The WHO active ageing pillars and its association with survival: Findings from a population-based study in Spain

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Arch Gerontol Geriatr Sep-Oct 2020;90:104114.

which has been published in final form at

https://doi.org/10.1016/j.archger.2020.104114

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Declaration of Interest

This paper presents independent results and research. The views expressed are those of the authors and not necessarily those of Carlos III Institute of Health or funding agencies.

Highlights:

- Active ageing is multidimensional: health-participation-lifelong learning-security.
- There is no consensus on how to measure the construct and its different components.
- Little care is paid to the role of active ageing in reducing mortality as people age.
- We identified the factor structure of each active ageing domain using principal component analysis.
- Promoting the physical health component of active ageing is key to enhance survival.

Abstract

Background: The World Health Organization's active ageing model is based on the optimisation of four key "pillars": health, lifelong learning, participation and security. It provides older people with a policy framework to develop their potential for well-being, which in turn, may facilitate longevity. We sought to assess the effect of active ageing on longer life expectancy by: i) operationalising the WHO active ageing framework, ii) testing the validity of the factors obtained by analysing the relationships between the pillars, and iii) exploring the impact of active ageing on survival through the health pillar.

Methods: Based on data from a sample of 801 community-dwelling older adults, we operationalised the active ageing model by taking each pillar as an individual construct using principal component analysis. The interrelationship between components and their association with survival was analysed using multiple regression models.

Results: A three-factor structure was obtained for each pillar, except for lifelong learning with a single component. After adjustment for age, gender and marital status, survival was only significantly associated with the physical component of health (HR= 0.66; 95% CI= 0.47-0.93; p=0.018). In turn, this component was loaded with representative variables of comorbidity and functionality, cognitive status and lifestyles, and correlated with components of lifelong learning, social activities and institutional support.

Conclusion: According to how the variables clustered into the components and how the components intertwined, results suggest that the variables loading on the biomedical component of the health pillar (e.g. cognitive function, health conditions or pain), may play a part on survival chances.

Keywords

World Health Organization; Active aging; Survival; International Classification of Functioning, Disability and Health; Principal component analysis.

1. Introduction

As advances in medicine and public health have contributed to reduced mortality and increased life expectancy (Salomon et al., 2012), a new paradigm has emerged that the growing population of older people are now considered a potential resource for families, communities, the economy and society as a whole (Foster & Walker, 2015; World Health Organization, 2002). This positive perspective has gained momentum through the World Health Organization's (WHO) concept of active ageing, defined as '…the process of optimising opportunities for health, participation, and security in order to enhance quality of life as people age...' (World Health Organization, 2002).

First introduced in the 2000s (World Health Organization, 2002) and further updated in the 2010s (International Longevity Centre, 2015), active ageing is based on the optimisation of four key domains or 'pillars': health, participation, security and lifelong learning (International Longevity Centre, 2015). The WHO initiative captures the comprehensive life-course approach of the ageing process (Foster & Walker, 2015; Walker, 2002) within a multidimensional perspective that addresses both personal and demeanour circumstances, as well as contextual and environmental points of view (Foster & Walker, 2015; Marsillas, 2016).

The WHO active ageing model seeks to convey a more comprehensive message than other related terms, such as 'successful ageing' (Rowe & Kahn, 1987), 'productive ageing' or 'healthy ageing' (Walker, 2002; World Health Organization, 2002). In this sense, active aging seeks to enable the physical, social and mental well-being of the aging population, as well as their participation in society (International Longevity Centre, 2015). Unlike healthy or successful aging that prioritizes the achievement of clinical and medical criteria, or productive aging that focuses primarily on the production of goods and services regardless of well-being or health, active ageing does not only enlist individual actions as its predecessors but also actions at the organisational and social level (Foster & Walker, 2015; International Longevity Centre, 2015). Evidence of this is that

the active ageing model has been widely used to promote policy strategies in Europe to develop initiatives that enhance the involvement of older people in society (European Commission, 2013). Notwithstanding, there is still no standard on how to measure it, which is reflected in the wide range of models and indicators found in the literature, and the lack of uniformity and consistent operationalisation agreement (Álvarez-García, Durán-Sánchez, del Río-Rama, & García-Vélez, 2018; Boudiny, 2013; Marsillas, 2016). Some studies have often focused solely on the biomedical perspective or have been strongly economic oriented, delivering one-dimensional conceptions of active ageing, while other authors have focused on both physical, social and economic activities to addresses a multidimensional approach to the concept (Boudiny, 2013). In this sense, the main tool for monitoring the implementation of active ageing policies at European and national levels has been the Active Ageing Index for the European Union (AAI-EU). This construct based on social and economic indicators obtained from national statistics sources (Rodriguez-Rodriguez et al., 2017; Zaidi et al., 2013) has recently been widely criticised as falling back into a narrow and economistic view of the concept (Marsillas et al., 2017; Sao Jose, Timonen, Amado, & Santos, 2017).

Spain has experienced a rapid life expectancy increase over recent years and now has a population of more than 46 million, of which 18.5% is aged 65 or older (Instituto Nacional de Estadística, 2018), which is expected to reach 35.3% by 2050 (Instituto Nacional de Estadística, 2016). The challenge posed by the ageing population has prompted efforts to advance research on active ageing. Examples about operationalisation and measurement tools of the concept include the generation of a dichotomous variable based on five domains of active ageing (Lopez, Fernandez-Ballesteros, Zamarron, & Lopez, 2011), the definition of an 'activity profile' based on four dichotomous activity variables (Fernandez-Mayoralas et al., 2015) and most recently, a measurement tool based on *status-health* (related to physical, psychological and social health) and *processual-activities* (related to different type of activities, from labour force participation to social

activities and daily life routines) variables (Marsillas et al., 2017). However, few of them have addressed this measurement within the four pillar framework of the WHO active ageing model (Paul, Ribeiro, & Teixeira, 2012; Tareque, Hoque, Islam, Kawahara, & Sugawa, 2013). Besides the lack of agreement on its operationalisation, other debates have emerged in active ageing research, such as the inclusion of leisure activities in the active ageing concept, the dichotomy between active and passive activities, the socio-emotional character of healthy ageing, the importance of social and environment context in cognitive functioning, or the biophysical key aspects of active ageing that provide good functional status and longevity (Álvarez-García et al., 2018). Regarding the latter, according to the compression of the morbidity paradigm (Fries, 2005), a long and vigorous life should delay the onset of chronic conditions, reaching a shorter period of functional impairment before death. In this sense, if ageing is to be a positive experience with continuing opportunities for health, community participation and security, the 'active' years of life would lead to a long and independent life as the ideal conclusion of the active ageing model. Few studies have assessed the association between successful or healthy ageing and mortality risk (Domenech-Abella et al., 2018; Kim, Min, & Min, 2019; Kollia et al., 2018; Nosraty, Enroth, Raitanen, Hervonen, & Jylha, 2015); moreover, none of them have considered it in light of the WHO active ageing model.

Bearing in mind the foregoing, this study aimed to assess how active ageing can contribute to a longer life expectancy. As there is no consensus on how to measure the construct and its different components to assess the effect of active ageing on measurable targets such as survival, this study proposed to: i) operationalise the WHO active ageing framework by taking each pillar as an individual construct, ii) test the validity of the factors obtained by analysing the relationships between the pillars, in particular, the lifelong learning, participation and security pillars with the health pillar, and iii) explore the impact of active ageing on survival through the health pillar. The prioritization of the health pillar in the analysis was based on the consideration that health represents a critical parameter for active ageing, as we believed that the ability to participate in all

spheres of activity depends largely on having physical and mental health. Furthermore, this approach allowed us to compare with previous studies that mainly evaluated the biological and psychological aspects of positive aging with survival (Domenech-Abella et al., 2018; Kim et al., 2019; Kollia et al., 2018; Nosraty et al., 2015).

2. Materials and Methods

2.1. Participants

Study data were excerpted from the Ageing in Spain Longitudinal Study-Pilot Survey (ELES-PS) freely accessible at www.proyectoeles.es. This cross-sectional survey was conducted in 2011 among non-institutionalised individuals aged 50 or over living in Spain. The methodology and databases were previously described (Rodriguez Laso et al., 2013; Teófilo-Rodríguez, González-Cabezas, Díaz-Veiga, & Rodríguez-Rodríguez, 2011). Briefly, this cohort study was performed on a national geographic basis with stratification by region and size of the city/town of residence. A three-stage sampling was used: census tracts, households, and informant sampling units. Data collection was arranged sequentially in four phases: computer assisted telephone interview (CATI), trained nurse visit, computer assisted personal interview (CAPI) and self-administered questionnaire. A collection of objective and subjective questions of ageing dimensions was collected throughout the phases of the study. Most of the variables for this paper were retrieved from the CAPI; those questions on sensitive issues, such as sex life or depression, where collected by the self-completed questionnaire. At the nurse's visit, the Mini-Mental State Examination (MMSE) questionnaire was collected. In the case of cognitive impairment, the CAPI interview could be carried out by a proxy respondent. In the case of the self-administered questionnaire, the interviewer helped the subject to complete the questionnaire if it was not filled out, and the individual wanted to answer it. Individuals who completed the survey up to the self-administered questionnaire (n=1145) were included; as the sample was weighted to correct the overrepresentation of people from the Basque Country (a region located in northern Spain), the final number of

weighted interviews was 898 subjects (error of ±3.3% for a confidence level of 95%) (Rojo-Pérez et al., 2012). For the purpose of this study, those that had at least one variable missing were excluded, resulting in a final sample of 801 subjects. Ethical approval from the Bioethics Subcommittee of the Spanish National Research Council and written informed consent from each participant were obtained.

2.2. Survival

To evaluate the effect of active ageing on survival after a 4-year follow-up period, data were retrieved from the Spanish National Death Index (IND) held by the Ministry of Health, which includes all deaths in Spain since 1987. Full name, sex and date of birth were employed to conduct a person search from the ELES-PS sample. A second ethical approval was obtained for this part of the study, since the mortality data was not among the initial objectives of the ELES study.

2.3. Definition of active ageing

According to WHO, active ageing offers a policy framework that enables older people to build up their potential for physical, mental and social wellbeing, as well as participate in society according to their desires and capacities, providing them adequate protection, security and care when required (World Health Organization, 2002). In terms of the four active ageing pillars, the 'health' pillar, rooted in the WHO concept of health, encompasses the objective of health promotion and protection. Risk factors, morbidity and functional decline must be low, while healthier lifestyles and access to health services should be enhanced. 'Lifelong learning' refers to the importance of access to information to stay healthy and remain relevant and committed to society. 'Participation' means engagement in physical, cognitive, social, recreational, economic and cultural activities that provides a sense of purpose and belonging. Finally, 'security' implies the provision of food, financial security, access to essential services such as housing, health, long-term care and social services, as well as meeting physical and environmental security (Álvarez-García et al., 2018; International Longevity Centre, 2015).

