessment of the population's health: health outcomes (mortality and morbidity), and determinants of

health (economic and social; physical environment; health care; and lifestyles). This study revealed that despite some health gains could be found, inequalities continue in 2011, even though there was a decrease in the disparities between municipalities in all dimensions, except for lifestyle, where there was a worsening in the order of 31%.

According to the profiles of performance on health index indicators of the population in 2011, Santana (2015) also stated that fragile rural areas, which includes Beira Interior (profile A), corresponding to 37.7% of the municipalities, had high mortality rates, high population aging, low levels of schooling, poor geographical accessibility to health care, and high alcohol consumption. On the other hand, areas of intensive urbanization with positive and negative health consequences (Profile D), mostly located in the metropolitan areas of Oporto and Lisbon (10%), were characterized positively with high levels of education and geographical proximity to health care, and negatively by high incidence rates of AIDS and tuberculosis and unfavorable health conditions (e.g., poorer air quality, high crime rate and high duration of commuting). In line with these findings, a recent study (Ribeiro et al., 2017) found that spatial inequalities in old-age survival exist in Portugal, and that socioeconomic deprivation was still the single most important determinant of old-age survival. The contribution of access to healthcare was smaller, and the impact of physical environment was null. In a study conducted fifteen years ago in the same Portuguese regions of the present study (Porto and Beira Interior), Paúl et al. (2003) found by comparing urban and rural older people that they differ in education level and wage (favoring urban elders) and in the level of physical functioning (higher in rural elders); they also showed differences in the social network (larger in rural older people) and in emotional distress (lower levels of anxiety in rural elders). The aims of this study are to analyze the health-related characteristics of centenarians from two Portuguese Centenarian studies (PT100 Oporto Centenarian Study – the urban sample, and PT100 Beira Interior Centenarian Study – the rural sample) exploring differences in the most frequent age-related illnesses, use of health care services and morbidity profiles.

2. METHODS

The sample comprised centenarians who integrated the Oporto Centenarian Study (PT100) and the Beira Interior Centenarian Study (PT100 BI). The first is a population-based study conducted in the Oporto city and its surrounding geographical area (Oporto Metropolitan Area, which comprises a region of approximately 60 km around Oporto), and corresponds to a predominantly urban sample. The second refers to a convenience sample of centenarians living in the interior part of the country with similar geographical extension around the city of Covilhã (Beira Interior region), corresponding to a predominantly rural sample.

The two samples followed identical design and methodology. The first step in the recruitment of centenarians was to identify and locate all potential participants in each municipality and parish, based upon the last National census information and through contacting parish councils, local churches, nursing homes, institutions, and health care centers. Then, in the case of centenarians residing in nursing homes, a contact was initially made with the institution's technical director to introduce the study and request collaboration with the research, followed by contacting the centenarians and/or their proxy. As for the centenarians who lived in the community, researchers contacted the centenarians and/or their relatives directly (in some cases the contact was mediated by local research partners who were enrolled in the identification of centenarians: doctors, nurses, social workers, or parish council). The recruitment of centenarians was conducted between December 2012 and May 2014, with all inhabitants who were aged 100 years and more at that dates were considered eligible.

In the PT100 Oporto Centenarian Study, 186 potential participants were identified, and of these, 140 were effectively face-to-face interviewed; the other 46 centenarians were subsequently excluded because they died in the interim or their relatives refused participation because of severe health problems, or lack of interest. In the PT100 Beira Interior Centenarian Study, 130 potential centenarians were identified, and 29 excluded. Eight centenarians died between the first contact and the interview, four centenarians refused collaboration due to serious health problems, and five centenarians didn’t show interest in participating in the study. In four cases, the centenarians or their relatives refused to participate in the study. In eight cases the reported age could not be validated. Information on these projects and on the methodology used for participant selection and data collection can be found elsewhere (Afonso et al., 2018; Ribeiro et al., 2015).

