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SOCIAL DETERMINANTS OF CARDIOVASCULAR DISEASES, FUNCTIONAL LIMITATIONS AND DISABILITY

Arlin Martha Bibiana Pérez Hernández

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Directors:

Dra. Esther García García-Esquinas

Dr. Fernando Rodríguez Artalejo

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Dra. Esther García García-Esquinas and Dr. Fernando Rodríguez Artalejo, inform that the thesis entitled *"Social determinants of cardiovascular diseases, functional limitations and disability"* is an original work carried out by Dña. Arlin Martha Bibiana Pérez Hernández under our guidance and supervision. This is an original work, rigorously carried out and is apt to be defended publicly in order to obtain the degree of Doctor on Epidemiology and Public Health.

For this to be recorded and to have the appropriate effects, this document is signed in Madrid, August, 2018.

Esther García García-Esquinas, MD, PhD
Universidad Autónoma de Madrid
School of Medicine
Department of Preventive Medicine,
Public Health and Microbiology.

Fernando Rodríguez Artalejo, MD, PhD
Universidad Autónoma de Madrid
School of Medicine
Department of Preventive Medicine
Public Health and Microbiology.

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To my parents and brother.

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SUMMARY

Background and objectives: The accelerated aging of the population and the increase in inequalities in access to health and social assistance services constitute one of the greatest challenges for public health in most countries. The burden of non-communicable diseases (NCDs) constitutes an important health problem with serious social and economic consequences. According to the World Health Organization (WHO), NCDs are the main cause of mortality in the world. Most of these deaths are premature and are concentrated in low and middle income countries, and are caused by known and preventable risk factors.

Bearing in mind that studies on social inequalities in chronic health disorders of the elderly are limited, the following objectives were proposed for this doctoral thesis:

• To examine the distribution of the main behavioral and biological cardiovascular risk factors (CVRF) according to socioeconomic status (NSE) among older adults in Spain.

• To evaluate the cross-sectional association between housing conditions and physical function limitations in older adults in Spain.

• To evaluate the prospective association between housing conditions and physical function limitations in older adults in Spain.

• To assess the contribution of the main social determinants to inequalities in disability in Europe.

Methods: For the first three objetives, data from the older adult components of the Nutrition and Cardiovascular Risk Study in Spain (Seniors-ENRICA) were used. Briefly, during the years 2008-2010, 3518 men and women aged 60 and over were selected by stratified random sampling of the non-institutionalized Spanish population. Participants were followed until 2015. At baseline, 2012 and 2015, reported information was collected on sociodemographic variables, health behaviors and morbidity. In addition, blood and urine samples were collected and a physical examination was performed. For the last objective, we worked with data from the 7th wave of the European Social Survey (ESS) 2014, which included a module on social inequalities in health and their determinants for several European countries. The sample included 19882 participants 30 to 79 years of age belonging to 19 countries in Europe.

Results: Older adults with higher education in Spain drank alcohol more frequently, engaged in more leisure-time physical activity, and spent less time watching television.

An inverse educational gradient was also observed for obesity, metabolic syndrome, diabetes and cardiovascular disease. Those who had worked or whose father had worked in a manual occupation, showed a higher prevalence of CVRF. Differences in CVRF across socioeconomic level were generally greater in women than in men.

In the Seniors-ENRICA study, poor housing conditions were associated with worse score in the Short Physical Performance Battery, greater frequency of agility limitations, and greater risk of frailty.

In most European countries, the prevalence of disability was higher among women and among less educated subjects. However, substantial differences were observed between countries. Factors related to working conditions among men, and health behaviors among women, contributed the most to explain inequalities in disability.

Conclusions: There are important inequalities in CVRF and in physical function limitations among older adults in Spain. Inequalities in disability in European countries are mainly explained by behavioral factors and by work-related conditions. These inequalities could be reduced by preventive actions focused on lifestyles and working conditions.

Key words: Cardiovascular risk factors, frailty, limitations in physical function, disability, social inequalities in health.

RESUMEN

Antecedentes y objetivos: El envejecimiento acelarado de la población y el aumento de las desigualdades en el acceso a los servicios de salud y de asistencia social constituyen unos de los mayores retos de salud pública para la mayoria de paises. La carga de enfermedades no trasmisibles (ENT) es un grave problema sanitario con serias repercusiones sociales y económicas para estos países. De acuerdo con la OMS, las ENT constituyen la principal causa de mortalidad en el mundo. La mayoría de estas muertes son prematuras y se concentran en países de ingresos medios y bajos, y son causadas por factores de riesgo conocidos y prevenibles.

Teniendo en cuenta que los estudios sobre desigualdades sociales en los trastornos crónicos de salud de las personas mayores son limitados, se propusieron los siguientes objetivos para esta tesis doctoral:

- Examinar la distribución de los principales factores de riesgo cardiovascular (FRCV), ligados a estilos de vida y biológicos, según el nivel socioeconómico (NSE) entre los adultos mayores de España.
- Evaluar la asociación transversal entre las condiciones de la vivienda y las limitaciones de la función física en los adultos mayores de España.
- Evaluar la asociación prospectiva entre las condiciones de la vivienda y el riesgo de limitaciones en la función física en los adultos mayores de España.
- Evaluar la contribución de los principales determinantes sociales a las desigualdades en la discapacidad en Europa.

Métodos: Para los tres primeros objetivos, se obtuvieron datos de la sección de ancianos del Estudio de Nutrición y Riesgo Cardiovascular en España (ENRICA-Seniors). En resumen, durante los años 2008-2010, 3518 hombres y mujeres de 60 y más años se seleccionaron por muestreo aleatorio estratificado de la población española no institucionalizada. Los participantes fueron seguidos hasta 2015. Al inicio del estudio, y en los años 2012 y 2015, se recogió información reportada sobre variables sociodemográficas, estilos de vida y morbilidad. Además, se realizó un examen físico y se recogieron muestras de sangre y orina de los participantes. Para el último objetivo, trabajamos con los datos de la séptima ola de la Encuesta Social Europea (ESS) (año 2014), que incluía un modulo sobre desigualdades en salud y sus determinantes para varios países europeos. La muestra incluyó 19882 participantes de 30 a 79 años de edad pertenecientes a 19 países de Europa.

Resultados: En España, las personas de 65 y más años con mayor nivel educativo consumían alcohol con mas frecuencia, realizaban más actividad física en tiempo libre y pasaban menos tiempo viendo televisión. También se observó un gradiente educativo inverso para la obesidad, síndrome metabólico, diabetes y enfermedad cardiovascular. Aquellos que trabajaron o cuyo padre había trabajado en ocupaciones manuales mostraron mayor prevalencia de FRCV. Las diferencias en FRCV por nivel socioeconómico fueron generalmente mayores en mujeres que en hombres.

En el estudio ENRICA-Seniors, las malas condiciones de la vivienda se asociaron con peor puntuación en la Short Physical Peformance Battery, mayor frecuencia de limitaciones en la agilidad, y mayor riesgo de fragilidad.

En la mayoria de paises de Europa, la prevalencia de discapacidad fue mayor entre las mujeres y en las personas con menor nivel educativo. Sin embargo, se observaron grandes diferencias entre países. Los factores relacionados con las condiciones de trabajo, en los hombres, y los comportamientos relacionados con la salud en las mujeres, fueron los que más contribuyeron a explicar las desigualdades en discapacidad.

Conclusiones: Existen importantes desigualdades en los FRCV y en las limitaciones de la función fisica de los adultos mayores de España. Las desigualdades en discapacidad en los países de Europa se explican principalmente por factores de comportamiento y por las condiciones de trabajo. Estas desigualdades podrían reducirse con acciones preventivas focalizadas en mejorar los estilos de vida y las condiciones de trabajo.

Palabras clave: Factores de riesgo cardiovascular, fragilidad, limitaciones en la función fisica, discapacidad, desigualdades sociales en salud.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Page

LIST OF ANNEXES

LIST OF ABREVIATIONS

BMI: Body mass index

CI: Confidence Interval

CVD: Cardiovascular disease

CVRF: Cardiovascular risk factor

EHN: The European Heart Network

ENABLE-AGE: The Home Environment as a Determinant for Healthy Ageing Project

ENRICA: Nutrition and Cardiovascular Risk Study

EPIC: European Prospective Investigation into Cancer and Nutrition Study

ESP: European Standard Population

ESS: European Social Survey

EU: European Union

GALI: Global Activity Limitation

IADL: Instrumental Activities of Daily Living

INE: National Institute of Statistics of Spain

ISCED: International Standard Classification of Education

MEDAS: Mediterranean Diet Adherence Screnner

MET: Metabolic Equivalents

MONICA: Multinational monitoring of trends and determinants in cardiovascular disease

NCDs: Noncommunicable diseases

OR: Odds ratio

PREDIMED: Prevention with Mediterranean Diet Study

SEC: Socioeconomic conditions

SEL: Socioeconomic level

SEP : Socioeconomic position

SES: Socioeconomic status

SPPB: Short Physical Performance Battery

TSHA: Toledo Study for Healthy Ageing

WHO: World Health Organization

1. INTRODUCTION

Currently, in most countries there is an accelerated aging of the population and inequalities in income and in access to health and care services have increased. These inequalities have generated higher demands in terms of health and social care services and increased the cost of health and pension systems. In order to respond to these challenges in public health, countries need to implement policies and prevention programs to increase early detection of chronic conditions and to ensure elderly people have timely and quality access to health and care services.