Due to the multidimensional nature of the WHO active ageing model, we believed that considering each pillar as an independent construct, constituted by the combination of information through many different measurements, could facilitate the interpretation of complex data. This delivered cluster variables that allowed, in a simpler way, to analyse how the pillars interrelated with each other and how health was associated with survival, providing some clues on the functional mechanism of active ageing. To achieve this, another framework that provides a scientific basis for the complex interrelationships between health, functioning, environment and personal factors was considered: the International Classification of Functioning, Disability and Health (ICF-WHO) (World Health Organization, 2001).

The ICF-WHO is organised into four components, two health-related domains: 'body function and structure' and 'activities and participation', and contextual domains: 'environmental factors' and 'personal factors'. When choosing the variables and assigning them to the pillars, in addition to making decisions on the basis of a literature review on the topic of active, successful and healthy ageing (Cosco, Prina, Perales, Stephan, & Brayne, 2014; Depp & Jeste, 2006; Fernández-Ballesteros, 2011; Marsillas, 2016; Paul et al., 2012; Pruchno, Wilson-Genderson, & Cartwright, 2010; Tareque et al., 2013; World Health Organization, 2002), the ICF-WHO was used as a guide to outline the active ageing pillars from a theoretical point of view. Each pillar was considered as a construct composed of body functions, activities and/or environmental factors to different degrees, attaching each ELES-PS variable to the most appropriate ICF-WHO domain and active ageing pillar (Figure 1).

2.4. Measures

The ELES-PS survey has 218 items, grouped into twenty sections assessing five domains: health, psychosocial functioning, socio-demographics, social networks and participation, economic and environment considerations (Teófilo-Rodríguez et al., 2011). Along with socio demographic characteristics (gender, age and marital status), the variables from the ELES-PS survey that

comprised the most common indicators assessed in active ageing studies were included (Marsillas, 2016; World Health Organization, 2002).

Cognitive functioning was measured by the MMSE (Folstein, Folstein, & McHugh, 1975). The 10-item version of the Center for Epidemiological Studies Depression Scale (CES-D10) was used to assess depression (Robison, Gruman, Gaztambide, & Blank, 2002). Personality and emotional balance analysis was based on positive and negative feelings according to the Scale of Positive and Negative Experience (SPANE balance); proposed as a proxy measure, lower scores would reflect neuroticism, while higher scores would reflect positive affectivity and well-being (Cronbach's alpha = 0.74) (Diener, 2009). The Attitudes Toward Own Ageing subscale (Cronbach's alpha = 0.70) (Levy, Slade, Kunkel, & Kasl, 2002) and a self-rated ageing satisfaction scale (Montross et al., 2006) compiled the ageing self-perception.

A sum of 21 diagnosed medical problems evaluated the presence of illness (Cronbach's alpha = 0.63) (Wijers et al., 2017), in addition to health self-assessment ('In general, how would you rate your health: very good, good, fair, poor or very poor?'). The question 'How often does the pain make it difficult for you to do your usual activities such as household chores or work? assessed the presence of pain' (Pruchno et al., 2010). Functionality was evaluated by a 24-item Functional Activity scale for activities of daily living (ADL) resulting in a score from 24 to 96; the latter indicating absence of disability (Cronbach's alpha = 0.91) (Health and Retirement Study, http://hrsonline.isr.umich.edu). The need for technical help was measured by a sum of six devices for personal use (cane, walker, wheelchair, eating tools, diapers and others).

Sleep characteristics and lifestyle factors, such as smoking and alcohol consumption, were evaluated by self-reported questions. Individual indices for physical activity dimensions (vigorous activity and low intensity walking) were created by multiplying frequency by duration (Dipietro, Caspersen, Ostfeld, & Nadel, 1993).

Number of friends, the Duke-UNC Functional Support questionnaire (DUFSS) (Cronbach's alpha = 0.81) (Ayala et al., 2012), and the De Jong Gierveld Loneliness scale (Cronbach's alpha = 0.68) (De Jong Gierveld & Van Tilburg, 2006) were used to evaluate social networks, while the involvement in seven community and civic activities measured social engagement and activity. Leisure satisfaction was assessed by asking 'How would you rate your overall satisfaction with your free time?' using a 10-point Likert scale.

Finally, the evaluation of twelve resources provided by public institutions analysed health and social services use. The characteristics of dwelling, measured through self-rated satisfaction, a sum of thirteen dwelling amenities, a sum of five dwelling and environmental barriers, and a sum of ten residential quality and sanitation issues, were considered surrogate measures of economic and environmental security. Table 1 shows all the measures included in this work.

2.5. Data analysis

The analytical strategy was performed in three phases. First, to set each pillar as an individual construct, the factor structure of each active ageing pillar was explored using principal component analysis (PCA) with varimax rotation. PCA is an exploratory factor analysis technique based on multivariate data analysis that allows highly correlated items to be condensed and grouped together to create a new composite factor that represents each group of items. The main components selected correspond to those factors that explain most of the information provided by the initial variables, resulting in a simpler structure with easier and more meaningful interpretation.

Evaluation of appropriateness for PCA was based on the measure of Kaiser-Meyer-Olkin (KMO) sampling adequacy, with values of 0.60 or greater considered appropriate for PCA. The number of latent factors to retain for each pillar was determined according to an eigenvalue equal to or greater than 1, and the scree-plot characteristics (the number of factors to be retained is the number of factors which come before the curve flattens out) (Hair, Anderson, Tatham, & Black, 1998). In the construction of the components, the factor matrix of loadings was examined to

identify variables to be excluded from the model, with a factor loading below 0.30, and a communality score of 0.10 or less considered as exclusion criteria (Hair et al., 1998). The model was restated if any variable was eliminated. The factor loading was also examined in the case of cross loadings: when variables had similar loadings on two factors, the assignment of a variable to the factor was decided in the sense of what is reasonable based on the previous evidence. PCA was followed by orthogonal varimax rotation providing uncorrelated factors. This choice produced easily interpretable results. Afterwards, component scores were calculated and the extracted factors were labelled according to the variables loading on them, so that the components reflected the meaning of the original data.

Second, the relationship between pillars was analysed by multivariable linear regression analysis. The components of the health pillar were considered dependent variables, and all other pillars, represented by each component of lifelong learning, participation and security, were considered as independent variables. The model analysis followed the sequence:

Model 0: Crude association of each health component with each component of lifelong learning, participation or security.

Model 1: Adjusted for age, gender and marital status.

Model 2: Adjusted for age, gender, marital status, and all other principal components of lifelong learning, participation and security.

Thirdly, Cox proportional hazards multivariable regression models were used to estimate the probability of survival by unit change of each health pillar components. These models were further adjusted by age, gender and marital status.

Table 1: Selected ELES-PS variables by active ageing pillar and ICF-WHO component.

ICF COMPONENT	*ICF Domain*	*MEASUREMENT*		*ELES-PS VARIABLES*	
HEALTH					
Body Function and Structure	Global Mental Functions	1	Cognitive Functioning	MMSE scale	Total score: 0-30
	Thought Functions	2	Depression	CES-D 10	Total score: 0-10
	Temperament and Personality	3	Personality and Emotional Balance	SPANE-balance scale	Total score: -24 +24
	Experience of Self and Time Functions	4	Self-Rated Ageing Satisfaction	Ageing satisfaction scale	Total score: 0-10
		5	Ageing Self-Perception	Attitudes Toward Own Ageing subscale	Total score: 0-5
		6	Health Self-Perception	How would you rate your health status?	1=very poor; 2=poor; 3=reasonable; 4=good; 5=very good
	Health Conditions	7	Illness	21 diagnosed chronic conditions	Total score: 0-21
	Sensory Functions and Pain	8	Pain	How often does the pain make it difficult for you to do your usual activities such as household chores or work?	1=never; 2=occasionally; 3=regularly; 4=frequently; 5=always
	Sleep Functions	9	Sleep Characteristics	How many hours do you sleep on average?	
				How often do you wake up rested in the morning?	1=rarely; 2=sometimes;3=most of the time
				Within the last four weeks, how many times have you had difficulty falling asleep?	1= always; 2= frequently; 3=regularly; 4=occasionally; 5= never
				Within the last four weeks, how many times woke up several times while sleeping?	1= always; 2= frequently; 3=regularly; 4=occasionally; 5= never
				Within the last four weeks, how many times woke up too early?	1= always; 2= frequently; 3=regularly; 4=occasionally; 5= never
Activities and Participation	Mobility; Self-Care, Domestic Life; Interpersonal Interactions and Relationships; Major Life Areas	1	Physical Functioning and ADL Problems	24-item Functional Activity scale	Total score: 24-96
Personal Factors		1	Smoking	Could you tell me if you currently smoke?	1=never; 2=ex-smoker; 3=smoker
		2	Drinking	How often have you consumed alcohol in the past 12 months?	0=never; 1=nothing within last year; 2=occasionally; 3=monthly; 4=weekly; 5=daily

Environmental Factors	Products and Technology	1	Technical Help	Sum of 6-devices	Total score: 0-6
PARTICIPATION					
Body Function and Structure	Support and Relationships	1	Loneliness Self-Perception	De Jong scale	Total score: 0-6
	Experience of Self And Time Functions	2	Leisure Satisfaction	How would you rate your overall satisfaction with your free time?	Total score: 0-10
Activities and Participation	Community, Social and Civic Life	1	Social Engagement and Activity	Cultural activities (museum, theater, cinema…)	1=never; 2=less than 1 day per year; 3=less than 1 day per month; 4=1 or more days per month
				Social activities (dinner with friends, social club…)	1=never; 2=less than 1 day per year; 3=less than 1 day per month; 4=1 or more days per month
				Travel, sightseeing	1=never; 2=less than 1 day per year; 3=less than 1 day per month; 4=1 or more days per month
				Private hobbies (gardening, handicrafts...)	1=never; 2=less than 1 day per year; 3=less than 1 day per month; 4=1 or more days per month
				Activities in the neighborhood (sports, go on walks or to the park…)	1=never; 2=less than 1 day per year; 3=less than 1 day per month; 4=1 or more days per month
				Associative participation (political, volunteering…)	1=never; 2=less than 1 day per year; 3=less than 1 day per month; 4=1 or more days per month
Personal Factors	Physical Activity	1	Physical activity	MVPA score	Total score: 0-60
				Leisure walking score	Total score: 0-48
Environmental Factors	Support and Relationships	1	Social Networks	DUFSS questionnaire	Total score: 11-55
				Number of friends	
SECURITY					
Body Function and Structure	Experience of Self and Time Functions	1	Environment Self-Perception	Dwelling satisfaction	Total score: 0-10
Environmental Factors	Products and Technology; Natural Environment and Human-Made Changes to Environment	1	Environment Safety	Dwelling amenities	Total score: 0-6
				Architectural barriers	Total score: 0-5
				Dwelling quality and sanitation problems	Total score: 0-6
	Services Systems and Policies	2	Health and Social Services Use	Elderly care economic help	0=no need; 1=no use; 2=use
				Housing adaptation	0=no need; 1=no use; 2=use
				Personal care help	0=no need; 1=no use; 2=use
				Daily center	0=no need; 1=no use; 2=use
				Tele-assistance	0=no need; 1=no use; 2=use
				Temporally nursing home	0=no need; 1=no use; 2=use
				Food and cleaning service	0=no need; 1=no use; 2=use

				Technical aids grants	0=no need; 1=no use; 2=use
				Supervised housing	0=no need; 1=no use; 2=use
				Holidays	0=no need; 1=no use; 2=use
				SPA resort	0=no need; 1=no use; 2=use
				Education grants	0=no need; 1=no use; 2=use
LIFELONG LEARNING					
Activities and Participation	Major Life Areas	1	Education	Education level	1=no education; 2=less than primary school;3=primary school; 4=secondary school; 5=college degree
		2	Learning Commitment	Learning activities (attend courses, take classes, etc.)	1=never; 2=less than 1 day per year; 3=less than 1 day per month; 4=1 or more days per month

ICF: International Classification of Functioning, Disability and Health; ELES-PS: Ageing in Spain Longitudinal Study-Pilot Survey; MMSE: Mini-Mental State Examination; CES-D10: 10-item version of the Center for Epidemiological Studies Depression Scale; SPANE: Scale of Positive and Negative Experience; ADL: Activities of Daily Living; MVPA: Moderate to Vigorous Physical Activity; DUFSS: Duke-UNC Functional Support Scale.