A total of 140 centenarians from the PT100 Oporto Centenarian Study, and 101 centenarians from the PT100 Beira Interior Centenarian Study integrated this particular study.

2.1. Measures and Procedures

2.1.1. Sociodemographic characteristics regarding age, gender, marital status, number of living children, education, monthly income, income adequacy for medical expenses, living arrangements, and living alone (yes/no) were collected.

2.1.2. Health status was assessed using measures of:

(i) ***physical health****,* indicated by the ability to perform activities of daily living (BADL and IADL) and measured with items retrieved from the Older Americans Resources and Services (OARS) Multidimensional Functional Assessment Questionnaire (Fillenbaum & Smyer, 1981); information of mobility (bedridden vs. non-bedridden), use of assistive technical advices (i.e., cane, walker, wheelchair, hearing aid, glasses) and number of falls in the last five years was also collected;

(ii) **m*ental status,*** indicated by the Mini Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) with a maximum score of 21 points instead of 30, and the Global Deterioration Scale (GDS) (Reisberg et al., 1982). Dementia/cognitive impairment was determined using thresholds of these two dementia screeners and defined by either a score of 4 or higher (i.e., severe cognitive decline) given by the interviewer on the GDS, or a score of 10 or lower on the shortened MMSE (max. 21 points), which includes original MMSE items that are unlikely to be biased by the poor sensory functioning highly prevalent in the centenarian population (Holtsberg et al., 1995);

(iii) ***age-related illnesses***, indicated by a checklist of common health conditions: hypertension, heart disease, diabetes, chronic lung disease, ulcers or other serious stomach issues, cirrhosis or other liver problems, kidney condition, frequent urinary infections, incontinence, prostate problems, problems with vision, problems with hearing, arthritis, osteoporosis, other, and stroke, falls, pneumonia, and cancer (from age 95 on). To facilitate the analysis of acute and chronic health conditions we grouped them in the following manner: cancer,

cardiovascular conditions, endocrinological system conditions, gastrointestinal system conditions, mobility, musculoskeletal conditions, neurological/brain conditions, sensory impairments, respiratory system conditions, urinary system conditions, and other.

2.1.3. Use of health care services was assessed with questions on (i) the number of visits to the general practitioner (GP) in the last year (ii) the number of visits to an emergency department (ED) in the last year, (iii) the number of daily medicaments, and (iv) the use of formal health and social services (e.g., domiciliary nursing care).

Information was collected during one or two sequential semi-structured face-to-face interview sessions directly with the centenarian and/or with a proxy respondent by trained interviewers. All procedures of age validation (i.e., via confirmation with identity card or birth certificate) and informed consent for participating in the study were fully applied. All centenarians (and/or their proxies in case of cognitive impairment) signed a written informed consent form. The study followed all ethical procedures in accordance with the Declaration of Helsinki.

2.2. Analysis

Descriptive statistics were used to present the sociodemographic and health profile of the two samples of centenarians considered. Pearson´s Chi-squared and Student t-tests were performed to identify differences between centenarians from the PT100 Porto and from the PT100 BI. All analyses were performed using IBM SPSS Statistics version 21.0 (IBM Corporation, Armonk, NY, USA) and a p-level of 0.05 was considered as significant.

3. RESULTS

3.1. Centenarians' profile

The analysis of the sociodemographic and health-related characteristics of the two samples (Table 1) revealed that most centenarians were female (89.3% in PT100 Oporto and 86.1% in PT100 BI), widowed/divorced (80.0% in PT100 Oporto and 91.1% in PT100 BI), and had living children (76.1% in PT100 Oporto and 90.1% in PT100 BI). Regarding living arrangements, while in PT100 Oporto more than half of centenarians (57.9%) lived in the community, in PT100 BI the distribution was more equal (49.0% vs. 51.0% institutionalized). Differences in the monthly income were also found, with a higher percentage of centenarians with a monthly income inferior to 250€ (19.4% vs. 7.0%) in PT100 BI sample.