According to the World Health Organization (WHO), non-communicable diseases (NCDs), including heart diseases, stroke, cancer and diabetes, are responsible for almost 70% of all deaths worldwide. Every year, more than 63% of people aged 30 to 70 die from these causes, and more than 90% of these premature deaths occur in low and middle-income countries. Many of these deaths are linked to common lifestyle risk factors (e.g.: smoking, physical inactivity, unhealthy diet, harmful use of alcohol or obesity) and so are preventable (1). It is also known that health impact of low socioeconomic status is comparable to most of these risk factors (2).

With the aging of the population worldwide, the global burden of disease and death has focused on NCDs and disability (3, 4). In European Union (EU) countries, the rapid increase of the population aged 65 and over has resulted in a substantial increase in the number of older adults with functional limitations and activity restrictions, especially among the oldest old (aged 85 and over) (5). In this sense, in 2015 25.2% of the population aged 16 and over in the EU (22.9% in men and 27.4% in women) declared some type of activity limitations. In Spain, this proportion was 24.8% and the frequency of activity limitations was more than 50%, (4).

Although the association between low socioeconomic status and greater rates of morbidity and premature mortality have been observed for centuries in most countries of the world (2, 6), there are still gaps in knowledge regarding the specific role that social determinants plays in health inequalities. Contributions to this knowledge will allow a better understanding of socioeconomic inequalities in health, and also improving definition of target groups for policies and interventions to let prevent or reduce these inequalities.

1.1 Health Inequalities

Social inequalies are defined as systematic differences in health between social groups within a society. Because these are socially produced and potentially avoidable, they are considered unacceptable and unfair (7). Despite this fact, large health inequalities have persisted over time among countries and within them (8-10). As an example, the EU includes countries with some of the best levels of health in the world, with developed welfare states and high-quality education and health services. However, not all regions have this social, economic, and health development, and health inequities are increasing across countries (11).

Reducing social inequalities in health constitutes one of the major challenges for Public Health systems in European countries. First, for reasons of social justice, because people in low socioeconomic position already have to face many social and economic disadvantages, over which they have not control (7, 12). Second, because the high rates of morbidity and mortality among individuals in low socioeconomic position generate high costs for health services, losses of productivity, and losses of revenue for countries (11, 13).

1.1.1 Understanding health inequalities

There are several theories that attempt to explain social inequalities in health, although none of them can totally explain why they persist over time (10, 14, 15). Also, it is unclear which factors mediate the relationship between socioeconomic status and health (10, 16). Below, we present some of the most accepted theories regarding social inequalities in health:

Materialist explanation/structuralist: It is based on how material factors, such as income and wealth, let people access goods and services such as better food, better housing, safer environments and better access to health care (15); limiting their exposure to physical, environmental and psychosocial risk factors (14). And social inequalities in health arise from differences in structural factors such as housing and working conditions and material deprivation (17).

The cultural-behavioral: Based on how cultural factors, beliefs, knowledge and access to health-related information determines the cognitive skill, behaviors and lifestyle of

individuals (such as smoking, unhealthy diet, hamful consumption of alcohol, sedentaryness or lack of physical activity), which are associated with risk of many adverse health conditions (10, 15, 17)

Psychosocial pathways: Based on how social inequalities make people have negative feelings like social exclusion, stress, low social support or discrimination, all of which affect phycological and mental health by activating the biological stress response. This can lead to negative health outcomes like increased inflammatory response, or elevated heart rate and blood pressure, among others (16).

Life course perspective: Based on the fact that health at older ages is partly detemined by exposure to biological and social factors at the start of life, and that the roots of health inequalities may have origined in circunstances experienced in the womb, during childhood and adolescence (10).

Fundamental causes: according to this theory, socioeconomic position, determines access to resources such as money, knowledge, prestige, power and beneficial social connections; which can be used to avoid disease risks or to minimize the consequences of disease once it occurs (10, 14).

Social selection: Based on the fact that health or the health determinants of a person influence their social mobility and their position in the social hierarchy. This theory describes a reverse causal relationship between health and social position (10).

Personal characteristics: Based on the fact that socioeconomic position is strongly associated with personality, congnitive ability and other personal characteristics which affect people´s health (10).

1.1.2 Social determinants of health

Social determinants of health are a consequence of the socioeconomic circumstances of people´s lives and constitute the welfare resouces necessary to lead a good life (14). Different conceptual models have been described to explain social health inequalities and their determinants. These have been represented through diagrams and figures, which allow to integrate key elements and show causal relationships between different factors, facilitating understanding and guiding new investigations (18). One of the most referenced is the clasical model or Dalghren and Whitehead, from 1991. Figure 1 shows

some of the main aspects of this model. In the center, we can observe a group of individuals, defined by characteristics that can not be modified, such as age, sex, or constitutional factors. These factors are successively enveloped by the main social determinants of health in concentric layers, beginning with individual behavioral risk factors, then social and community networks, structural determinantes (such as living and working conditions), and finally, general socioeconomic, cultural and environmental conditions (14, 18).

Figure 1: Dahlgren and Whitehead model of the deteminants of health.
Source: Eikemo TA, et al The first pan-European sociological health inequalities survey of the general population: the European Social Survey rotating module on the social determinants of health. European Sociological Review 2017(14)

Other is The Commission of Social Determinants of Health model, which includes first the structural determinants (i.e. social, economic and political context of a society,…); and includes governance, macroeconomic policies, social policies cultural and societal. These, act through intermediary factors (i.e. material circumstances, psychosocial circumstances, biological and behaviour factors, the health system itself,…), which are social determinants of health (19, 20) (Figure 2).

A recent review, argues that it is possible to group main determinants of health inequalities in five: early childhood environment, material living conditions (e.g. adequate working and employment conditions, good quality neighbourhood and housing conditions), social and psychological factors, health-related behaviors (e.g. smoking, alcohol consumption and lack of physical activity), and health care services (11).

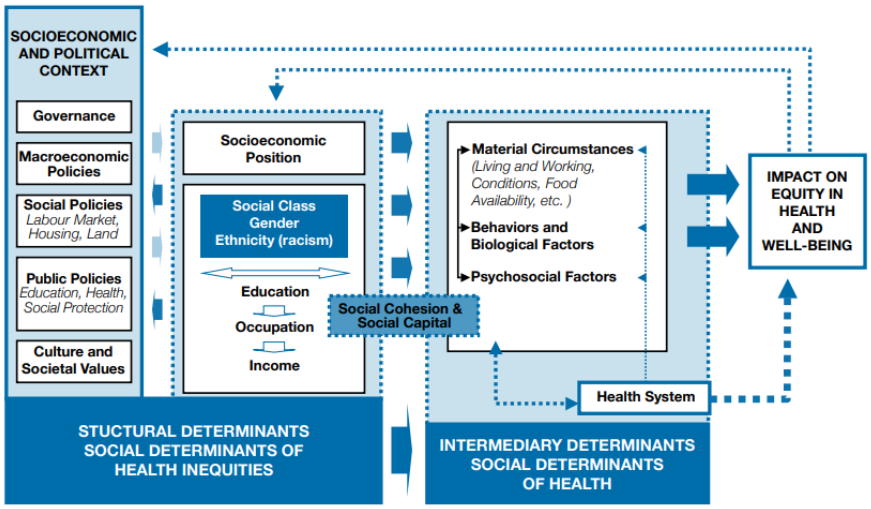


Figure 2: Model of social determinants of health.
Source: Solar O, Irwin A. A conceptual framework for action on the social determinants of health. 2010 (19).

In the Annex 1, we proposeus a diagram to explain main social determinants of CVD, functional limitations and disability.