Adjustments by age, gender and marital status were performed, as age has been associated independently with functionality and number of chronic conditions and women seem to experience more chronic conditions and poorer functional ability than men (Pruchno et al., 2010). Marital status related with social engagement and isolation (Grundy, 2006).

Due to the characteristics of survey sampling, complex analysis taking into consideration weighted, clustering and stratification were applied, which resulted in 668 weighted subjects (error of ±3.8% for a confidence level of 95%). Age was categorised into three groups (50–67, 68–74 and ≥75 years old). The grouping was based on the assumption that the degree of participation in external activities may affect to the behaviours and health needs of the older population (Sowa, Tobiasz-Adamczyk, Topor-Madry, Poscia, & la Milia, 2016). The first group represented people potentially labour market active; in Spain, the retirement age is gradually increasing to 67 years old. The second group included retired people still with the potential for involvement in social activities, while the third group represented people that are less likely to experience positive ageing in line with health deterioration (McLaughlin, Jette, & Connell, 2012; Pruchno et al., 2010).

The analysis was performed using Stata v.15 and a p value < 0.05 was considered statistically significant.

3. Results

3.1. Sample characteristics

The final sample contained 801 subjects aged 50–98 years, with a mean age of 61.0 years (standard deviation, SD = 8.13). Half of the participants (50.57%) were females and the mortality rate was 2.41% after the 4-year follow-up. Regarding marital status, 80.5% were married or living with a partner, 5.0% divorced, 8.2% widowed, and 6.3% single. Descriptive statistics results are displayed in supplementary material.

3.2. Principal components factor analysis

PCA revealed three independent components in the health, participation and safety pillars, respectively, and one component for lifelong learning. Table 2 shows de components resulting from de varimax rotation. KMO values ranged from 0.698 to 0.860 indicating sample adequacy for factor analysis for each pillar. Communality values ranged from 0.12 to 0.72, the higher the communality, the better the original variables were represented by the extracted factors.

Three distinctive components for the health pillar were revealed, explaining 44.9% of the total variance (KMO=0.860), namely ‘Psychological health’, ‘Healthy sleep’ and ‘Physical health’. The variance was distributed relatively homogeneously among the factors: 1) ‘Psychological health’ comprised 17.0% of total variance, loaded with positive measures of self-perception and satisfaction of health and ageing, as well as emotional balance, with only two measures loaded in its negative pole, the presence of diagnosed chronic diseases and depression; 2) ‘Healthy sleep’ accounted for 14.4% of the total variance, with five heavily loaded variables that measured sleep characteristics; 3) ‘Physical health’ explained 13.5% of total variance, with three higher positive loadings of functional activity, cognitive functioning and alcohol consumption, while measures regarding problems due to pain, presence of chronic comorbidities, tobacco consumption and need of technical help devices loaded heavily in its negative pole .

The participation pillar was also composed of three components that explained 48.3% of the total variance (KMO=0.698): 1) ‘Social activities’ were positively loaded by measures of social engagement and activity, explaining 17.1% of total variance; 2) ‘Social support and leisure perception’ (16.9% of total variance explained) was loaded by positive measures of social support and satisfaction, as well as leisure activities, with loneliness self-perception measured by the De Jong scale loaded negatively; 3) ‘Physical activity’, accounting for 14.3% of variance, was heavily loaded by positive measures of physical activity. The variable 'private hobbies' was excluded when the PCA was conducted, as its factorial load was less than 0.30.

The structure of the security pillar revealed three components that accounted for 42.6% of total variance (KMO=0.799): 1) 'Institutional supports' explained the highest percentage of variance (21.4%) and comprised variables that recognise social protection programmes (housing adaptation, personal care, tele-assistance, etc); 2) 'Leisure grants' (11.8% of the total variance) positively loaded by financial support for recreation and leisure activities (holidays or spa resort, and education) by institutions; and 3) 'Housing issues' (9.3% of the variance) loaded by two measures of dwelling problems (environment insecurity and architectural barriers) in its positive pole and two measures of good dwelling conditions (housing satisfaction and dwelling amenities) in its negative pole.

Finally, as KMO for lifelong learning was not sufficient to establish a sample adequate for PCA (KMO = 0.50), a single component was defined composed by level of education and attendance at training activities.

Table 2: Principal components analysis (varimax rotation) for each pillar of active ageing.

HEALTH				
Variable	**1 (Psychological health)**	**2 (Healthy sleep)**	**3 (Physical health)**	Communality
Ageing satisfaction	**0.75**	-0.04	-0.09	0.58
Ageing self-perception	**0.62**	0.11	0.25	0.46
Health self-perception	**0.61**	0.16	0.33	0.23
SPANE-balance scale	**0.54**	0.21	0.02	0.33
Diagnosed chronic conditions	**-0.49**	-0.26	**-0.48**	0.53
CES-D 10	**-0.63**	-0.28	-0.15	0.49
Awake too early	0.17	**0.74**	0.10	0.59
Difficult falling asleep	0.25	**0.68**	0.05	0.53
Morning rested	0.24	**0.62**	0.08	0.45
Sleep quantity (daily)	-0.06	**0.61**	-0.06	0.38
Night awakening	0.08	**0.60**	0.15	0.39
Functional activity scale	0.38	0.17	**0.64**	0.58
Alcohol consumption	-0.02	0.08	**0.53**	0.29
MMSE scale	0.08	-0.05	**0.47**	0.51
Difficulty because of pain	-0.38	-0.18	**-0.49**	0.42
Tobacco consumption	0.32	-0.15	**-0.52**	0.40
Technical help devices	-0.30	0.07	**-0.63**	0.49
Eigenvalue	4.58	1.68	1.37	
Per cent of variance	17.04	14.38	13.51	
Per cent Cum variance	17.04	31.42	**44.93**	
PARTICIPATION				
Variable	**1 (Social activities)**	**2 (Social support and leisure perception)**	**3 (Physical activity)**	Communality
Cultural activities	**0.78**	0.04	0.09	0.61

Associative participation	**0.71**	0.13	0.22	0.57
Social activities	**0.70**	0.08	0.19	0.54
Travel	**0.42**	0.24	-0.12	0.25
DUFSS questionnaire	0.09	**0.83**	-0.07	0.71
Leisure self-satisfaction	0.14	**0.49**	0.33	0.37
Number of friends	0.10	**0.33**	0.03	0.12
De Jong-LS	-0.03	**-0.85**	-0.03	0.72
MVPA score	-0.09	0.12	**0.80**	0.67
Activities in the neighborhood	0.19	-0.02	**0.70**	0.53
Leisure walking score	0.14	0.01	**0.46**	0.23
Eigenvalue	2.6	1.51	1.21	
Per cent of variance	17.07	16.9	14.3	
Per cent Cum variance	17.07	33.98	**48.27**	
SECURITY				
Variable	**1 (Institutional support)**	**2 (Leisure grants)**	**3 (Housing issues)**	Communality
Personal care help	**0.68**	-0.04	0.13	0.49
Tele-assistance	**0.67**	-0.03	0.03	0.45
Food and cleaning service	**0.66**	0.13	0.02	0.46
Technical aids grants	**0.66**	0.09	0.03	0.44
Temporally nursing home	**0.64**	0.11	0.00	0.43
Elderly care economic help	**0.57**	-0.08	0.04	0.33
Supervised housing	**0.54**	0.27	-0.05	0.37
Housing adaptation	**0.50**	0.08	-0.01	0.26
Daily center	**0.47**	0.20	-0.01	0.26
Holidays	0.04	**0.80**	0.00	0.65
SPA resort	0.15	**0.79**	0.02	0.65
Education grants	0.09	**0.67**	0.01	0.46
Environment insecurity	-0.09	0.02	**0.67**	0.48
Architectural barriers	0.29	0.01	**0.47**	0.31
Architectural amenities	-0.04	-0.03	**-0.50**	0.25
House general satisfaction	0.05	0.04	**-0.73**	0.53
Eigenvalue	3.67	1.68	1.46	
Per cent of variance	21.40	11.83	9.34	
Per cent Cum variance	21.40	33.23	**42.57**	
LIFELONG LEARNING				
Variable	**1**			Communality
Education level	**0.80**			0.63
Learning activities (courses…)	**0.80**			0.63
Eigenvalue	1.25			
Per cent of variance	**63.26**			
Per cent Cum variance	**63.26**			

CES-D10: 10-item version of the Center for Epidemiological Studies Depression Scale; SPANE: Scale of Positive snd Negative Experience; MMSE: Mini-Mental State Examination; LS: Loneliness Scale; DUFSS: Duke-UNC Functional Support Scale; MVPA: Moderate to Vigorous Physical Activity. In bold, variable's highest loading for each principal-component.

3.3. Relationship between pillars

After adjusting for age, gender, marital status and the rest of the active ageing pillar components, 'Psychological health' was directly correlated with the three participation components and inversely correlated with 'Institutional support' and 'Housing issues'

(R^2=0.35). 'Healthy sleep' was directly correlated with 'Social activities' and 'Social support', and inversely with 'Housing issues' (R^2=0.10), whereas 'Physical health' was directly correlated with 'Lifelong learning' and 'Social activities', and inversely with 'Institutional support' and 'Leisure grants' (R^2=0.27). Table 3 presents the standardised betas and associated 95% confidence intervals (CI).

3.4. Survival and active ageing

Regarding health, Figure 2 shows the decrease in mortality hazard per unit increment in each health pillar component: 'Psychological health' [hazard ratio (HR) = 0.62; 95% IC = 0.41–0.94; p = 0.026], 'Healthy sleep' (HR = 0.80; 95% IC = 0.53–1.21; p = 0.288), and 'Physical health' (HR = 0.55; 95% IC = 0.39–0.77; p = 0.001). After adjustment for age, gender and marital status only the component 'Physical health' remained significantly associated (HR = 0.66; 95% CI = 0.47–0.94; p=0.018).

Table 3: Correlation between each health component (Psychological health, Healthy sleep, Physical health) and other active ageing pillars (participation, security and lifelong learning components).