Table 1. Sociodemographic characteristics and health status of the centenarians by sample

	PT100 Oporto (n= 140)		**PT100 BI (n=101)**		**Differences**
	N	%	n	%	
Sociodemographic variables					*p*-value
Age					
Mean (SD)	101.18(1.6)		101.14(1.5)		0.406
Gender					
Female	125	89.3	87	86.1	0.548
Male	15	10.7	14	13.9	
Marital status					
Never married	25	17.9	6	5.9	**0.024**
Married/Living as married	3	2.1	3	3.0	
Widowed/Divorced	112	80.0	92	91.1	
Children					
Yes	105	76.1	91	90.1	**0.006**
No	33	23.9	10	9.9	
Schooling					
No	46	33.8	47	47.5	
No, but can read and write	12	8.8	7	7.1	0.107
Yes	78	57.4	45	45.5	
Monthly income					
Less than 250€	9	7.0	18	19.4	
250-500€	90	69.8	66	71.0	**0.002**
More than 500€	30	23.3	9	9.7	
Income adequacy for medical expenses					
Not difficult at all/not very difficult	70	59.8	50	52.1	
Somewhat difficult	24	20.5	30	31.3	0.200
Very difficult	23	19.7	16	16.7	
Residence					
Community	81	57.9	49	49.0	0.190
Nursing home	59	42.1	51	51.0	
Living alone (% yes)	6	4.3	12	12.0	**0.024**
Physical health variables					
IADL capacity					
Mean (SD)	2.02(2.22)		3.04(3.73)		**0.000**
BADL capacity					
Mean (SD)	6.69(4.5)		8.40(4.67)		0.642
Mobility					
Bedridden	83	61.0	37	38.1	**0.001**

Falls in the last 5 years (% yes)	76	54.3	41	40.6	**0.036**
Use of assistive devices (% yes)					
Cane	28	31.5	29	30.5	0.891
Walker	9	10.1	13	13.5	0.472
Wheelchair	53	42.4	37	37.8	0.483
Hearing aid	9	6.5	3	3.2	0.259
Glasses	47	33.8	38	39.6	0.365
Mental health variables					
Global Deterioration Scale					
Mean (SD)	4.50(2.3)		3.52(2.0)		**0.045**
MMSE					
Mean (SD)	9.20(9.9)		14.55(6.6)		**0.000**
Diseases and use of care services					
Number of diseases					
Mean (SD)	4.80 (2.01)		2.96 (1.77)		0.196
Number of diseases					
0-2 diseases	16	11.4	48	47.5	
3-5 diseases	77	55.0	45	44.6	0.000
≥5 diseases	47	33.6	8	7.9	
Number of drugs (per day)	3.56 (2.6)		2.87 (2.5)		0.791
Number of GP visits (last year)	4.12 (7.6)		1.09(1.6)		**0.001**
Number of ED visits (last year)	0.65 (1.3)		0.37(0.6)		**0.002**
Number of hospitalizations/in continuous care (last year)	0.17 (0.5)		0.33(1.9)		0.055
Support of home care (% yes)	18	12.9	13	13.3	0.927
Support of nursing care (% yes)	74	52.9	29	29.6	**0.000**
Support of physiotherapy (% yes)	18	12.9	7	7.2	0.159

In terms of physical health characteristics, differences were found for IADL levels and mobility. Findings pointed to higher levels of dependency in the PT100 Oporto sample in instrumental daily activities (M=2.02 vs. M=3.04), and a higher percentage of bedridden centenarians in the PT100 Oporto (61% vs. 38.1% in PT BI). As for mental health characteristics, worst cognitive function was found in the PT100 Oporto sample (M=9.20 vs. M=14.55), as well as higher levels of global deterioration (M=4.50 vs. M=3.52). Differences were also found for the number of GP and ED visits, which was higher in the PT100 Oporto sample (M=4.12 vs. M=1.09 and M=0.65 vs. M=0.37, respectively); a higher percentage of centenarians with nursing support was also found in the PT100 Oporto sample (12.9% vs. 7.2%).