1.2 Population Aging and Health Inequalities

Worldwide, the sustained increase in life expectancy has generated an increase in the proportion of older persons (Figures 3 and 4). According to WHO estimates, between 2000 and 2050, the aging of the population will be accelerated, and the proportion of people over 60 years will double, from 11% to 22% (21). By 2050, it is expected that all regions of the world, except Africa, will have nearly a quarter or more of their populations at ages 60 and above (22). This sustained increase in life expectancy presents important challenges. Economically, it will affect economic growth, savings, investment capacity, consumption, labor markets, pensions and taxation. Socially, it will affect the social assistance systems, the composition of families and their living conditions (23). In terms of Public Health, the use of health and protection systems will be increased, hospital stays will be longer and dependency and demand for health services will increase (including long-term care needs), especially for people aged 80 and over.(24)

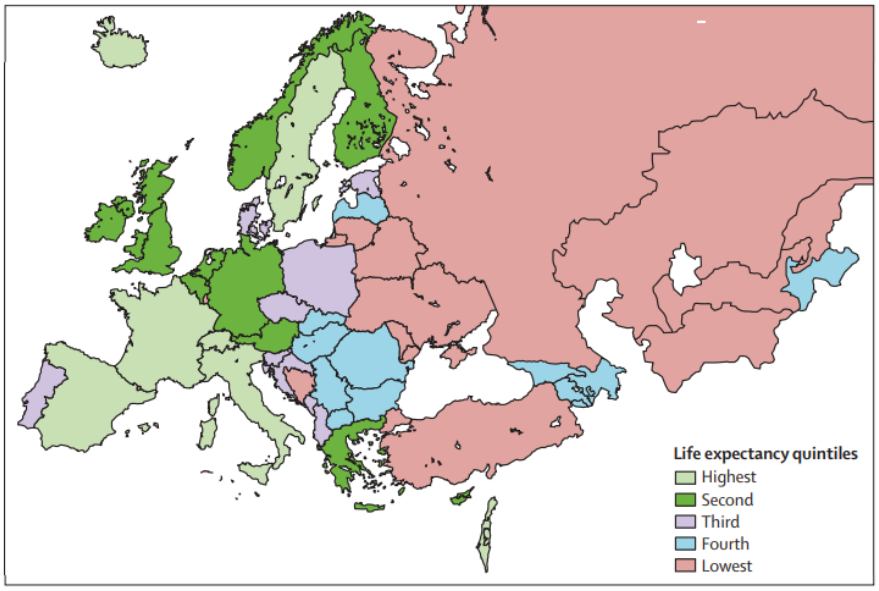


Figure 3: Life expectancy in countries in the WHO European region, 2010.
Source: Marmot M, et al. WHO European review of social determinants of health and the health divide (11).

Currenly, European countries have the greatest percentage of population aged 60 or over (25%). In these countries, 25% of the population is already aged 60 years or over, and it is estimated, that this proportion will reach 35% by 2050 and 36% by 2100 (22). (Figure 4).

Spain has one of the higest expectancy at birth in Europe and in world (Figure 5). Currently, life expenctancy at birth in Spain is 80.3 years for men and 85.8 for women, and the proportion of the population aged 65 years and over excesses 8.7 million, and represents 19 % of the total population. Moreover, 6% of the population in Spain is aged 80 years or over. Spain is also one of the European countries with the largest differences between life expectancy and healthy life expectancy (25). Old Spanish women experience worse health and more years in disability than men.

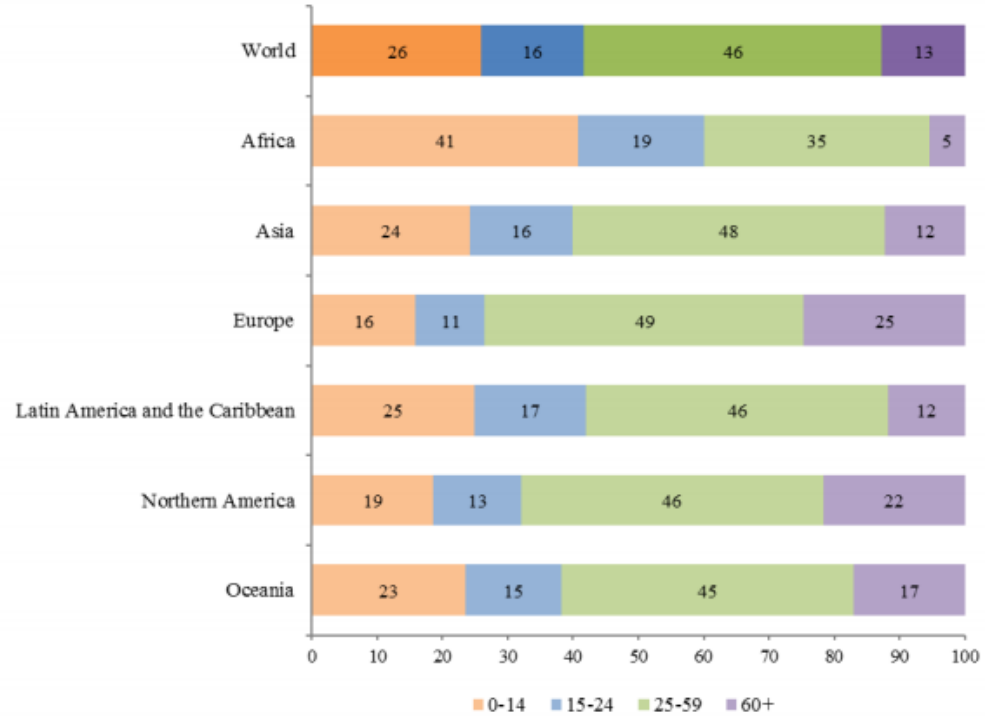
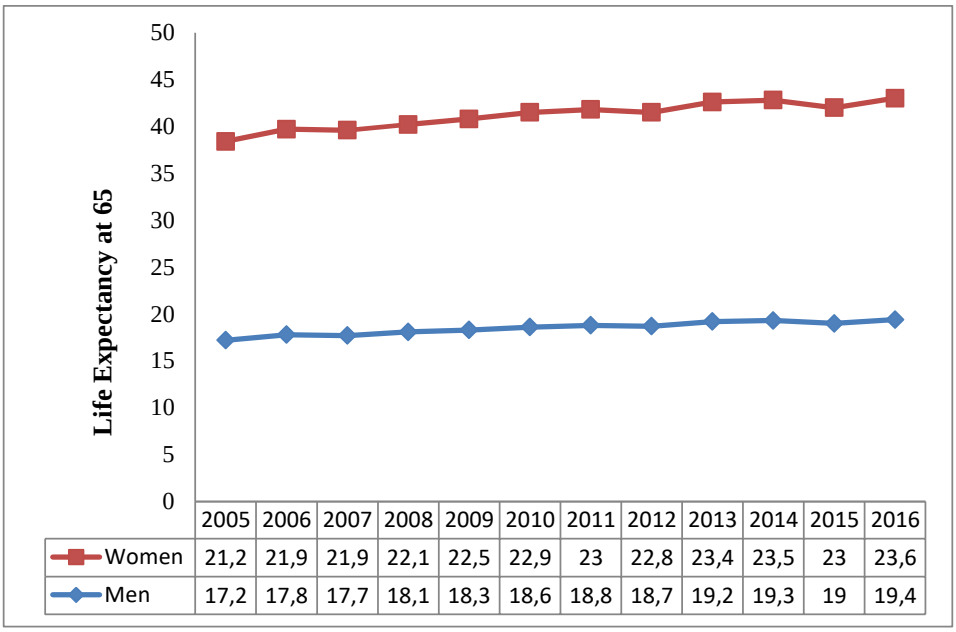


Figure 4: Percentage of the population in age groups for the world and by region, 2017.
Source: United Nations, Department of Economic and Social Affairs, Population Division (2017). World Population Prospects: The 2017 Revision. New York: United Nations. (22).



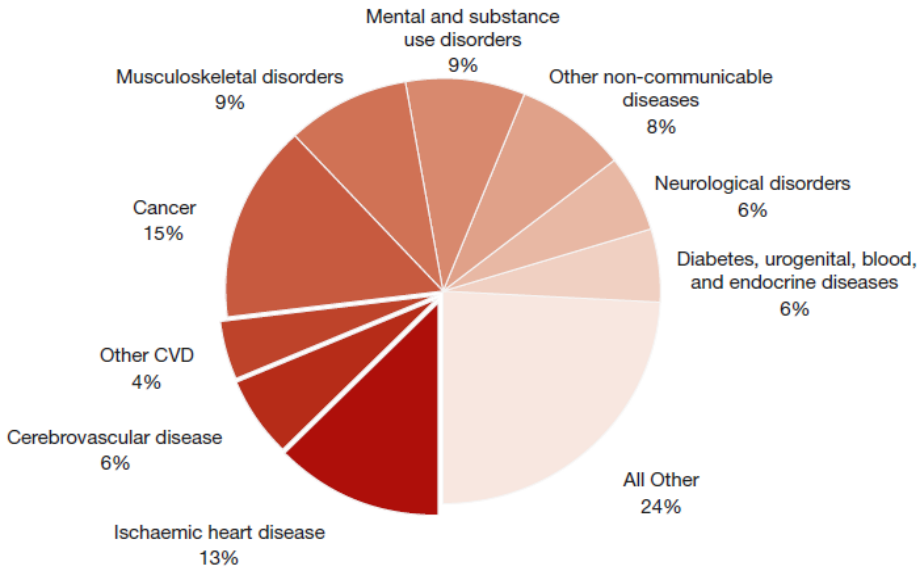
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Women	21,2	21,9	21,9	22,1	22,5	22,9	23	22,8	23,4	23,5	23	23,6
Men	17,2	17,8	17,7	18,1	18,3	18,6	18,8	18,7	19,2	19,3	19	19,4

Figure 5: Life expectancy at age 65, Spain, 2016.