		Psychological health			Healthy sleep			Physical health		
Active Ageing pillar	**Principal component**	Model 0	Model 1	Model 2	Model 0	Model 1	Model 2	Model 0	Model 1	Model 2
Lifelong learning		**0.09* (0.02;0.16)**	**0.10* (0.03;0.17)**	0.02 (-0.47;0.09)	**0.11* (0.03;0.19)**	**0.09* (0.01;0.17)**	0.04 (-0.05;0.12)	**0.23* (0.17;0.30)**	**0.16* (0.10;0.22)**	**0.14* (0.08;0.20)**
Participation	Social activities	**0.15* (0.08;0.23)**	**0.15* (0.07;0.21)**	**0.13* (0.06;0.20)**	**0.12* (0.04;0.21)**	**0.13* (0.05;0.22)**	**0.11* (0.02;0.20)**	**0.18* (0.10;0.26)**	**0.12* (0.05;0.19)**	0.06** (-0.01;0.13)
	Social support and leisure perception	**0.47* (0.40;0.54)**	**0.47* (0.40;0.54)**	**0.43* (0.36;0.50)**	**0.15* (0.07;0.22)**	**0.15* (0.08;0.22)**	**0.13* (0.06;0.20)**	-0.06** (-0.14;0.01)	-0.04 (-0.11;0.03)	-0.05 (-0.12;0.01)
	Physical activity	**0.22* (0.16;0.29)**	**0.23* (0.16;0.30)**	**0.21* (0.15;0.27)**	0.07 (-0.01;0.15)	0.04 (-0.04;0.12)	0.03 (-0.05;0.11)	**0.08* (0.00;0.17)**	0.03 (-0.04;0.10)	0.03 (-0.03;0.10)
Security	Institution supports	**-0.14* (-0.23;-0.04)**	**-0.13* (-0.23;-0.04)**	**-0.09* (-0.16;-0.02)**	-0.09** (-0.18;0.00)	-0.08** (-0.17;0.01)	-0.06 (-0.14;0.2)	**-0.18* (-0.30;-0.06)**	**-0.10* (-0.20;-0.01)**	-0.08** (-0.18;0.02)
	Leisure grants	0.00 (-0.07; 0.06)	0.00 (-0.07; 0.06)	-0.03 (-0.08;0.02)	-0.05 (-0.14;0.04)	-0.03 (-0.11;0.05)	-0.04 (-0.17;0.04)	**-0.13* (-0.20;-0.06)**	**-0.08* (-0.14;-0.01)**	**-0.10* (-0.16;-0.03)**
	Housing issues	**-0.27* (-0.35;-0.19)**	**-0.27* (-0.35;-0.19)**	**-0.17* (-0.24;-0.11)**	**-0.12* (-0.21;-0.03)**	**-0.11* (-0.20;-0.03)**	**-0.09* (-0.17;-0.00)**	-0.02 (-0.12;0.07)	-0.02 (-0.10;0.06)	-0.02 (-0.10;0.06)

Data are β values and 95%CI.

Model 0: Crude β values obtained from linear regression with each health principal-component as dependent variable and each principal-component of active ageing (lifelong learning, participation and security) as independent variable.

Model 1: Adjustment by age, gender and marital status.

Model 2: Adjustment by age, gender, marital status and the rest of components of active ageing.

*In bold statistically significant associations p<0.05; ** p<0.10.

4. Discussion

This study addressed two aspects of active ageing research to establish factors that make it possible to predict the achievement of active ageing and to predict future outcomes, in this specific case, the chances of survival due to active ageing. The WHO model of active ageing with the variables included in a Spanish national study of ageing was operationalised to evaluate the relationship between the core domains of active ageing and determine the impact of health on survival. There were three main findings: 1) the search for an internal structure of the four pillars of active ageing through exploratory PCA revealed three independent components of each pillar, health, participation and security, and one component for lifelong learning; 2) the multivariable analysis enabled us to ascertain the heterogeneous relationships between active ageing pillars, revealing how different components were interlinked, particularly how participation and health were correlated; and 3) a positive association between survival and the biomedical component of the health pillar was identified. The way in which components were intertwined provides insight on how each pillar indirectly might influence survival. Figure 3 summarises the main relationships found.

4.1. The active ageing model

The active ageing theoretical definition is universally agreed, however, different ways of approaching the conceptualisation of the construct have been developed. This study based the construct of active ageing on a formula that considered the WHO four fundamental pillars as independent constructs by combining information across many different measurements. In this way, not one index but four were analysed, thereby broadening the focus of previous studies primarily focused on health and productivity (Boudiny, 2013; Foster & Walker, 2015; Marsillas, 2016). This provided insight into the health and functionality of the subjects, in addition to the interactions with the social and physical environment that surrounds them. We believe this is crucial when it comes to exploring strategies for coping with ageing in the context of achieving measurable outcomes as a result of active ageing.

Due to the complexity of the model and the need to take into account multiple measures, the exploratory factor analysis was an appropriate way to cluster the variables into components that not only facilitated the interpretation of the results, but also provided clues about how variables were related and played a role in the 'active' condition. Several authors have developed an approximation to the construct by factorial analysis (Fernández-Ballesteros, 2011; Marsillas et al., 2017; Mount, Ferrucci, Wesselius, Zeegers, & Schols, 2019; Paul et al., 2012; Thanakwang, Isaramalai, & Hatthakit, 2014), attempting to develop profiles of active ageing (Fernández-Ballesteros, 2011; Paul et al., 2012) or implementing measurement tools of active ageing (Marsillas et al., 2017; Thanakwang et al., 2014). All these studies evinced the importance of integrating a physical perspective with a psychosocial perspective, as well as the importance of including objective and subjective aspects in the development of potentially satisfactory active ageing indicators. Nevertheless, depending on the variables considered, the internal structure of the active ageing model varies.

In terms of the internal structure of our active ageing model, the results showed that most of the variables included in the health pillar comprise what Marsillas et al. (2017) defined as *state variables,* elements related to the concept of health (valuation of objective and subjective health, functionality, cognition and emotional balance) that proved a high value (β= 0.74) in relation to what 'active' implies in the construct. Regarding the components of this pillar, we found that the component 'Psychological health' had a slightly superior variance account (17.0%) than the component 'Physical health' (13.5%). This presumably means that psychological characteristics and the capacity to cope with health and ageing better determine how people actively age rather than functional limitations (Paul et al., 2012). The psychological component was mainly loaded by measures of self-perception about age and health, as well as emotional balance in its positive pole, meaning that the higher the scores in these variables, the more positive the score on this component. On the contrary, the presence of depression and chronic diseases negatively affected this component, confirming that the better the psychological wellbeing, the better the ageing. This agreed with previous studies that found a

similar active ageing component loaded by both positive measures of satisfaction, emotional balance, and self-efficacy for ageing (Fernández-Ballesteros, 2011), as well as positive (e.g., happiness, optimism) and pathological characteristics of individuals (e.g., psychological distress, neuroticism) (Paul et al., 2012).

The second component, 'Healthy sleep', was clearly grouped independently, possibly because several variables measuring sleep were included which correlated with each other, resulting in an independent factor. There are hardly any studies that consider this measure (Driscoll et al., 2008; Paul et al., 2012). Our results supported that achieving adequate sleep, both in quantity (sleep hours) as well as quality (absence of sleep problems and proper rest), contributes positively to healthy ageing (Driscoll et al., 2008; International Longevity Centre, 2015).

Regarding the component 'Physical health', contrary to the findings of previous authors (Fernández-Ballesteros, 2011; Paul et al., 2012), this component primarily contained the so-called 'objective measures' of health (functionality, lifestyles, cognitive functioning, chronic diseases and pain) (Pruchno et al., 2010). The variables that loaded this component underlie the biomedical approach of successful ageing (Rowe & Kahn, 1987), although it is remarkable that cognitive functioning was not an independent component (Fernández-Ballesteros, 2011; Paul et al., 2012). The correlation between cognitive capacity and lifestyles and habits, which in turn correlate with chronic diseases and functionality, may explain the distribution (Kollia et al., 2018). Besides that, despite the fact that other studies used a single scale to assess cognitive function (Marsillas et al., 2017; Paul et al., 2012), some models in which cognition appeared as an independent factor included several variables comprising different aspects of cognitive function (Depp & Jeste, 2006; Fernández-Ballesteros, 2011). Using a single indicator of cognition probably left cognitive performance coverage underdeveloped, which represents a clear weakness in our study. The load distribution of the variables showed that functionality, both positive (ability to perform ADL) and negative (need of technical aids), may be a key aspect in active ageing rather than the presence of the chronic diseases itself. Surprisingly,

alcohol consumption had a positive contribution on the component, probably due to the definition of alcohol consumption that we used, that encompassed only the frequency of consumption, not the amount actually consumed. This effect has been described in other studies that found alcohol consumption to be positively related with successful ageing (Kim et al., 2019; Kollia et al., 2018). This could be attributed to the fact that alcohol consumption would have an important social connection, so that 'active' individuals could maintain their social networks by drinking together (Kauppila & Hellman, 2018). In addition, subjects with a poorer physical condition, especially in old age, would tend to have lower consumption due to medical recommendations, incompatibility with medication, etc. This structure of the health pillar resembled the one proposed by Pruchno et al. (2010), who divided the concept of successful ageing into subjective and objective success. Although, it should be noted that diagnosed chronic diseases cross-loaded both on the components 'Psychological health' and 'Physical health', highlighting the relevance that biomedical problems have on psychological wellbeing.

The model proposed by Pruchno et al. (2010) was particularly evident in the participation pillar. Thus, the first component, 'Social activities', comprised positive measures of time spent on community and leisure activities, reflecting objective engagement in community and social participation, while the second component, 'Social support and leisure perception', was highly loaded with subjective measures of social satisfaction and social networking. Both components explained a similar percentage of variance (17.1 vs 16.9%), supporting that both social relationships, whether structural (integration with social networks) or functional (received and perceived social support) (Holt-Lunstad, Smith, & Layton, 2010) are essential for active ageing. Additionally, physical fitness was included within this pillar as a form of active participation. In this case, it was proposed as a way of spending free time, either individually or collectively, beyond the approach as a determinant of health. Accordingly, an independent component was obtained, 'Physical activity', which was consistent with other studies that identified practising physical activity as an independent factor for active ageing (Fernández-Ballesteros, 2011; Thanakwang et al., 2014). The participation pillar in the present

study was loaded partially by variables defined as *processual variables* (which capture the activity meaning of active ageing; from labour force participation to engaging in social activities and daily life routines) (Marsillas, 2016); above all by leisure and social activities. We tried to go beyond the economistic and productive aspect of the participation domain that other studies focus on (Zaidi et al., 2013), as for some older adults, leisure is the prime way to re-engage with life (Boudiny, 2013; Sao Jose et al., 2017).

In the construction of the internal structure of this pillar, the measure which referred to the participation in 'private hobbies', such as gardening, handicrafts, etc., which could be considered within the scope of 'passive activities', has to be excluded, probably because most of the considered participation activities fell within the scope of 'active' outdoor activities. This reaffirms the debate regarding the evaluation of participation taking into account both scopes, reinforcing the need to analyse the role of passive activities in active ageing research (Álvarez-García et al., 2018; Boudiny, 2013).