3.2. Age-related illnesses and morbidity profiles

The analysis of age-related illnesses by sample (Table 2) revealed that problems with vision (73.6%), hearing (71.4%), arthritis (56.4%) and incontinence (55.7%) were the most frequent health conditions in the PT100 Oporto sample, whereas in the PT100 BI problems with hearing (73.3%), and vision (60.4%), incontinence (31.7%) and high blood pressure (23.8%) were the most common. The same comparative analysis also revealed significant differences for hypertension, heart condition, ulcers or other serious stomach issues, cirrhosis or other liver problems, kidney condition, frequent urinary infections, urinary incontinence and arthritis, all of them pointing to a higher percentage of centenarians without the condition in the PT100 BI sample.

Table 2. Self-reported illnesses by sample

	PT100 Oporto (n= 140)		**PT100 BI (n=101)**	
	n	%	n	%
Cancer[1]	8	5.7	5	5.0
Non-skin cancer	4	2.8	3	3.0
Skin cancer	4	2.8	2	2.0
Cardiovascular conditions				
High Blood Pressure	60	42.9	24	23.8
Heart condition	55	39.3	20	19.8
Endocrinological system				
Diabetes	7	5.0	4	4.0
Gastronintestinal system				
Ulcers or other serious stomach issues	45	32.1	11	10.9
Cirrhosis or other liver problems	14	10.0	1	1.0
Musculoskeletal system				
Arthritis	79	56.4	19	18.8
Osteoporosis	15	10.7	8	7.9
Neurological/brain condition				
Dementia/cognitive impairment	84	65.6	41	41.4
Stroke[1]	1	0.7	1	1.0
Respiratory system				
Pneumonia[1]	18	12.9	6	5.9
Chronic lung disease	31	22.1	14	13.9
Sensory conditions (vison + hearing)	125	89.3	86	85.1
Problems with vision	103	73.6	61	60.4
Problems with hearing	100	71.4	74	73.3
Urinary system				

Incontinence	78	55.7	32	31.7
Frequent urinary infections	22	15.7	4	4.0
Prostate problems[2]	5	3.6	4	4.0
Kidney condition	11	7.9	2	2.0
Other	20	14.3	9	8.9

*[1] from age 95; *[2] n = 15 men in PT100 Oporto and n=14 in PT100 BI;

Considering Evert et al.'s (2003) morbidity classification we found that in the PT100 Oporto sample 34.3% could be labeled as "survivors", 35.3% as "delayers" and 30.4% as "escapers", whereas in the PT100 BI the percentages were 15.6%, 12.5% and 71.9%, respectively (Figure 1). The analysis of the morbidity profile based only in the three most lethal diseases - heart disease; non-skin cancer; stroke (Figure 2) revealed, in turn,

that 16.0% of centenarians from the PT100 Oporto were "survivors", 24.0% were "delayers", and 60.0% "escapers". In the PT100 BI 4.5% of centenarians were "survivors", 10.1% "delayers" and 85.4% "escapers".

INSERT FIGURES 1 AND 2

4. DISCUSSION

In profiling two distinct groups of Portuguese centenarians this study brought to light important findings that should be considered due to its implications for the provision of geographically sensitive health services and ultimately to the development of health policies that consider the importance of contexts in shaping ill-health profiles in very advances ages. Main selected findings include: first, the higher levels of physical dependence and mental health problems in the predominantly urban sample, which potentially relates to a higher use of healthcare services (a finding also observed in this sample); second, the lower use of healthcare services in the predominantly rural sample; third, the higher frequency of sensorial impairments in both samples; and fourth, the higher number of centenarians who escaped common age-related diseases in the predominantly rural sample.