Source: Own elaboration based on data from Life Expectancy. Eurostat (2016) (Data available online in http://ec.europa.eu/eurostat/statistics-explained/index.php?title=Mortality_and_life_expectancy_statistics#Publications; Access date: June 2018)

1.3 Inequalities in Cardiovascular Diseases

Although trends indicate that CVD mortality is decreasing in most European countries, it still remains as one of the leading cause of morbidity and premature death worldwide (Figure 6). In this sense, according to The European Heart Network (EHN) statistics, every year there are 11 million new diagnosis and 3.9 million deaths from CVD in Europe (26). In addition, CVD remains the main cause of disability-adjusted life years lost in Europe. Higher rates of CVD mortality and morbidity are reported in Central and Eastern European countries than in their Northern, Western and Southern European counterparts (26).



Source: Wilkins E. et al. European cardiovascular disease statistics 2017. (26)

Figure 6: Disability-adjusted life years lost by cause, 2015. Europe.

In Spain, CVD is the leading cause of disease burden. In 2015, 29% of all deaths are due to CVD; they represent the first cause of death among women (32%) while in men (26%). Among cardiovascular deaths, half are due to cerebrovascular diseases (23%) and ischemic heart diseases (27%)(26-28).

Despite that in Spain and the majority of European countries downward trends in some of the main CVD risk factors such as smoking, harmful consumption of alcohol, and levels of mean blood cholesterol have been reported, other CVRF, such as obesity and diabetes have increased considerably in recent decades, raising doubts that the observed reduction in CVD mortality will be maintained (26).

Most of the main CVRF (i.e. smoking, unhealthy diet, lack of physical activity, harmful use of alcohol, excess salt intake, high blood pressure, overweight and obesity) are preventable and are frequently associated with low socioeconomic position (29-31). In this sense, available evidence shows a strong inverse relation between SES and risk of morbidity and mortality by CVD (32-36), mainly attributed to differences in CVRF.

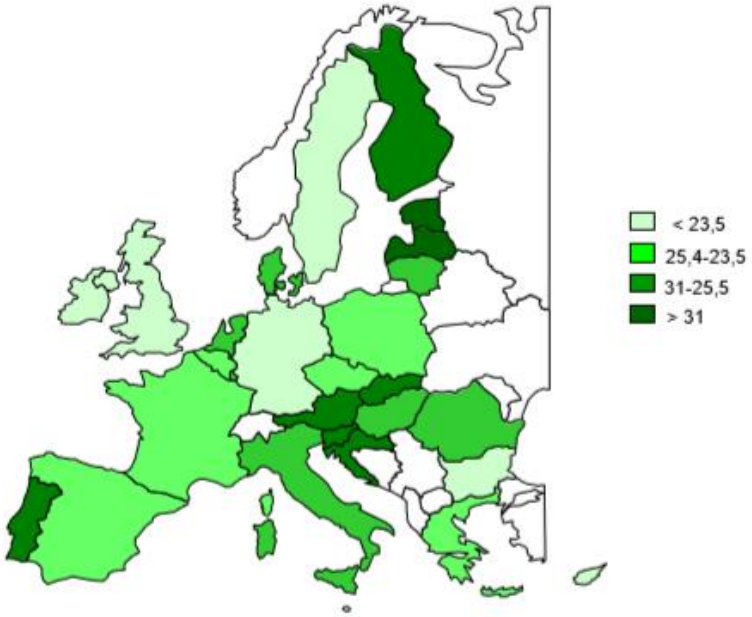
1.4 Inequalities in Functional Limitations, Frailty and Disability

Functional limitations occur when a person's capacity to carry out basic actions of daily life is compromised. When this compromise implies limitations on activities in a social contex, it is denominate disability (37). Evidence has shown that CVRF such as high body mass index, smoking, low level of physical activity and low socioeconomic conditions are predictors of functional status declive and disability (37-39).

According to the WHO, more than one billion people in the world (about 15% of the world´s population) live with some form of disability, of whom nearly 200 million experience considerable functional limitations (40). In the year 2015, around 37% of the population in the EU aged 15 and over reported (moderate or severe) physical or sensory limitation; 26,8% of this population reporting moderate funcional limitation and 10.1% reporting several. The proportion of women that reportedmoderate or severe physical and sensory limitation was higher than that of men in almost all EU countries. The percents of people who reported any physical or sensory limitations increased with age, especially among those aged 45 and over, whith the highest percent observed among persons aged 65 and over. In this group, around two thirds reported any type of physical or sensory limitation(41) . (Figure 7)

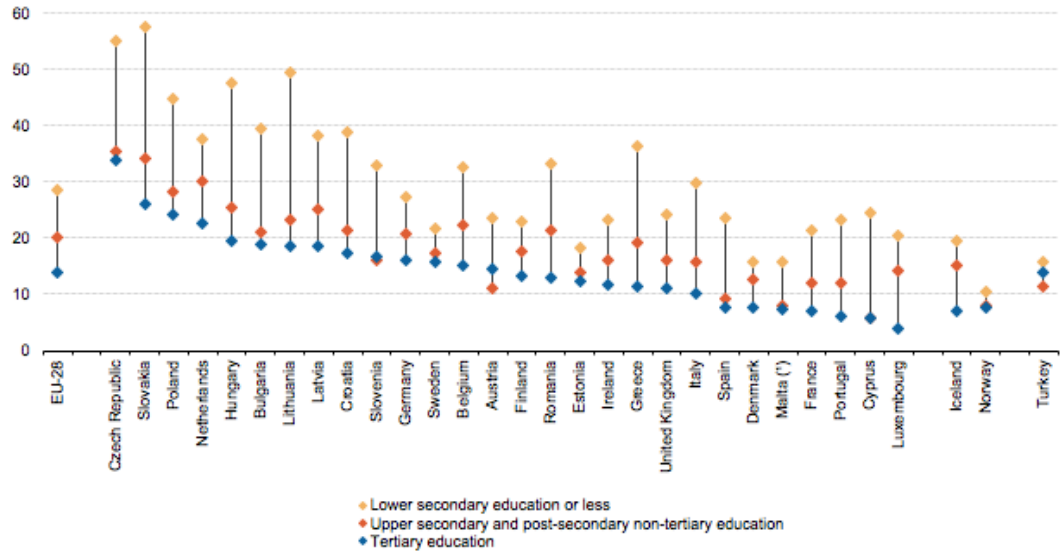
Additionally, about 24% of the population aged 65 and over reported moderate or severe difficulties in personal care activities, which included feeding, getting in and out of a bed or chair, dressing and undressing, using toilets, and bathing or showering. In addition, more than half reported moderate or severe limititations in household activities, which included using the telephone, shopping, managing medication, light housework, occasional heavy housework, taking care of finances and everyday administrative tasks. In this age group, limitations with respect to personal care or household activities were more prevalent among women and among those with low educational attainment (41). (Figure 8)

Frailty is an indicator of health status among older people (42). It has been defined as a biological syndrome consisting of a physiological declive of multiple systems, mainly the skeletal muscle and manifes with loss of homeostatic capacity to respond to stressor factors. It is a characteristic of the aging process, which makes older people more vulnerable. to falls, hospitalization, dependency and death (42-44). The prevalence rates of frailty reported in the literature vary widely (45). with recent studies showing prevalence rates of frailty that range from 4.9% to 27.3%, and prevalences of pre-frailty that range from 34.6% to 50.9% (46). It is expected that, as occurs with other functional limitations, frailty and pre-frailty prevalences will continue to increase as a result of the aging of the population. Fortunately, this syndrome can be reversible with the implementation of specific exercise programs and nutricional suplementation (47).