Our theoretical model attempted to go one step further, incorporating not only social and leisure activities, lifelong learning, etc. proposed by previous studies that sought to broaden the initial focus of the concept of active ageing (healthy and productive) (Fernández-Ballesteros, 2011; Marsillas et al., 2017; Paul et al., 2012), but also including environmental and safety measures. By doing so, the security pillar was defined by three components, two related to institutional support, and one related to environmental/dwelling characteristics, which allowed us to assess the role of social protection programmes in balancing needs and wellbeing, and to estimate how environmental attributes can pose barriers/facilitators to active engagement with life.

In summary, we found that even when our hypothetical framework considered the construction of active ageing taking into account the pillars independently, we shared similarities with the models previously proposed, both in terms of the main components extracted and the distribution of the items, as can be seen in table 4.

Table 4: Components for Active Ageing compared with previous models.

AA PILLARS	PRINCIPAL COMPONENTS	(Paul et al., 2012)	(Fernández-Ballesteros, 2011)	(Pruchno et al., 2010)	(Depp & Jeste, 2006)	(Rodriguez-Rodriguez et al., 2017)
LIFELONG LEARNING	Lifelong learning (education level, learning activities)	Cognitive performance (cognitive impairment, vision, income, education level)				Lifelong learning
HEALTH	Physical health (MMSE, pain, tobacco and alcohol consumption, illness diagnosed, ADL, technical help devices)		Cognition (MMSE, cognitive plasticity, digit symbol, digit backward)		Cognitive functioning (MMSE, memory, learning ability)	
		Health (subjective health, sleep problems, subjective physical condition, ADL, illness)	Health (medication, illness diagnosed, subjective health, fitness appraisal)	Objective success (functional activity, pain, illness)	Disability/physical functioning (ADL, technical devices, illness, health self-perception)	
	Healthy sleep (sleep hours, sleep problems, sleep sufficiency)					
	Psychological health (health self-perception, depression, emotional balance, ageing satisfaction, ageing self-perception, illness diagnosed)		Health (medication, illness diagnosed, subjective health, fitness appraisal)	Subjective success (ageing satisfaction, successful ageing, life rating)	Disability/physical functioning (ADL, technical devices, illness, health self-perception)	
		Personality component (extraversion, openness to experience)				
		Psychological component (psychological distress, happiness, optimism, neuroticism, QoL, loneliness)	Affect (emotional balance, life satisfaction, self-efficacy for ageing)		Life satisfaction/well-being (happiness, optimism, depression)	
		Biological component (peak flow and grip strength)	Physical fitness (dynamic balance, BMI, static balance)			

PARTICIPATION	Social support and leisure perception (loneliness, social support perception, friends, leisure satisfaction)	Psychological component (psychological distress, happiness, optimism, neuroticism, QoL, loneliness)			
		Social relationship (family, friends, confidence)		Social engagement (contacts, outside social activities, perceived social support, employment)	
	Social activities (cultural activities, social activities, travel, associative participation)		Activity (productive and leisure activities)	Participation in society (voluntary work, political participation, providing care to relatives/older adults)	Employment
					Capacity and enabling environment for active and healthy ageing
	Physical activity (activities in the neighborhood, MVPA score, leisure walking score)				
SECURITY	Institutional support (elderly care economic help, housing adaptation, personal care help, daily center, tele-assistance, temporally nursing home, etc.)				Independent, healthy and secure living (physical exercise, access to health, financial security)
	Leisure grants (holidays, SPA resort and education grants)				
	Housing issues (house satisfaction, architectural amenities and barriers, environment insecurity)				Physical safety

AA: Active Ageing; MMSE: Mini-Mental State Examination; ADL: Activities of Daily Living; MVPA: Moderate to Vigorous Physical Activity; QoL: Quality of Life; BMI: Body Mass Index.

4.2. Relationships between active ageing pillars

By knowing how the pillars relate through the promotion of the components of one pillar, another pillar could be indirectly promoted. In this particular case, the relationships between the other pillars with the health pillar could, to some extent, help to know how they may indirectly influence the survival of subjects. In the present study, the correlation between 'Psychological health' and all components of participation sustained that social integration bear relation with life meaning, will to live and positive emotions (Sowa et al., 2016). 'Social support' (β = 0.44; 95% CI: 0.37–0.51), 'Physical activity' (β = 0.20; 95% CI: 0.14–0.26) and 'Social activities' (β = 0.11; 95% CI: 0.04–0.18) correlated positively with the psychological component of health. This supports that public health initiatives increasing elders' participation in the community by physical activities outside the home, enhancing social contact and improving social skills, would help older adults to cope with depression and functional decline, as well as reducing feelings of loneliness (International Longevity Centre, 2015). Surprisingly, 'Physical health' was weakly correlated with the components of participation. Although 'Social activities' and 'Physical activity' appeared positively correlated with 'Physical health' in the unadjusted model, the association was lost after adjustment by socio-demographics and other pillars. Social relationships, whether structural or functional, have evinced protective health effects on cognitive, behavioural, and biological aspects, by encouraging healthy behaviours and self-care (Golden, Conroy, & Lawlor, 2009; Holt-Lunstad et al., 2010); however, it may be that the role of the component' Lifelong learning' minimised this relation. Education links with health beliefs, level of health education and awareness of risk factors. Indeed, individuals with a higher education are more socially engaged, make healthy lifestyle choices and have better opportunities for health care use and quality of care (Sowa et al., 2016), even a greater 'cognitive reserve' has been described despite brain disease or cognitive functioning decline (Tucker & Stern, 2011). We found a positive relationship between both components, so that each increase in the score of the component 'Lifelong learning' meant an increase in the component 'Physical health' (β = 0.14; 95% CI: 0.08–0.20). This is in line with the theoretical

basis of the WHO active ageing model for lifelong learning refers that information access is important to stay healthy and remain relevant and engaged in society (International Longevity Centre, 2015). Providing good education at a younger age, and the possibility of increasing it in adulthood and old age might facilitate staying healthy and remaining engaged in society during old age.

In analysing the relationships between the health pillar and the security components, we observed that 'Institutional support' and 'Leisure grants' were inversely correlated with 'Psychological health' and 'Physical health'. Individuals with lower health component scores tended to report greater use of institutional resources, while better health was related with lower institutional support, which may be due to the presence of policies in Spain aimed to cover the needs of older people within the framework of health and social services (Instituto de Mayores y Servicios Sociales, 2015). In this way, subjects with greater needs would receive greater coverage indicating a relative success of such policies (Rodriguez-Rodriguez et al., 2017). Given that these policies are fundamental to promote health, and to prevent, treat, or manage health problems (International Longevity Centre, 2015), further work is needed to strengthen social protection and reduce inequalities.

Regarding the importance of the physical environment context, 'Housing issues' was inversely correlated with' Psychological health' and 'Healthy sleep', which agrees with other studies (Clarke & Nieuwenhuijsen, 2009). This component was comprised of surrogate variables of economic and environmental security, underlining that financial security determines a person's options for a more affluent lifestyle, housing, food, health care and so forth, while economic uncertainty (poverty and material deprivation) leads to chronic forms of stress and mental health disorders (International Longevity Centre, 2015); thus, environmental factors would contribute to the health and participation in activity of older adults (Annear et al., 2014). In this sense, high physical insecurity may restrict an individual's performance, resulting in adverse health outcomes such as psychological wellbeing restrictions, self-evaluated poor health, depression, and sleep problems, indirectly diminishing the chances of active ageing. On

the other hand, psychological restrictions would contribute to financial strain and social isolation, making people vulnerable to environmental barriers and socioeconomic disadvantages.

4.3. Survival and active ageing

Although WHO has proposed to enact policies and programmes regarding the health pillar to reduce chronic diseases, disabilities and premature mortality as people age (World Health Organization, 2002), to the best of our knowledge, little attention has been paid to the possible effect of active ageing on survival. So far, studies have assessed the association between AAI and disability-free life expectancy (Tareque et al., 2013) and life satisfaction (Marsillas et al., 2017), with some addressing the issue of successful ageing association with mortality (Domenech-Abella et al., 2018; Kim et al., 2019; Kollia et al., 2018; Nosraty et al., 2015).

We found that older adults who achieved active ageing had a mortality risk that decreased by 45% for each increment in 'Physical health' score (HR = 0.55; 95% CI = 0.39–0.77), 38% for each increment in 'Psychological health' score (HR = 0.62; 95% CI = 0.41–0.94) and 20% for each increment in 'Healthy sleep' (HR = 0.80; 95% CI = 0.53–1.21). However, after adjustment for age, gender and marital status, only 'Physical health' remained as an independent factor for survival with a mortality risk reduction by 34% for each increment in this health component (HR = 0.66; 95% CI = 0.47–0.93). These findings were consistent with prior studies that found a link between successful ageing and mortality. In a Spanish study, Domenech et al. (2018) found that biomedical success (i.e., absence of chronic medical conditions, cognitive impairment, depression or smoking, and practice of physical activity) and psychological wellbeing (i.e., participation in social activities, frequent social contacts, good self-reported quality of life) predicted a lower risk of mortality over a 3-year follow-up among 2,783 participants, after adjustment for age, sex, marital status, labour situation, and socioeconomic status (HR = 0.66; 95% CI: 0.49–0.87 and HR = 0.84; 95% CI: 0.73–0.95, respectively). According to Kollia et al. (2018), a health metric reflecting functionality

(comprising 39 self-reported health questions related to impairments in body functions, limitations in ADL, limitations in instrumental ADL, cognitive functioning and walking speed) was identified as a strong and independent protective factor against 10-year mortality (HR between 0.40 and 0.70 across five-periodic examinations). This study also found that education and financial status were independent predictors of healthy ageing, being smoking and alcohol consumption, and physical activity mediators of the association. In a Finnish study, after 4 and 7 years of follow-up, the mortality risk gradually reduced (HR = 0.59; 95% CI: 0.41–0.83 and HR = 0.74; 95% CI: 0.56–0.97) by the degree of 'success' in physical (i.e., disease and functional ability), psychological (i.e., depression and self-rated health), and social components (i.e., frequency of meeting with children and frequency of talking on the phone with family) (Nosraty et al., 2015), while Kim et al. (2019) observed a 1.69-fold higher risk of mortality in older men and 2.37-fold higher in older women who not achieved successful ageing than those who achieved it, with seven negative components (major disease, disability, depressive symptom, poor social engagement, dissatisfaction with life, and low physical and cognitive function) significantly associated with increased risk of mortality.

We are aware that the variations in the definitions make it impossible to directly compare our findings with the available studies, but we supported the evidence that achieving active ageing, particularly emphasising the importance of physical health, is a predictor of mortality and survival. This is plausible since this component was loaded by well-established risk factors for mortality, like cognitive decline, chronic conditions (GBD 2013 Mortality and Causes of Death Collaborators, 2015) and unhealthy behaviours (World Health Organization, 2002). The component 'Physical health' displayed higher scores with lower morbidity and lower disability, healthier behaviours and better cognitive status, so it was related to increased survival. From another perspective, our findings confirmed that suffering from a high number of chronic diseases and functional decline, often associated with frailty, produces greater vulnerability and all-cause mortality (Shamliyan, Talley, Ramakrishnan, & Kane, 2013).