As for the first finding, our data revealed that centenarians from the predominantly urban area presented an overall worst physical and mental status, in line with Paúl et al.'s (2003) findings, but somewhat different from most of the available international studies on the topic of differences between urban and rural individuals considering samples of adults or older adults (e.g. Bull et al., 2001; Goins et al., 2005; Greiner et al., 2004; Fogelholm et al., 2006; Parks et al., 2003). In 1995, Mainous and Kohrs reported that at that date the available literature on the topic of health comparisons between rural and urban elders was insufficient and limited to perceived health status, ADL and IADL scores, and mental health indicators. In overall, at that time studies pointed to a marginally better perceived health status and limitations on ADLs in urban elders, but no differences in mental health. Considering that, the authors conducted a study to examine and compare health status between rural and urban adults, using data from the 1993 Kentucky Health Survey, and found that not just physical functioning, but also emotional status and wellbeing were worse among rural elders (Mainous and Kohrs, 1995). Other studies also found that rural elders generally had higher rates of poverty, less formal

education, poorer housing, limited transportation, and more chronic health problems and disabilities (Rosswurm, 2001; Song et al., 2007).

Specifically on centenarians, available data concerning differences between rural and urban individuals is very scarce. Clayton et al. (1994) found no differences regarding physical health (both self-reported and objectively measured with physical examination) and mental health, though they found less frequent visits to physicians, less medication use, and less reliance on physical aides (e.g., walkers, hearing aids) among the rural participants. Zeng et al., 2017 also studied rural-urban differences in centenarians' health status, and found that when compared to their urban counterparts, rural centenarians showed better health status (measured by self-reported ADL ability and objective physical performance tests), but that urban centenarians tended to report better life satisfaction. Similarly to Zeng et al.'s (2017) findings, our findings showed higher levels of functional independency in the rural centenarians, which we can argue to be potentially associated with the more active lifestyle of this population. When analyzing the occupation of the centenarians considered in our study, we verified that in the rural sample, 58.4% of centenarians worked in agriculture, while in the urban sample, the percentage decreases to 32.1%, and it is known this is an occupation that is often maintained after retirement, contributing to physical activity in more advanced ages (Zimmer et al., 2012). Moreover, may be that rural food habits, based on local and seasonal foods raised by themselves, are beneficial for their health. Even so, some studies found that rural elders referred to be less often engaged in leisure physical activities (Araújo, 2008; Fogelholm et al., 2006) as the concept itself may be meaningless for people that work all day around, as they are mostly self-sufficient, leaving few place and time for other activities besides those related with religious and cultural obligations. Nonetheless, further studies should be conducted in order to better understand the impact of lifestyle factors in the health status of individuals who reach very advanced ages.

In what regards our second highlighted finding, which showed differences in the use of healthcare services, being lower in the rural sample, it corroborates Clayton et al. (1994) and Santana's studies (e.g. Santana, 2000, 2009, 2015) and is in line with other international studies which referred that rural elders tend to present a limited access to nursing care and health care services in general (e.g. Rosswurm, 2001; Song et al., 2007). However, we should not disclaim the possibility that as rural centenarians of our study are in better

health condition, they do not need to apply for health services as much as the urban counterparts. We can also speculate about the lower expectations that rural older people may have toward medicine and drugs to cure their "normal" health problems.

Recognizing the importance of the need for more information about the constrains that can contribute to the limited access to care services, Goins et al. (2005) examined the barriers rural elders tend to report when accessing health care needs, and found five main categories of barriers: transportation difficulties, limited health care supply, lack of quality health care, social isolation, and financial constraints. Regarding the first reason, it is known that in Beira Interior region the access to transportation is reduced, and users usually had to travel long distances to hospital and health care centers, contributing to high costs and time spent in travels, which is expected to have a negative impact and reduce the use of preventive services and hospital care (Santana, 2002); furthermore, it may also contribute to explain the lower number of visits to the GP and ED in the rural sample, in line with previous studies (e.g. Furtado & Pereira 2010; Nemet & Bailey, 2000; WHO, 2004).