Source: Wilkins E. et al. European cardiovascular disease statistics 2017. (26)
Figure 7: Percentage of population aged 15 and over with activity limitation in the Europe Union. 2015

In the EU, one in six people has a disability, and 30% of people with a disability are at risk of poverty or social exclusion, compared to 21.5% of people without disabilities (40). The association between disability and SES is well documented. Several studies have shown a higher prevalence of disability among the poorly educated (48) and among persons with low economic resources (49). Furthermore, trend studies have revealed the persistence of social inequalities in disability in Europe (48, 50) and other countries, like the United States (51, 52) and China (53). However, studies of the determinants of social inequalities in disability are rare (50, 54).

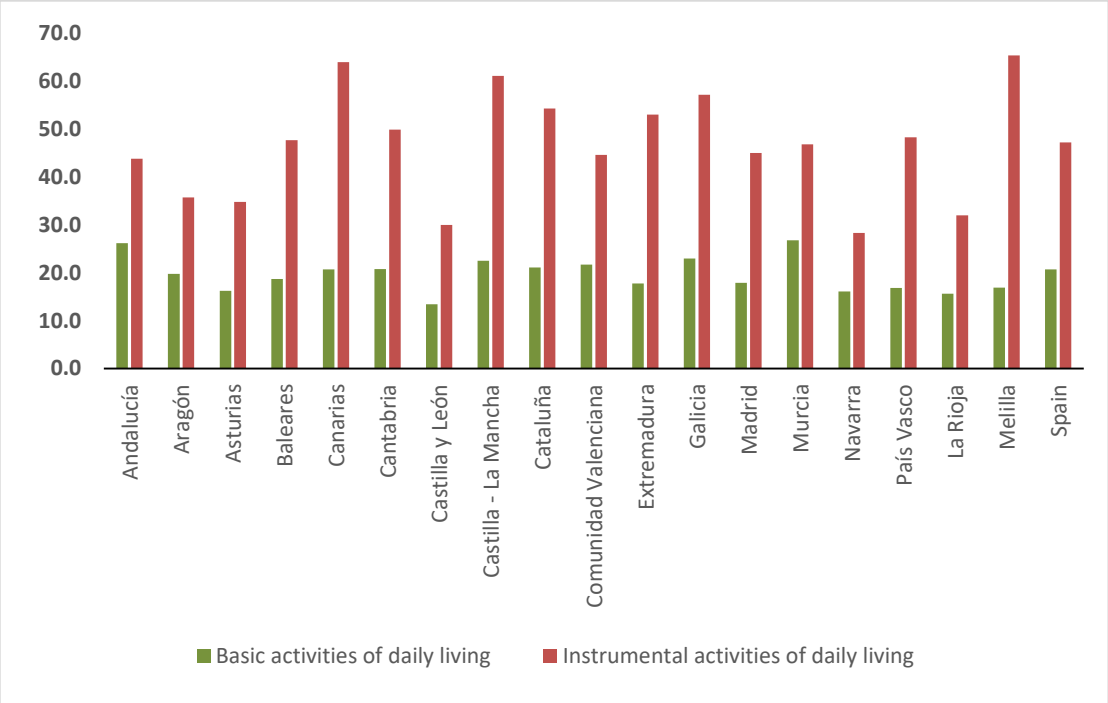


Source: Functional and activity limitations statistics. Eurostat. Statistics Explained. 2017(41)
Figure 8: Distribution of persons aged 65 and over with limitations to personal care activities, by level of education. Europe Union. 2014

In Spain in 2015, 24.8% of people aged 16 and over, reported to have any activity limitation. This prevalence of activity limitations was higher among women (28.8%) than among men (21.5%). Moreover, the greatest prevalence of activity limitations was observated in people aged 65 and over (66.7%); 20.7% of whom reported limitations in basic (personal care) activities and 47.2% in household activities (4, 41). These difficulties increase with age; in the population aged 85 and over, 53,7% reported have some degree of difficulty in performing some of the personal care activities of daily living and 82,6% in everyday household activities. Interestingly, Murcia, Galicia, the Canary Islands and Andalusia were the autonomous communities with the greatest frequency of limitations of activity(55), suggesting the importance of socioeconomic factors in the development of these limitations. (Figure 9)

Regarding frailty, it is estimated a prevalence of about 10% in the population over age 60 years, and 25% in those aged 80 years and over (45, 56). For instance, the Toledo Study for Healthy Aging (TSHA) 2011, reported a prevalence of this syndrome of 8.4% in the population aged 65 years and older (57). In line with this results, the Study on Nutrition and Cardiovascular Risk Factors in Spain (Seniors-ENRICA), reported a

prevalence about 8.3% among noninstitutionalized Spanish population aged 60 and over (58).



Source: National Statistics Institute (INE) and the Ministry of Health, Social Services and Equality.(55)
Figure 9: Limitation in basic and instrumental activities of daily living in population aged 65 and over. Percentage distribution by sex and autonomous community, Spain, 2014

1.4.1 Housing conditions and risk of functional impairments

Housing conditions are a reflection of the opportunities and socioeconomic circumstances that people have had throughout their lifetime, for this reason they are an important social determinant of health (59). Previous studies have shown that housing renovation can lead to health improvements, especially where changes are targeted at those with inadequate warmth or chronic respiratory disease (60). Despite this evidence, fuel poverty and cold housing are enduring problems, which frequency has increased during the recent economic crisis because of higher energy prices and lower household incomes. For instance, in England the number of fuel poor households increased dramatically between 2004 and 2010, from 1.2 to 4.6 million (61). In Spain in 2010, 10% of households were in fuel poverty, defined as spending a disproportionate share of its annual income (10%, twice the national average) on energy, or being unable to keep the home adequately warm in the winter (62). In addition, 14.5% of the households lacked any heating system (63).

Besides, in 2012 about 65% of the Spanish population lived in apartment buildings (41), and only about half of them had an elevator; specifically, 21% of the buildings of four or more stories lacked an elevator (4). This seriously limits home accessibility for people with reduced mobility, which is particularly frequent in the oldest segment of the population.

Studies focusing on the elderly (64) have shown that poor housing conditions are associated with higher risk of falls (65, 66), worse respiratory and mental health(67, 68), and higher risk of disease-specific and all-cause mortality(69). In addition, the fact that older people spend more time at home makes them especially vulnerable to poor housing conditions. Moreover, while housing conditions and functional impairment are strongly linked to SES(61, 70, 71), it is still uncertain if the association between housing conditions and physical function is independent of SES attained in early life (e.g. education) and in adult life (e.g. occupation). Studies to clarify the influence of housing conditions on functional status, are needed, specifically, those with a wide variety of physical function limitations, both self-reported and objectively measured, in older adults (64).

2. OBJECTIVES

2.1 Objectives

2.1.1 General Objective

The main aim of this thesis is to examine social determinants of cardiovascular disease, physical limitations and disability in older adults from the Spanish general population. Additionally, this thesis aims to describe the contribution of behavioral, work-related and living conditions to social inequalities in disability in Europe.

2.1.2 Specific objectives

- To examine the distribution of the main behavioral and biological cardiovascular risk factor according to socioeconomic status (NSE) among older adults in Spain.
- To evaluate the cross-sectional and prospective associations between housing conditions and physical function limitations in older adults in Spain
- To analyze the contribution of behavioral, work-related and living conditions to social inequalities in disability in Europe.

3. METHODS

3.1 The ENRICA Study

3.1.1 Study design

A cross-sectional survey of 11911 individuals representative of the non-institutionalized population age ≥ 18 years in Spain was conducted between 2008 and 2010 (ENRICA study) (28). Survey participants were selected by stratified cluster sampling according to province (the 50 provinces of Spain) and size of municipality (10 000; 10 000-100 000; 100 000-500 000; >500 000 population). Clusters were then selected randomly in two stages: municipalities and census sections. Finally, the households within each section were selected by random telephone dialing using the directory of telephone landlines as the sampling frame. Subjects in the households were selected proportionally to the distribution of the population of Spain by sex and age group (72).

Participants aged ≥ 60 years form ENRICA (n=2519; baseline wave or wave 1) were invited to participate in the Seniors-ENRICA, a follow-up study consisting in biannual phone interviews and home visits to obtain information on socio-demographic factors, lifestyle and morbidity, collect biological samples, perform a physical exam and obtain a diet history. All participants gave informed consent, and the Clinical Research Ethics Committee of the *La Paz* University Hospital in Madrid approved the study (73).

Baseline information was collected in 3 stages: *a)* A computer-assisted telephone interview on sociodemographic factors, health behaviors and morbidity; *b)* A first home visit to collect blood and urine samples; and *c)* A second home visit to perform a physical examination, collect information on drug treatments and assess diet (74). During follow-up (waves 2 (2012) and 3 (2015)), 177 participants died and 616 were lost to follow-up, so information in 2015 was obtained among 1821 individuals. Subjects lost to follow-up were older, had a lower educational level, and showed a higher prevalence of morbidities and functional limitations.