Since the component ‘Physical health’ was a construct of several variables related with functionality, cognitive functioning and lifestyles, and correlated with the components ‘Lifelong learning’ and ‘Institutional support’, promotion of several aspects to cope with vulnerability would become the basis for balance between reserve capacity and external stressors (Grundy, 2006). Such interventions would include cognitive stimulation, change of unhealthy behaviours, self-care literacy, clinical treatment of pain, development of barrier-free environments and social involvement which might improve health, ultimately resulting in a higher survival.

It should be noted that not all findings were totally consistent. ‘Psychological health’ was associated with less risk of mortality, but after adjustment for sociodemographic variables, this association was no longer significant. This could be attributed to the small number of deaths with a wider confidence interval and greater uncertainty about the results. Nonetheless, all health components association attenuated after controlling for age, gender and marital status, which highlights the importance of including these factors in future studies.

4.4. Limitations and strengths

The inclusion and exclusion criteria may have resulted in the final sample's distribution of characteristics being different from the total study sample. Although no exclusion criteria according to cognitive function were predefined, a lower level of response has been found among older individuals with lower level of cognitive functioning, lower ageing self-perception, higher disability, lower social participation and lower education level, which means exclusion of non-responders may result in an underrepresentation of participants with high cognitive or physical impairments (Rodriguez Laso et al., 2013). This could have influenced the subsequent survival rate and affected the validity of the estimates made by capturing only the results of the most active subjects in our population.

Since data came from a cross-sectional survey at baseline, it was not possible to infer causal relationships between the components of active ageing, so there may be reciprocal associations. For example, better health can cause higher participation, while higher participation may improve mental health. Some determinants of active ageing (such as income,

hearing or visual impairments, strength, body mass index, nutrition, sexuality, spirituality and/or religiosity, employment and working conditions, etc.) were not assessed, and variables were selected from a pre-existing database, so we should carefully consider the context in which this model was developed. In addition, this active ageing model was a theoretical construct, measured by proxies that depended on the author's choice, which could lead to a misclassification bias.

The results should be interpreted with caution as this analysis was performed on an exploratory basis and the number of people who died within the study period was low. Confirmatory factor analysis and structural equation modelling are needed to test the hypothesised model, but this was not possible due to the low number of events. Nevertheless, the model was a good representation of the diverse variables used for active ageing measurement presented in the literature, assessed by a comprehensive set of measures administered and tested cross-culturally. We included variables that were often not taken into account in previous models of active ageing, such as sleep, leisure activities, institutional support, or aspects of environment safety and accessibility. Furthermore, clustering variables into domains helped the interpretation of a complex framework as active ageing and captured changes in ageing status, and the multivariable analysis enabled us to explore the heterogeneous relationships between active ageing pillars, revealing how the different components interrelated, validating the multidimensional frame of active ageing.

4.5. Future directions

The findings of this study underline the need to implement intervention programmes to augment one's active ageing through different dimensions, particularly those affecting different aspects of health that, in turn, could improve the opportunity of survival. Further research on the role of active ageing in survival and other consequential outcomes, such as quality of life, life satisfaction, healthy life expectancy is needed; as well as to assess how improvements in all areas of ageing could reduce the risk of death. Longitudinal studies with standardised indicators taking into account the multidimensionality of active ageing are needed. Also, future research

should clarify how differences in active ageing components contribute to the gender mortality gap.

5. Conclusions

This study contributes to broaden the approach on active ageing by supporting the multidimensionality of the concept. This model took into account, not only health and participation frequently assessed in other proposals, but other dimensions like security and lifelong learning, also at the core of the WHO active ageing framework. Our findings showed that the combination of complex measurements makes it possible to predict future health outcomes within the domain of active ageing. According to how the variables clustered into the components and how the components intertwined, results suggest that the variables loading on the biomedical component of the health pillar (e.g. cognitive function, health conditions or pain), could play a part on survival chances. A comprehensive and multidimensional assessment of the health pillar of active ageing is fundamental to the evaluation of survival, with the rest of the pillars interlinked to achieve active ageing. Intervention programmes, particularly oriented to encourage variables that contribute to the component 'Physical health', such as cognitive stimulation, change of unhealthy behaviours, self-care literacy, clinical treatment of pain, development of barrier-free environments and social involvement, may be key to reduce disabilities and chronic diseases, promoting a person's active ageing and improving chances of survival.

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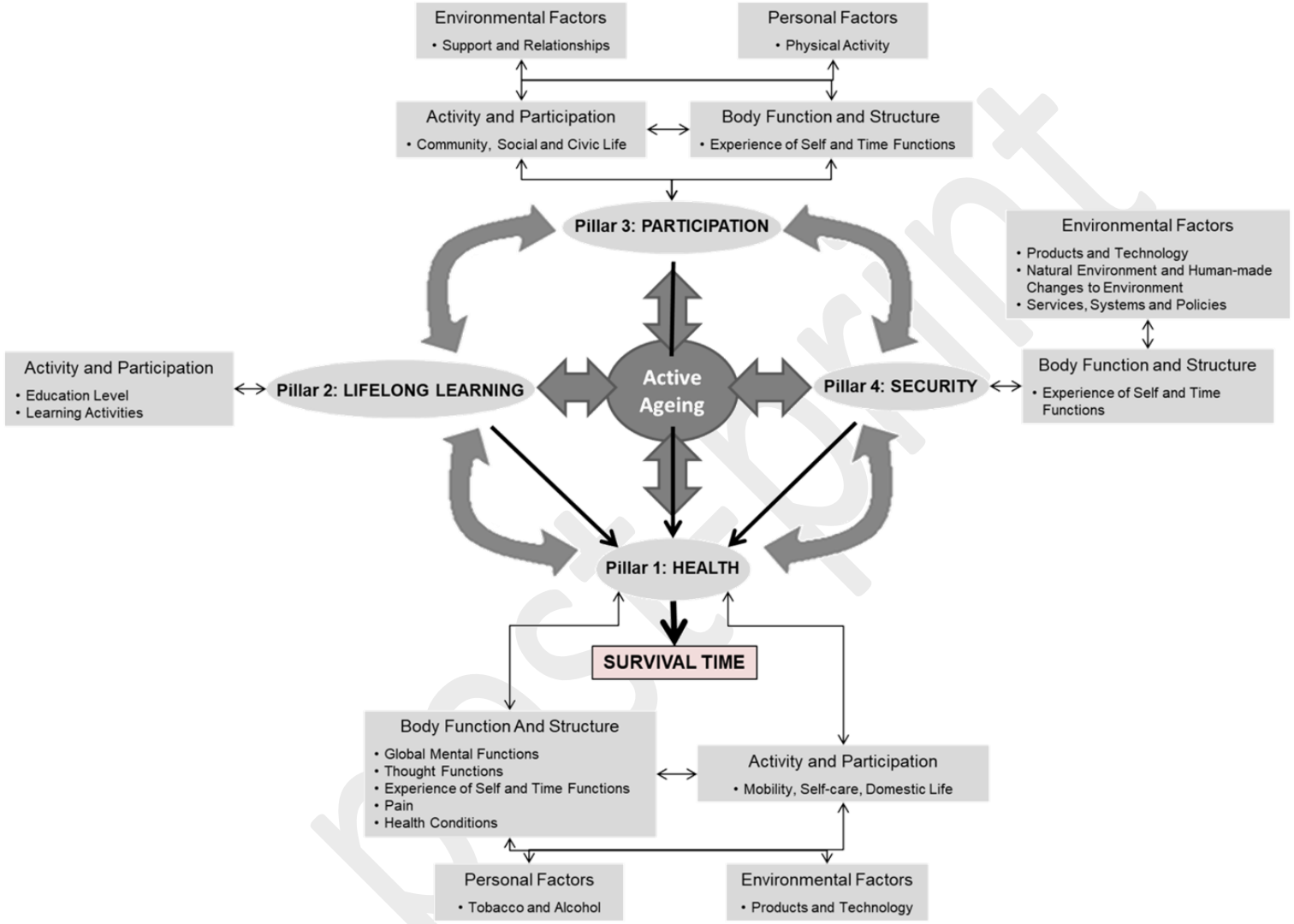
Figure captions

Figure 1: Hypothetical conceptual framework for the construction of active ageing “pillars”.

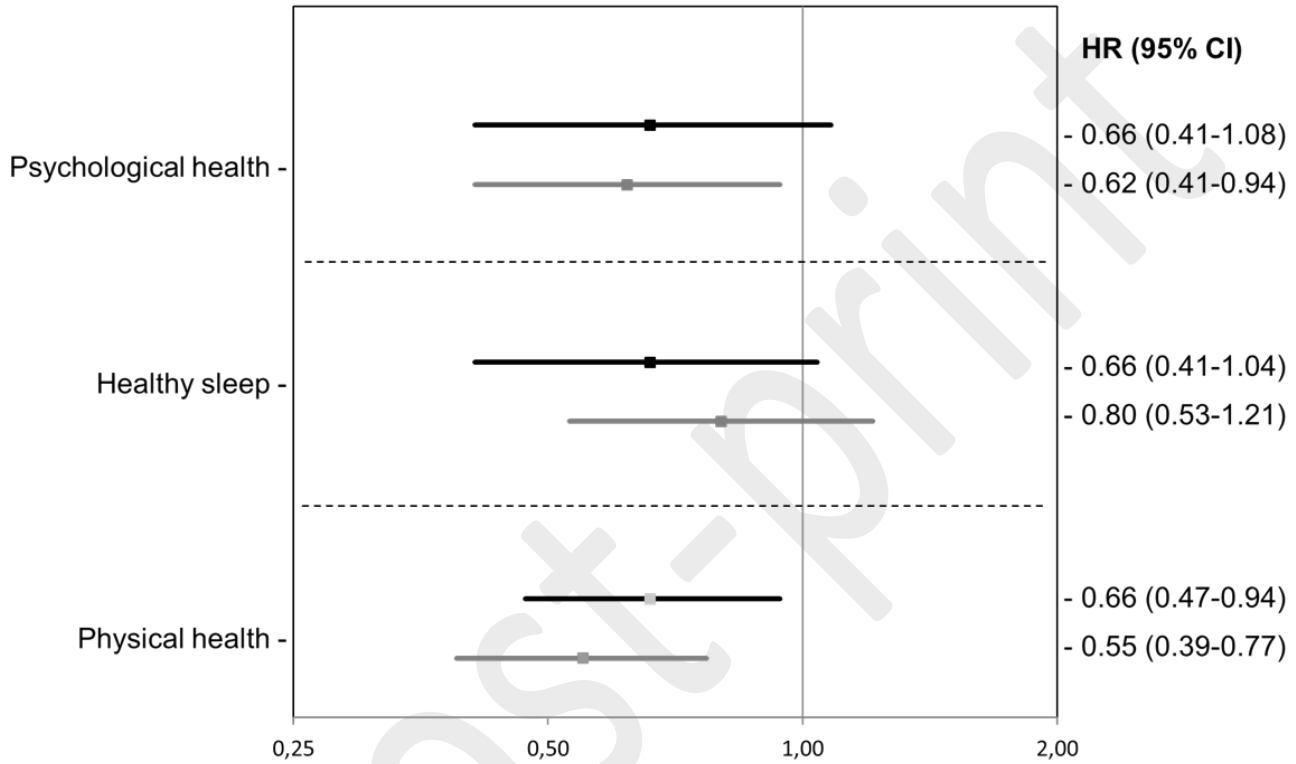
Figure 2: Mortality HRs per unit of increase in each health principal-component’s score.