As for the second and third barriers, we verified that even with the improvements in the Portuguese National Health Service, the increasing number and proportion of elderly people in the population has not been accompanied by clear policy measures that fully consider their needs. Currently, the Portuguese public health system is a multilevel system, with the primary health care referring to specialized care levels. However, this referral model does not have the capability of sending everybody that needs specialized care to hospitals. Poorer and geographically isolated people are often excluded or, at least, have to face more obstacles to use hospitals (Santana, 2002); moreover, they also have a less diversified network of health care services, since hospital beds and specialized doctors are concentrated in urban areas. The referring process and the waiting lists, as well as the lower health literacy of the users needs were found to be important barriers in the access to specialized care in our country (Furtado and Pereira, 2010), and as a consequence, users habitually visit public hospital emergency departments, where a referral is not needed (Santana, 2002).

Health illiteracy usually prevents an appropriate usage of the services, particularly among the elderly population, as older persons were identified to attend less and avoid regular check-ups at the primary care services facilities (Doetsch et al., 2017). Low levels of education have an effect on mortality rates as low levels

of health literacy mean that preventive practices may not be understood, and this is an important issue in our population, since almost half of the rural sample (47.5%) did not attend school, and did not know how to write or read (even in the urban sample this percentage is of 33.8%).

Finally, regarding the importance of economics as a barrier to health care use, this can indeed be an important issue, since we verified that in both samples centenarians had a low monthly income (highlighting that the lack of income is more pronounced in the rural sample). Moreover, the recent economic and financial crisis in Portugal, further exacerbated the importance of this barrier, as Doetsch et al. (2017) found that the health reforms implemented as part of the austerity measures have been associated with increasing health inequalities in the access to healthcare services for the elderly population. We can argue that lower income can also contribute to a scarce use of formal support services and technical assistance, which we observed even in the urban PT100 Oporto sample, which presents a higher level of physical and mental dependency, potentially indicating the incapacity to pay for private healthcare services or home doctor visits.

In what concerns to our third highlighted finding, related to the high frequency of sensorial impairments in both samples, a recent study that presented the health and sociodemographic characteristics of Portuguese centenarians as given in the 2011 Census found major constrains in seeing (67.4%) and hearing (72.3%) in this population (Ribeiro et al., 2016). Also in German centenarians, sensory conditions were found to be common (94% of the sample) (Jopp et al., 2016), and in Greek centenarians a lower though still representative part (40-50%) presented hearing and/or visual problems (Stathakos et al., 2005). With a sample of centenarians and near-centenarians living in New York city, Cimarolli and Jopp, (2014) found that 17% of participants reported having a visual impairment only, 18% having a hearing impairment only, and 38% with both a visual and hearing impairment (dual sensory impairment), which sets a better status than we found in our study – in both samples more than 85% presented dual sensory impairment. Vision and hearing loss are associated, for instance, with a heightened risk for functional disability, depression, reduced social interaction, increased risk for falls and hip fractures, cognitive decline, and even mortality risk (e.g. Burmedi et al., 2002; Kempen et al., 2012; Wahl et al., 2013). Moreover, previous research reported that the poorer functioning among individuals with dual sensory impairment compared with those with visual or hearing impairment alone is even greater

among oldest individuals (Swenor et al., 2013). Despite hearing and vision impairment are among the most burdensome disorders for older adults (Prince et al., 2014), previous studies reported that age-related hearing impairment is often underreported (Kiely et al., 2011) and its impacts are poorly recognized, perhaps explaining why rates of hearing aid use are usually low (Chien and Lin, 2012). This reinforced the need of a greater recognition by the health policy makers of the importance of sensory impairment as a public health issue, and the need to deliver effective interventions tailored to the needs of older adults, promoting the management and rehabilitation of hearing and vision impairment in this population (Whitson and Lin, 2014).