3.1.2 Study variables

Indicators of Socioeconomic Level

The participants reported their educational level, which was taken as the highest level reached (primary or below, secondary, or university). Occupation and father's

occupation corresponded to the last profession performed and was coded according to the National Classification of Occupations in Spain (75). Housewives were assigned the occupation of their spouse. For the analysis, occupations were grouped into manual and non-manual jobs.

Regarding housing conditions, participants reported whether they lived in a walk-up building, or in a house that lacked running hot water, heating, a bathtub or shower, an individual bedroom, a fridge, an automatic washing machine or a telephone, as well as whether they frequently felt cold at home. A score of 1 was assigned for the absence of each of these services or for feeling cold; and a scale ranging from 0 to 9 was constructed by summing the scores across the 9 items. This questionnaire has previously been shown to predict mortality among patients with heart failure (76). For some analyses individuals were classified into two categories: those with no poor conditions and those with ≥1 poor conditions.

Cardiovascular Risk Factors

For *behavioral CVRF,* information was collected on smoking (never smoker, ex-smoker, or current smoker) and alcohol consumption (never, no longer drinks alcohol, moderate consumption, or excessive consumption). The cutoff between excessive and moderate alcohol consumption was set at 40 g/day in men and 24 g/day in women. Information on diet was obtained using a validated dietary history (77). Adherence to the Mediterranean diet was assessed using MEDAS (Mediterranean Diet Adherence Screener) (78): this score ranges from 0-14, with a higher score indicating better adherence; a score ≥ 9 is considered good. Leisure time physical activity was measured in metabolic equivalent (MET-hours/week) using the questionnaire from the EPIC (European Prospective Investigation Into Cancer and Nutrition)-Spain study (28). Subject reported their participation in the following recreational activities: walking, cycling and practicing sports other than cycling (mainly running, playing soccer, doing aerobics, swimming and playing tennis); as well as in the following household activities: household chores (cleaning, cooking, doing laundry, children rearing). The assigned metabolic equivalent (MET) values (using the EPIC data manual guidelines) were 3.0 for walking and house-working and 6.0 for cycling and sports. Overall physical activity was measured with the Cambridge index, which categorizes each individual as inactive, moderately inactive, moderately active, or active (28).

Additionally, physical activity was also expressed as a continuous variable in metabolic equivalent-hours/day. Lastly, sedentary lifestyle was estimated using the number of hours per week spent watching television, obtained using the questionnaire from the Nurse's Health Study validated for Spain (28).

For *biological CVRF*, weight, height, and waist circumference were measured with standardized procedures. Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared and general obesity was defined as a BMI ≥ 30 kg/m^2. Abdominal obesity was defined as a waist circumference ≥ 102 cm in men and ≥ 88 cm in women (79).

Blood pressure was measured under standardized conditions with validated automatic sphygmomanometers (28), and hypertension was defined as a systolic/diastolic blood pressure of ≥140/90 mmHg or receiving antihypertensive treatment. Laboratory analysis was performed on serum samples taken after 12 hours of fasting, in a central laboratory. Lipids were measured using enzymatic techniques. Hypercholesterolemia was defined as total cholesterol ≥ 200 mg/dL or receiving pharmacological treatment. Blood glucose levels were measured using the glucose oxidase technique, and diabetes mellitus was defined as a blood glucose level ≥ 126 mg/dL or receiving treatment with oral antidiabetics or insulin.

In line with the new harmonized definition, metabolic syndrome was defined as meeting at least 3 of the following 5 criteria: abdominal obesity, blood glucose ≥ 100 mg/dL or receiving oral antidiabetics or insulin, systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg or receiving antihypertensive drugs, triglycerides ≥ 150 mg/dL, and high-density lipoprotein cholesterol < 40 mg/dL in men or < 50 mg/dL in women (28).

Lastly, the study participants reported whether their doctor had diagnosed CVD, defined as ischemic heart disease, stroke, or heart failure. For each individual with no history of CVD, the 10-year risk of fatal CVD was estimated using the SCORE (Systematic Coronary Risk Evaluation) equation (80); this equation estimates the risk of CVD based on age, sex, smoking, systolic blood pressure, and total cholesterol. Because risk estimated using SCORE is very sensitive to the effect of age, the risk calculation was adjusted for age assuming all subjects to be 60 years old.

Limitations in physical functioning

We considered a variety of function impairments, from less severe problems -such as poor lower extremity performance or agility limitations-, to more serious conditions -such as frailty and disability in IADL. All these functional impairments have shown to predict adverse outcomes in older adults, including falls, hospitalization, nursing home admission, or death (43, 81, 82).

Performance of the lower extremities: It was objectively measured with the Short Physical Performance Battery (SPPB), which includes three components: balance testing, a three meter walking speed test, and a sit-to-stand test(83). Each component was scored on a 0-4 scale and the total SPPB was calculated by the sum of the three components (range 0-12). A higher score in each test and across them indicates better performance. Balance testing included a side-by-side, a semi-tandem and a tandem stand. Participants were first asked to stand with their feet together. Those who were able to stand for 10 seconds in this position were tested in the semi-tandem stand position, where the heel of one foot is placed to the side of the big toe of the other foot. Those who were able to stand for 10 seconds in the semi-tandem position were then tested in the full tandem stand, where the heel of one foot is placed in front of the toes of the other foot. A score of 0 in the balancing testing indicates inability to stand in any of the positions, while a score of 4 indicates a full tandem stand for 10 seconds. Participants were also asked to walk 3 meters, and their gait speed was calculated as the distance in meters divided by the time in seconds. In this test, 0 points indicated inability to perform the walk, and 4 indicated being in the lowest quartile of the sample-specific walking speed, adjusted for sex and height. Finally, participants were asked to stand up from a chair and sit down again five times repeatedly, without leaning on anything, as quickly as possible. A score of zero was given if a participant was unable to perform five chair stands, while a score of 1, 2, 3, or 4 was assigned to a participant who completed five chair stands in ≥16.7, 13.7-16.6, 11.2-13.6, and ≤11.1 seconds, respectively.

Agility limitations: An affirmative answer to the question "Do you experience any difficulty in bending or kneeling?"

Frailty: According to the definition proposed by Fried et al.(75), we assessed the following criteria: 1) Exhaustion: any of the following responses to two questions taken from the Center for Epidemiologic Studies Depression Scale: "I felt that everything I did was a big effort" or "I felt that I could not keep on doing things" at least 3-4 days a week; 2) *Weight loss*: unintentional loss of ≥4.5 kg of body weight in the preceding year; 3) Low physical activity: walking ≤2.5 h/week in men and ≤2 h/week in women 4) Weakness: the lowest quintile in the study sample of grip strength, measured with a Jamar dynamometer and adjusted for sex and body mass index (BMI), with the highest value in two consecutive measures used in the analyses; and 5) Slow walking speed: the lowest quintile in the study sample for the three meter walking speed test, adjusted for sex and height. Frailty was defined as having ≥3 of the above criteria and pre-frailty as having 1 or 2 of them.

Disability in IADL: It was assessed with the Lawton and Brody Scale(77). This scale evaluates the individual´s ability to use the telephone, go shopping, prepare meals, do housework, do laundry, use different means of transportation, take medication, and manage finances. Due to cultural issues, the questions on meal preparation, housework and laundry were excluded in men; thus summary scores ranged from 0 (no disability) to 5 in men, and from 0 to 8 in women. The presence of limitation in at least one IADL (score ≥1) was considered as a disability.

3.1.3 Study population

Article 1

For this article, we excluded baseline participants aged ≥60 years who did not provide information on their educational level (n = 8) or profession (n = 294), as well as those with no information on their father's education (n = 166) or profession (n = 8). We also excluded participants with missing data on CVR (i.e., BMI (n = 173), alcohol consumption (n = 49), blood lipids (n = 76), blood pressure (n = 22), dietary quality (n = 12), and sedentary lifestyle (n = 11)). Thus, the analyses were conducted with 2699 individuals. Compared with the excluded participants, included participants were younger, more frequently men, more active, and had a higher frequency of metabolic syndrome and of non-manual father's occupation.

Article 2

From the initial 2519 participants, we excluded 434 individuals with no information on frailty and 73 individuals with missing data on potential confounders, leading to a final analytical sample of 2012 individuals.