Figure 3: Active ageing and survival relationship.



Hypothetical conceptual framework for the construction of active ageing. Pillars were delineated based on the components and dimensions of the International Classification of Functioning, Disability and Health.
Thick black arrows represent associations tested in the analytical approaches of the study:

1) **Participation, Lifelong learning and Security with Health.**
2) **Health with Survival**.

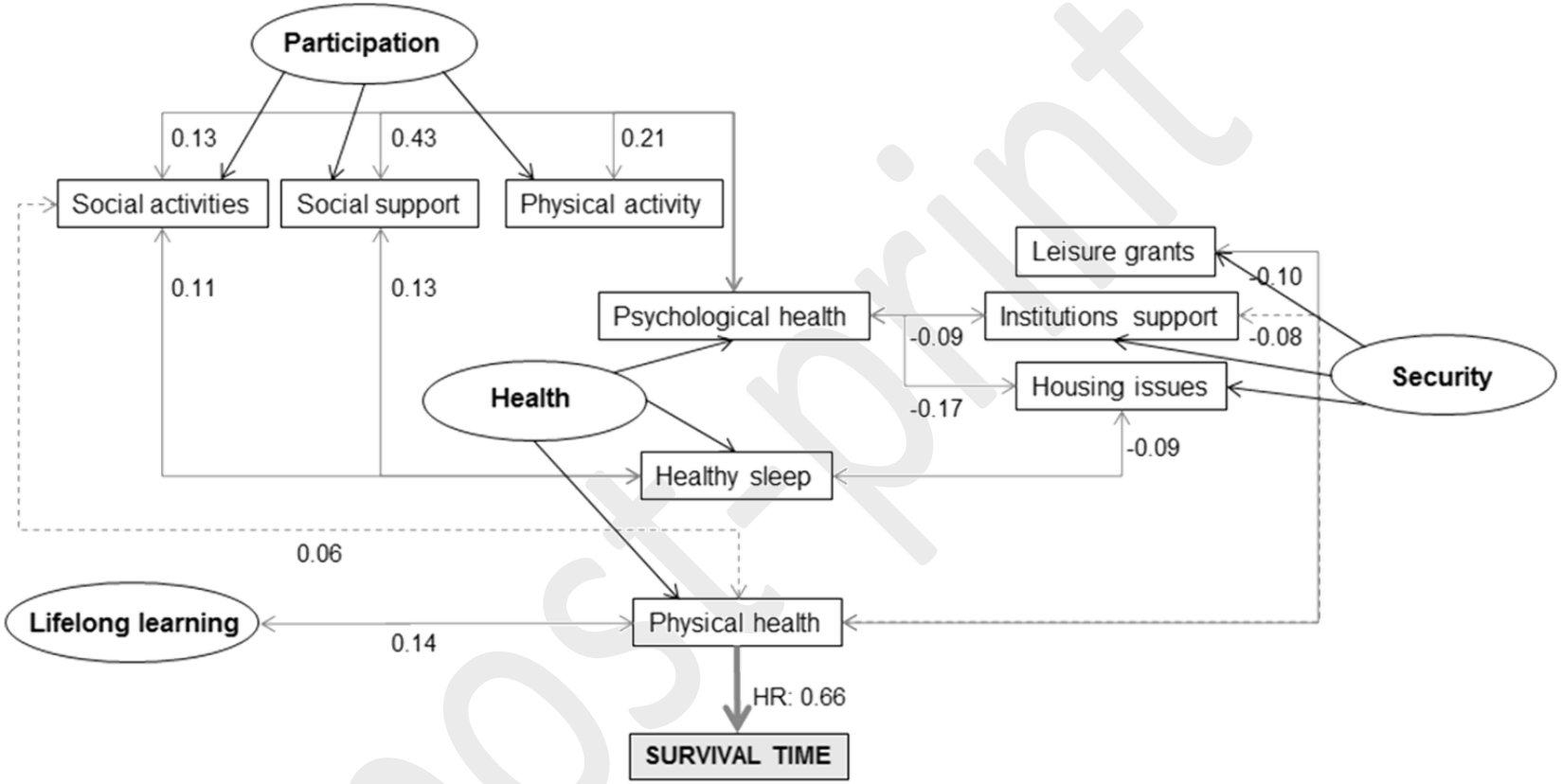


Mortality HRs per unit of increase in each health principal-component's score:

Crude

Adjusted for age, gender and marital status

HR: Hazard ratio; CI: Confidence Interval



Significant associations found with:

a) **Multivariate linear regression model between components of health and principal components of lifelong learning, participation and security (β-coefficient, Table 3).**

b) **Cox proportional hazards multivariate regression of survival with respect to health pillar (HR, Figure 2).**

Note: All numbers are standardized betas except when otherwise indicated (HR). Circles represent active ageing pillars. Non-shaded rectangles represent principal components that form each pillar. A dashed line represents a statistical tend (p≤0.10).

Supplementary data:

Baseline characteristics by indicators of active ageing pillars and survival status (weighted sample).

ICF COMPONENT	*MEASUREMENT*	*ELES-PS VARIABLES*		*Overall N (%*)*	*Dead n (%*)*	*Alive n (%*)*	*p-value*
Personal Factors		Gender	0= female	338 (50.57)	4 (27.86)	333 (51.13)	**0.046**
			1= male	330 (49.43)	12 (72.14)	319 (48.87)	
		Age (years)		60.97 (8.13)	72.95 (16.65)	60.70 (7.66)	**<0.001***
		Age groups	1= 50-67 years	535 (80.52)	5 (31.11)	533 (81.73)	**<0.001**
			2= 67-74 years	97 (14.51)	4 (25.88)	93 (14.23)	
			3= 75 years or more	33 (4.97)	7 (43.01)	26 (4.03)	
		Marital status	1= married/living with partner	538 (80.54)	11 (72.14)	527 (77.92)	**0.006**
			2= separated/divorced	34 (5.03)	0 (0.00)	34 (5.64)	
			3= widowed	54 (8.17)	4 (26.57)	50 (10.43)	
			4= single	42 (6.26)	1 (0.99)	41 (6.01)	
HEALTH							
Body Function and Structure	1 Cognitive Functioning	MMSE scale	Total score: 0-30	28.84 (1.31)	28.59 (2.22)	28.85 (1.29)	0.599*
	2 Depression	CES-D 10	Total score: 0-10	1.80 (2.29)	2.12 (2.47)	1.79 (2.28)	0.505*
	3 Personality and Emotional Balance	SPANE-balance scale	Total score: -24 +24	12.90 (6.83)	13.65 (7.57)	12.89 (6.80)	0.591*
	4 Self-rated Ageing Satisfaction	Ageing satisfaction scale	Total score: 0-10	7.88 (1.60)	7.52 (82.46)	7.89 (1.58)	0.430*
	5 Ageing Self-perception	Attitudes Toward Own Ageing subscale	Total score: 0-5	3.21 (1.59)	2.32 (2.01)	3.23 (1.57)	**0.011***
	6 Health Self-perception	How would you rate your health status?	1= very poor	5 (6.20)	1 (0.99)	4 (0.61)	**<0.001**
			2= poor	23 (3.46)	2 (14.43)	21 (3.19)	
			3= reasonable	169 (25.33)	9 (56.72)	160 (24.56)	
			4= good	399 (59.83)	4 (27.86)	395 (60.62)	
			5= very good	72 (10.76)	0 (0.00)	72 (11.02)	
	7 Illness	21 diagnosed chronic conditions	Total score: 0-21	2.19 (2.24)	4.12 (3.27)	2.14 (2.20)	**0.002***
	8 Pain	How often does the pain make it difficult for you to do your usual activities such as household chores or work?	1= never	444 (66.45)	9 (55.73)	435 (66.72)	0.342
			2= occasionally	90 (13.47)	3 (16.41)	87 (13.39)	
			3= regularly	63 (9.46)	1 (6.22)	62 (9.54)	
			4= frequently	53 (7.89)	2 (14.43)	51 (7.73)	
			5= always	18 (2.74)	1 (7.21)	17 (2.62)	
	9 Sleep Problems	How many hours do you sleep on average?		7.06 (1.39)	6.96 (1.58)	7.07 (1.38)	0.697*
		How often do you wake up rested in the	1= rarely	85 (12.78)	5 (34.08)	80 (12.25)	0.002
			2= sometimes	108 (16.09)	2 (8.21)	106 (16.28)	

			morning?	3= most of the time	475 (71.13)	9 (57.71)	466(71.46)	
			Within the last four weeks, how many times have you had difficulty falling asleep?	1= never	382 (57.23)	7 (44.27)	375 (57.55)	0.116
				2= occasionally	168 (25.15)	4 (26.87)	164 (25.11)	
				3= regularly	41 (6.12)	1 (8.21)	40 (6.07)	
				4= frequently	50 (7.46)	3 (19.66)	47 (7.16)	
				5= always	27 (4.03)	1 (0.99)	26 (4.11)	
			Within the last four weeks, how many times woke up several times while sleeping?	1= never	223 (33.43)	3 (20.65)	220 (33.75)	0.062
				2= occasionally	213 (31.93)	3 (20.65)	210 (32.21)	
				3= regularly	69 (10.28)	4 (25.88)	65 (9.90)	
				4= frequently	98 (14.69)	3 (21.64)	95 (14.52)	
				5= always	65 (9.67)	2 (11.18)	63 (9.63)	
			Within the last four weeks, how many times woke up too early?	1= never	361 (54.01)	6 (36.07)	355 (54.46)	0.287
				2= occasionally	160 (23.88)	5 (28.85)	155 (23.75)	
				3= regularly	60 (9.01)	1 (8.21)	59 (9.03)	
				4= frequently	51 (7.6)	3 (18.66)	48 (7.32)	
				5= always	36 (5.50)	1 (8.21)	35 (5.43)	
Activities and Participation	1	Physical Functioning and ADL Problems	24-item functional activity scale	Total score: 24-96	92.41 (80.5)	83.19 (20.05)	92.64 (7.52)	**0.006***
Personal Factors	1	Smoking	Could you tell me if you currently smoke?	1= never	300 (44.94)	6 (41.30)	294 (45.03)	0.693
				2= ex-smoker	253 (37.84)	7 (46.26)	245 (37.63)	
				3= smoker	115 (17.23)	2 (12.44)	113 (17.35)	
	2	Drinking	How often have you consumed alcohol in the past 12 months?	0= never	109 (16.35)	4 (23.63)	105 (16.17)	0.096
				1= nothing within last year	54 (8.02)	2 (13.44)	52 (7.89)	
				2= occasionally	126 (18.80)	0 (0.00)	126 (19.26)	
				3= monthly	27 (4.11)	1 (6.22)	26 (4.06)	
				4= weekly	122 (18.24)	1 (6.22)	121 (18.53)	
				5= daily	230 (34.48)	8 (50.50)	222 (34.09)	
Environmental Factors	1	Technical Help	Sum of 6-devices	Total score: 0-6	0.08 (0.32)	0.41 (0.86)	0.07 (0.30)	**0.036***
PARTICIPATION								
Body Function and Structure	1	Loneliness Self-perception	De Jong scale	Total score: 0-6	2.12 (1.68)	1.58 (1.68)	2.14 (1.68)	0.107*
	2	Leisure Satisfaction	How would you rate your overall satisfaction with your free time?	Total score: 0-10	7.11 (1.80)	7.32 (2.39)	7.11 (1.78)	0.616*
Activities and Participation	1	Social Engagement and Activity	Cultural activities (museum, theater, cinema…)	1= never	200 (29.85)	6 (36.07)	194 (29.70)	0.586
				2= less than 1 day per year	41 (6.16)	1 (7.21)	40 (6.14)	
				3= less than 1 day per month	172 (25.83)	5 (34.08)	167 (25.62)	
				4=1 or more days per month	255 (38.15)	4 (22.63)	251 (38.54)	
			Social activities (dinner with friends, social club…)	1= never	100 (15.00)	5 (28.85)	95 (14.66)	**0.048**
				2= less than 1 day per year	11 (1.62)	1 (7.21)	10 (1.48)	
				3= less than 1 day per month	71 (10.60)	2 (14.43)	69 (10.51)	
				4=1 or more days per month	486 (72.79)	8 (49.50)	478 (73.36)	