Along with (dual) sensorial impairments, our data also reinforced the high frequency of dementia, musculoskeletal and cardiovascular conditions in Portuguese centenarians, which is in line with international findings (e.g. Andersen-Ranberg et al., 2001; Gellert et al., 2017;). Regarding the evolution of mortality in our country, we can say that in the last 40 years there has been a decrease in general mortality, particularly due to the reduction of diseases of the circulatory system (as a result of improvements in lifestyle and access to health care) and the accentuated reduction in mortality caused by infectious diseases (due to a larger coverage of vaccination), to improvements in the standard of living and housing/environmental conditions (Santana, 2009). The WHO evaluation of the Portuguese health system (2004-2010) carried out in 2008 and 2009 reported that mortality rates for some key causes of death under the age of 65 years have decreased since 2000, in particular mortality due to circulatory diseases (WHO, 2010), that contributed to 39% of the total number of deaths. Even so, cerebro-cardiovascular diseases continue to be the principal cause of mortality among the Portuguese population (DGS, 2013), and the promotion of education and health literacy assume a particular importance, in order to promote the recognition of warning signs by the population (Cortes, 2015), as acute cerebrovascular disease was found to be one of the most common reasons for hospital admission among centenarians in our country (Brandão et al., 2017b). A brief note about to mental diseases should also be made, since some studies found that living in the countryside may also favor the development of mental illness (e.g. Vlahov et al., 2005). Higher isolation, poor transportation and communications, difficulties to access health and social services are potentially risky conditions for mental health (Loureiro et al., 2015); even though in our study we found a lower percentage of dementia in the rural sample, it should be object of further attention.

Finally, our finding on the morbidity profiles pointed to a better overall status of the centenarians living in the predominantly rural area, which reinforced the exceptional character of these centenarians. For rural centenarians, reaching 100 years means that these individuals were capable of facing a series of additional adversities (e.g. lower education, lower income, higher premature death, and higher distance to healthcare services), but we found that in the sample of rural centenarians the percentage of escapers was high. Comparing to previous studies using the same morbidity profile classification, we found that the number of centenarians coded as "escapers" when considering the three most lethal diseases is in line with the findings of Richmond et al. (2012), which was of 74%, although higher than the percentage found in the study of Evert et al. (2003), that was of about 50%. We must take into account that when the centenarians of our study were born, life expectancy at birth was of about 40 years: in 1920 it was of 40 years for women and of 35.8 years for men (Santana, 2009), so these individuals lived more than the double of what is was expected and use less the health services. Probably these escapers' health outcomes are better explained by their lifestyle and genetics than by the effect of health services.

Despite the importance of this study's findings, there are some limitations in the data set that should be addressed, namely the self-report of diseases and use of care services. Older age is associated with less accurate self-reports of diseases, and it is also difficult to obtain precise medical histories of the participants (Short et al., 2009). This may have led to an underestimation of our sample's medical conditions. Even though, caregivers validated and/or complemented the centenarians' answers, which diminishes to some extent the self-report bias. In addition, in those cases where the centenarians lived in nursing homes, health professionals of the institutions were interviewed to collect their medical history and diagnoses. Secondly, survival bias (those with serious medical diseases have died at an earlier age) and selection bias (those with more serious medical diseases are not included in the studies) can also be present, though in the two Portuguese studies centenarians were included regardless of their morbidity and health status. Finally, our findings should be replicated using a higher sample of centenarians and living in other areas of our country, and further studies should also include self-perceived health and use of specialist care and inpatient care variables, which can help us to understand how the healthcare system is used.