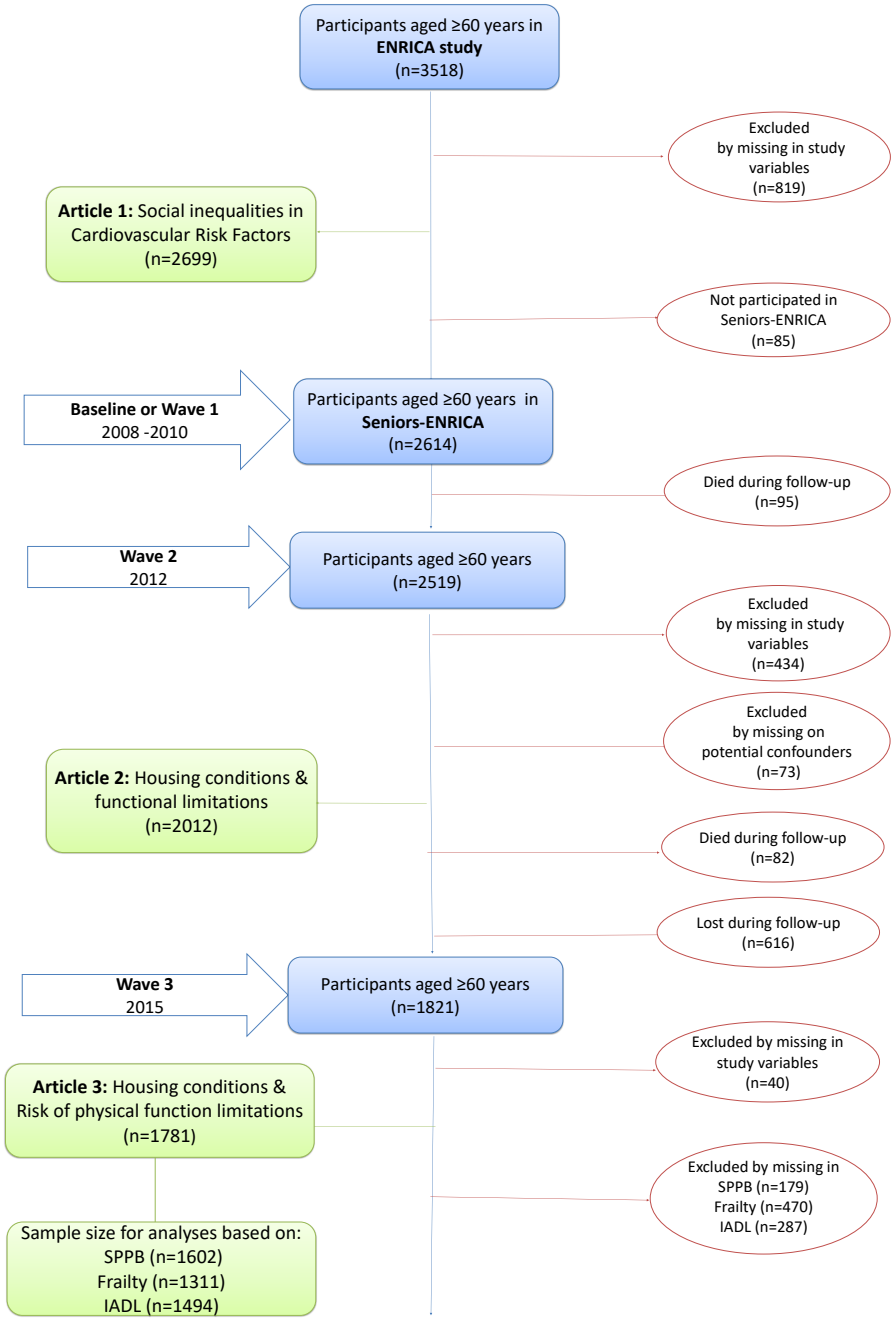


Figure 10: Flow of participants in the ENRICA Study

Article 3

From the initial 2519 participants, during follow-up (waves 2(2012) and 3 (2015)), 177 died and 616 were lost to follow-up. Thus, in 2015 there were 1821 participants available to study. From these participants, 40 subjects were excluded by lacked information in housing conditions or potential confounders. Additionally, for analyses based on the SPPB score were excluded 179 by lacked information on study variables. Similarly, for analyses based on frailty and instrumental activities of daily living (IADL) disability, were excluded those who lacked information in study variables (510 and 327 respectively), so that analyses were performed with 1311 and 1494 participants, respectively (See figure 10).

3.1.4 Statistical analyses

Statistical significance was set at two-sided $p < 0.05$. Analyses were performed using STATA (version 13.0, College Station, TX: Stata Corp LP). To reflect the structure of the Spanish population and account for random errors derived from the complex sample design, analyses were performed with the STATA survey procedure.

Article 1

The prevalence of CVRF and of CVD was estimated according to indicators of SEL, for the total sample and for each sex. The associations of educational level, occupation, and father's occupation with CVRF and CVD were summarized with odds ratio (OR) and 95% confidence interval (95%CI) obtained using logistic regression. When the dependent variables had several categories (e.g. smoking and alcohol consumption or overall physical activity) polytomous logistic regression was used. To study the association between indicators of SEL and mean CVRF values (e.g. leisure time physical activity, hours of television) or the risk of CVD, linear regression was used, and the results are expressed as the regression coefficient and 95%CI. All models were adjusted for age, except those with risk of fatal CVD (SCORE) as a dependent variable. Analyses of the total sample were also adjusted for sex. Lastly, we examined if the associations were different for men and women, testing the statistical significance of interaction terms defined by the product of the variables of interest by sex.

Article 2

The association between housing conditions and the SPPB score was assessed with linear regression, while the association with the rest of limitations in physical function was evaluated using logistic regression, Housing conditions were classified into three categories: no poor conditions (reference), 1 poor condition, and ≥2 poor conditions, based on whether the individual lived in a walk-up building, in a household with no heating or in a household where he/she felt cold frequently; the rest of poor conditions were excluded from the analysis because only 10 individuals reported to have at least one of them.

Several regression models were built. Model 1 adjusted for age, sex, tobacco and alcohol consumption, physical activity, sedentary behavior, energy intake, MEDAS score, BMI, morbidity (cancer, diabetes, cardiovascular disease, osteomuscular disease, respiratory disease) and number of drug treatments. Both physical activity and sedentary behavior were included in the models because there is evidence that sedentary behaviors are associated with functional limitations in older adults independently of physical activity (84-87). Models 2 and 3 further adjusted for education or occupation, respectively, while model 4 adjusted for both educational and occupational level. Of note is that education does not change much during adult life while occupation usually changes as individuals grow older; therefore, these two variables may represent socioeconomic status during different periods of life.

We tested whether the study association varied with sex, by using interaction terms defined as the product of the housing conditions by sex. Statistical significance was assessed with likelihood ratio tests, which compared models with interaction terms and without.

Article 3

Linear regression was used to assess the prospective association between housing conditions and the SPPB score, while logistic regression was used to assess the association between housing conditions and risk of frailty and its components, or risk of IADL disability. We fitted two regression models. Model 1 adjusted for age, sex and educational level; and model 2 further adjusted for smoking status (never, ex-smoker, current-smoker), physical activity (MET-h/week), sedentary behavior (hours watching

television/week), BMI (<25, 25-29.9, ≥30 kg/m^2), and morbidity (cancer, diabetes, cardiovascular disease, osteomuscular disease, chronic respiratory disease). Models based on the SPPB score further adjusted for its baseline value. As a sensitivity analyses, we compared the main baseline characteristics of study participants according to follow-up status (followed vs. lost-to follow-up or dead) in supplementary table 1. In addition, we evaluated the risk of presenting an SPPB score over 9 and analyzed the IADL scale as a continuous variable.

3.2 European Social-Survey

3.2.1 Study design

The European Social Survey (ESS) is a biennial, academically driven, cross-sectional, pan-European social survey that explains the attitudes, beliefs and behavior patterns between European countries. The questionnaire for each round consists of two main elements: a core module of substantive and socio-demographic items (around 100 items/questions in all); and two rotating modules, each including up to 30 items. These modules are administered together, and the questionnaire takes 1 hour to answer in British English. These questionnaires are administered through face-to-face interviews at the respondent's place of residence. The EES are freely accessible over the Internet and has already completed seven rounds since 2002, which have covered over 30 nations.(88, 89) The 7th round of the European Social Survey (ESS) (2014) includes a rotating module that provides a complete and comparative pan-European data set on the social determinants of health and health inequalities. These includes representative samples of non-institutionalized populations aged 15 years and older living in Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Lithuania, the Netherlands, Norway, Poland, Portugal, Slovenia, Spain, Sweden, Switzerland and the UK. More information on the ESS survey can be found in Eikemo et al.(89), and Fitzgerald and Jowell et al. (88).