			Travel, sightseeing	1= never	136 (20.36)	6 (37.06)	130 (19.95)	0.363
				2= less than 1 day per year	63 (9.49)	1 (6.22)	62 (9.57)	
				3= less than 1 day per month	300 (44.89)	6 (35.08)	294 (45.13)	
				4=1 or more days per month	169 (25.26)	3 (21.68)	166 (25.35)	
			Private hobbies (gardening, handicrafts...)	1= never	192 (28.69)	3 (19.39)	189 (28.92)	0.126
				2= less than 1 day per year	11 (1.72)	1 (6.22)	10 (1.61)	
				3= less than 1 day per month	27 (4.11)	2 (12.44)	25 (3.90)	
				4=1 or more days per month	438 (65.49)	10 (61.95)	428 (65.57)	
			Activities in the neighborhood (sports, go on walks or to the park…)	1= never	77 (11.53)	3 (21.64)	74 (11.28)	**0.011**
				2= less than 1 day per year	5 (0.75)	1 (6.22)	4 (0.61)	
				3= less than 1 day per month	18 (2.76)	0 (0.00)	18 (2.83)	
				4=1 or more days per month	568 (84.96)	12 (72.14)	556 (85.28)	
			Associative participation (political, volunteering…)	1= never	483 (72.24)	12 (78.36)	471 (72.09)	0.239
				2= less than 1 day per year	9 (1.42)	1 (6.22)	8 (1.30)	
				3= less than 1 day per month	36 (5.38)	1 (6.22)	35 (5.36)	
				4=1 or more days per month	140 (20.96)	2 (9.20)	138 (21.25)	
Personal Factors	1	Physical Activity	MVPA score	Total score: 0-60	12.16 (18.43)	5.59 (13.87)	18.38 (78.88)	**0.003***
			Leisure walking score	Total score: 0-48	25.85 (17.09)	19.38 (14.32)	26.01 (17.08)	**0.006***
Environmental Factors	1	Social Networks	DUFSS questionnaire	Total score: 11-55	42.87 (8.67)	45.34 (11.69)	42.81 (8.59)	0.270*
			Number of friends		5.18 (4.87)	5.16 (8.48)	5.19 (4.78)	0.988*
SECURITY								
Body Function and Structure	1	Environment Self-perception	Dwelling satisfaction	Total score: 0-10	8.51 (1.31)	8.94 (1.39)	8.50 (1.31)	0.134*
Environmental Factors	1	Environment Safety	Dwelling amenities	Total score: 0-6	2.24 (1.29)	2.05 (1.50)	2.25 (1.29)	0.422*
			Architectural barriers	Total score: 0-5	0.30 (0.67)	0.76 (1.62)	0.29 (0.64)	0.130*
			Dwelling quality and sanitation problems	Total score: 0-6	0.94 (1.07)	0.71 (0.83)	0.94 (1.07)	0.222*
	2	Health and Social Services use	Elderly care economic help	0= no need	579 (86.71)	10 (64.92)	569 (87.24)	**0.015**
				1= no use	54 (8.14)	3 (20.65)	51 (7.83)	
				2= use	34 (5.15)	2 (14.43)	32 (4.92)	
			Housing adaptation	0= no need	621 (92.88)	13 (78.36)	608 (93.24)	**<0.001**
				1= no use	38 (5.72)	3 (21.64)	35 (5.33)	
				2= use	9 (1.39)	0 (0.00)	9 (1.43)	
			Personal care help	0= no need	612 (91.63)	10 (63.93)	602 (92.31)	**<0.001**
				1= no use	42 (6.24)	5 (34.08)	37 (5.56)	
				2= use	14 (2.13)	1 (1.98)	13 (2.13)	
			Daily center	0= no need	639 (95.67)	15 (90.80)	624 (95.79)	0.084
				1= no use	20 (2.99)	1 (9.20)	19 (2.83)	
				2= use	9 (1.34)	0 (0.00)	9 (1.37)	
			Tele-assistance	0= no need	626 (93.69)	12 (72.14)	614 (94.22)	**0.001**
				1= no use	27 (3.98)	3 (19.66)	24 (3.59)	
				2= use	15 (2.33)	1 (8.21)	14 (2.18)	
			Temporally nursing	0= no need	639 (95.67)	14 (90.80)	625 (95.79)	**0.041**

		home	1= no use	24 (3.56)	1 (8.21)	23 (3.45)	
			2= use	5 (0.77)	1 (0.99)	4 (0.77)	
		Food and cleaning service	0= no need	637 (95.32)	14 (85.57)	623 (95.56)	0.056
			1= no use	29 (4.38)	2 (14.43)	27 (4.13)	
			2= use	2 (0.30)	0 (0.00)	2 (0.31)	
		Technical aids grants	0= no need	635 (95.05)	13 (8359)	622 (95.33)	**0.003**
			1= no use	22 (3.31)	1 (721)	21 (3.21)	
			2= use	11 (1.64)	2 (9.20)	9 (1.45)	
		Supervised housing	0= no need	640 (95.72)	15 (91.79)	625 (95.82)	0.416
			1= no use	26 (3.98)	1 (8.21)	25 (3.88)	
			2= use	2 (0.30)	0 (0.00)	2 (0.31)	
		Holidays	0= no need	481 (71.96)	11 (68.17)	470 (72.05)	0.595
			1= no use	98 (14.79)	3 (21.64)	95 (14.62)	
			2= use	89 (13.25)	2 (10.19)	87 (13.33)	
		SPA resort	0= no need	530 (79.40)	10 (63.93)	520 (79.78)	0.182
			1= no use	116 (17.35)	5 (28.85)	111 (17.07)	
			2= use	22 (3.25)	1 (7.21)	21 (3.15)	
		Education grants	0= no need	504 (75.38)	12 (71.15)	492 (75.48)	0.407
			1= no use	80 (11.98)	3 (20.65)	77 (11.76)	
			2= use	84 (12.65)	1 (8.21)	83 (12.76)	
LIFELONG LEARNING							
Activities and Participation	1 Education	Education level	1= no education	1 (0.20)	0 (0.00)	1 (0.20)	0.851
			2= less than primary school	148 (22.17)	5 (31.83)	143 (21.93)	
			3= primary school	159 (23.79)	3 (20.65)	156 (23.87)	
			4= secondary school	167 (25.04)	4 (25.88)	163 (25.02)	
			5= college degree	192 (28.80)	3 (21.64)	189 (28.97)	
	2 Learning Commitment	Learning activities (attend courses, take classes, etc.)	1= never	366 (54.90)	10 (71.15)	356 (54.50)	0.296
			2= less than 1 day per year	38 (5.55)	2 (6.2)	36 (5.54)	
			3= less than 1 day per month	74 (11.04)	3 (14.43)	71 (10.96)	
			4=1 or more days per month	190 (28.50)	1 (8.21)	189 (29.00)	
TOTAL				668 (100.00)	16 (2.41)	652 (97.59)	

ICF: International Classification of Functioning, Disability and Health; ELES-PS: Ageing in Spain Longitudinal Study-Pilot Survey; MMSE: Mini-Mental State Examination; CES-D10: 10-item version of the Center for Epidemiological Studies Depression Scale; SPANE: Scale of Positive and Negative Experience; ADL: Activities of Daily Living; MVPA: Moderate to Vigorous Physical Activity; DUFSS: Duke-UNC Functional Support Scale. Data are N (%) and Chi-square test; *Mean (SD) and Student's T-test. Due to the characteristics of survey sampling, complex analysis taking into consideration weighted, clustering and stratification were applied. In bold, statistical significant associations. $p<0.05$

Declaration of interest

Funding: This work was funded by the ELES Project (*Estudio Longitudinal Envejecer en España*) supported by the Ministry of Economy and Competitiveness/MINECO [ref. CSO2009-08645-E/SOCI, CSO2009-06638-E/SOCI, CSO2009-06637-E/SOCI]; Gobierno Vasco [Programa SAIOTEK 2009]; and Fundación Obra Social Caja Madrid; the ENVACES Project (*Envejecer Activamente en España*) supported by MINECO/FEDER/UE [ref. CSO2015-64115-R]; the QASP project, supported by the Institute of Health Carlos III [PI18CIII/00046]; and the ENCAGE-CM Project (*Envejecimiento Activo, Calidad de Vida y Género*) supported by Comunidad de Madrid [ref. H2019/HUM-5698, S2015/HUM-3367].

This paper presents independent results and research. The views expressed are those of the authors and not necessarily those of funding agencies

Author statement

Ana Isabel Hijas-Gómez: conception and design of the study, analysis and interpretation of data, writing of the manuscript, and final draft approval. **Alba Ayala**: data analysis and interpretation of data, writing of the manuscript, and final draft approval. **Maria Pilar Rodríguez-García**: acquisition, analysis and interpretation of data, and final draft approval. **Carmen Rodríguez-Blázquez**: conception and design of the study, interpretation of data, and final draft approval. **Vicente Rodríguez-Rodríguez**: conception and design of the study, acquisition of data, and final draft approval. **Fermina Rojo-Pérez**: interpretation of data, writing of the manuscript, and final draft approval. **Gloria Fernández-Mayoralas**: interpretation of data, writing of the manuscript, and final draft approval. **Angel Rodríguez-Laso**: review of the manuscript, and final draft approval. **Amaia Calderón-Larrañaga**: review of the manuscript, and final draft approval. **Maria Joao Forjaz**: conception and design of the study, analysis and interpretation of data, writing of the manuscript, and final draft approval.