5. CONCLUSION

This study provides a general overview about the health profile of Portuguese centenarians in two types of communities (predominantly rural vs. predominantly urban) and the findings raise important differences in morbidity profiles. Our study included a specific population of extremely long-lived individuals, showing a better health status for the rural sample than the urban one. Although previous studies usually point to a worst health status of older persons living in rural areas, we must stress that extreme longevity is a different phenomenon on its own, barely understood by looking to what happens with younger individuals. Despite the heterogeneity of centenarians' health status, they exhibit unusual energy/metabolic characteristics that contribute to their longevity (Franceschi et al., 2017) making them capable of avoiding or postponing the onset of major age-related diseases when most of the members of the same demographic cohort underwent a major disease or died. As spatial inequalities in old-age survival exist in Portugal, further studies on the health disparities of extremely long-lived individuals according to the geographical location are needed.

Conflict of interest

The authors declare no conflict of interest.

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Figure 1. Morbidity profiles according to a list of 10 health conditions (number of centenarians)

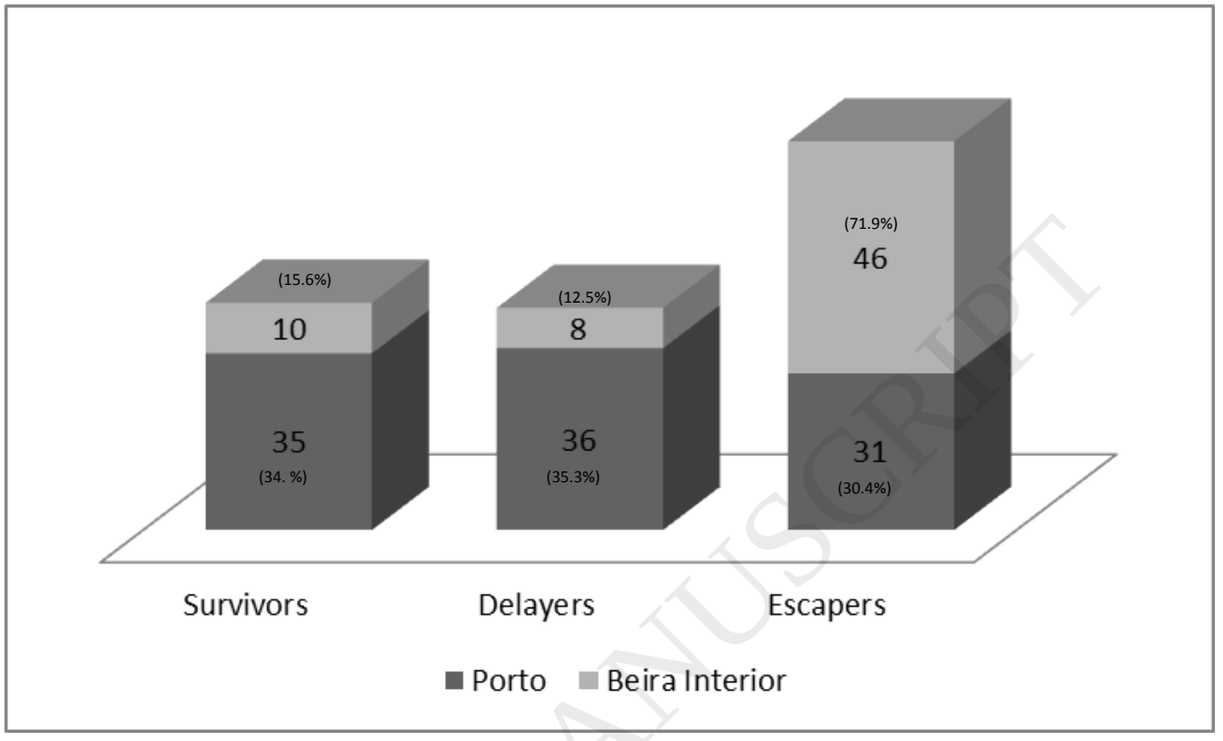

Figure 2. Morbidity profiles according to the 3 most lethal diseases (number of centenarians)