3.2.2 Study variables

Disability was measured with the Global Activity Limitation Indicator (GALI) (90, 91) using the question: "Are you hampered in your daily activities in any way by any longstanding illness, disability, infirmity or mental health problem?" The participants

had three possible answers: (1) yes, a lot, (2) yes, to some extent, or (3) no. For the analysis, we dichotomized the variable in (1) yes, a lot, or yes to some extent vs. (2) no.

We used the respondent's education as a measure for socio-economic position. The answer to the question: "What is the highest level of education you have successfully completed?" was harmonized based on the International Standard Classification of Education (ISCED)(92), and for the analyses we grouped it into three categories: low educated (ISCED I and II), medium educated (ISCED IIIa, IIIb and IV) and highly educated (ISCED V and VI).

Behavioral risk factors included smoking, frequency of alcohol consumption, and frequency of physical activity, consumption of fruit and vegetables and BMI. Smoking status was assessed as I smoke daily', 'I smoke but not every day', 'I do not smoke now but I used to', 'I have only smoked a few times', 'I have never smoked' and for the analyses it was categorized as: current regular (daily and occasional smoker (I have only smoked a few times or I smoke but not every day)), ex-smoker (I don't smoke now but I used to). For alcohol consumption, participants were asked the question: "in the last 12 months, how often have you had a drink containing alcohol?"; we categorized the answers as: never, less than once a month, once a month, once a week, daily or almost daily. Frequency of physical activity was measured by the question "on how many of the last 7 days you walked quickly, did sports and/or other physical activity for 30 minutes or longer?" and we categorized it as follows: daily, 4-6 times a week, 2-3 times a week, once a week, and never (0 times a week). Fruit and vegetable consumption was assessed separately by two questions: "how often do you eat vegetables or salad, excluding potatoes?" and "how often do you eat fruit, excluding drinking juice?" The answers for both were: three times or more a day, twice a day, once a day, less than once a day but at least 4 times a week, less than 4 times a week but at least once a week, less than once a week, never. For these analyses both questions were combined into consumption of vegetables and fruit at least once a day. The BMI was classified as underweight (10 to 18.5 kg/m^2), normal (18.5 to 24.9 kg/m^2), overweight (25 to 29.9 kg/m^2) and obese (30 to 70 kg/m^2)(89).

Living conditions included housing conditions, financial difficulty and household conflicts during childhood, current financial strain and lack of a social network. Housing conditions were assessed by asking the participants if they had any of a list of

poor housing conditions in their current residence: mould or rot in windows/doors or floors, damp walls or leaking roof, lack of an indoor flushing toilet, lack of a bathtub and shower, overcrowding, and extremely hot or extremely cold conditions. In our study, answers were grouped into two categories: presence of one or more poor housing conditions or not (89).

Financial difficulty and household conflict during childhood were assessed by two questions: "how often was there a serious conflict between the people living in your household when you were growing up?" and "how often you and your family experienced severe financial difficulties when you were growing up?" Both had the same response options: always, often, sometimes, hardly ever and never. For the analysis it was dichotomized in almost never (never, hardly ever) and frequently (sometimes, often and always). Current financial strain was assessed by asking about current household income, and the response categories were: living comfortably on present income, coping on present income, difficult on present income, very difficult on present income. For the analysis, the answers were dichotomized into presence or absence of financial strain. The robustness of the respondent's social networks was assessed by the frequency of social contact and answers were grouped into two categories: more than once a week and less than once a week (89).

The questionnaire also included physical work-related risk factors such as environmental and chemical hazards and psychosocial conditions. Environmental, chemical and ergonomic hazards were assessed by asking whether participants were ever exposed to a list of hazards. For the analyses, answers were grouped into 3 categories: exposure to no hazards, one hazard, or two or more hazards. Finally, psychosocial working conditions were evaluated by job control which refers to the capacity to influence activities of the work organisation, and answers were grouped into low, moderate and high control (89).

3.2.3 Study population

We selected participants aged 30 to 79 years (n=28,887) and excluded data from Portugal (n=990) because after stratification by sex and education, the sample was very small in size. We also excluded subjects without information on sex (n=15), presence of disability (n=57) and level of education (n=160). Additionally, for analyses based on

behavioural, occupational and living circumstances factors we excluded subjects with missing values in any of these variables, smoking (n=38), alcohol (n=5977), frequency of physical activity (n=337), consumption of fruit and vegetables (n=48) and body mass index (n=868), job control(n=1214), childhood financial difficulties (n=472), household conflicts in childhood (n=357), poor housing conditions (n=170), financial strain (n=132) and frequency of social meetings (n=101). The percentage of subjects with complete information in all study variables was 72% (n=19882).

3.2.4 Statistical analyses

For the descriptive analyses, we calculated percentages for every group of determinants by country with unweighted data, except for the total. The prevalence of disability by educational level and country was standardized by direct method using the European Standard Population (ESP). We calculated the simple prevalence difference between high and low educated groups. The frequency of disability was estimated, as well as their corresponding 95% confidence intervals, in subgroups defined by social determinants adjusted by age and stratified by gender. We used multivariate logistic regression to determine the contributions of social determinants to educational inequalities in disability, controlling for age and stratified by gender. Social determinants were grouped into three groups of determinants: behavioral factors, living conditions and work-related conditions. Within every group of determinants each determinant was first evaluated separately and then each group in combination with all other determinants in the group (simultaneous). Next, we examined pairs of groups and all factors simultaneously. To assess the contribution of each group of determinants to educational inequalities in disability, we calculated the percentage of reduction in odds Ratio (OR), in the model with the determinant (model k) compared with the reference model which was adjusted for age only (model 0). The percentage reduction in OR was calculated using the formula (OR model 0 – OR model k) / (OR model 0 - 1) and their 95% confidence intervals were obtained by bootstrapping (1000 bootstrap samples). All analyses and estimations were obtained by using weighted data. We used Post-stratification weights (Pspwght) reported in the European Social Survey 7 (2014), those allows adjusted for differences introduced by the sampling design among countries and reduce sampling error and potential non-response bias (93). All analyses were done for men and women separately and conducted using STATA v14.

4. RESULTS

4.1 Results article 1: Social inequalities in cardiovascular risk factors among older adults in Spain: the Seniors-ENRICA study

At baseline, the mean age of the study participants was 68.7 years, and 53% were female. Regarding indicators of SEL, 18.8% had university-level education, 62.4% had a non-manual occupation, and 61.3% of the participants' fathers had a non-manual occupation. At least 60% of the participants had abdominal obesity, hypertension, or hypercholesterolemia. In addition, 41.2% had metabolic syndrome, 17.4% had diabetes, and over 5% had a diagnosis of CVD (please see table 1). The characteristics of the participants, stratified by educational level, occupation, and paternal occupation can be seen in the supplementary material (please see Annex 2).

In comparison with men, women had a lower educational level and their occupations were more frequently manual. In addition, they consumed tobacco and alcohol more frequently, did less physical activity, and was more sedentary. Lastly, they had a higher prevalence of obesity, hypercholesterolemia, and metabolic syndrome, but a lower prevalence of diabetes and CVD risk (SCORE) (please see table 1).

Table 2 and Figure12 show the association between educational level and prevalence of CVRF. In the age- and sex-adjusted analyses, there was a higher frequency of ex-smokers and current smokers in the higher educational levels. In progressively higher educational levels, the frequency of moderate alcohol consumption and of physical activity (leisure time and overall) was higher, and the number of hours watching television was lower. There was also an inverse educational gradient for obesity, metabolic syndrome, diabetes, and CVD. However, there were no differences in CVD risk (SCORE) according to education level. In general, the associations observed in this study were greater in women than in men (*P*-interaction <0 .05) except for Mediterranean diet adherence, physical activity, sedentary lifestyle, hypercholesterolemia, and CVD. Compared with women with a primary level or below education, those with a university education had more favorable values for all risk factors except smoking, which was much more frequent in those with a university level education (Table 2). The educational gradient was especially strong for obesity, hypertension, metabolic syndrome, diabetes, and CVD, with university-educated women having these conditions at a frequency at least 40% lower than those with primary level or below education.

Table 1: Characteristics of the Seniors-ENRICA participants by sex, (2008-2010)

	Total (n=2699)	Men (n=1269)	Women (n=1430)	P Value
Age. median years (SD)	69.2(0.2)	68.7 (0.2)	69.5 (0.2)	<0.001
Education level, %				<0.001
Primary or less	58.0	47.4	67.3	
Secondary	23.2	27.1	19.8	
University	18.8	25.5	12.9	
Non-manual occupation, %	62.4	65.6	59.4	0.013
Non-manual father's occupation, %	61.3	62.3	60.5	0.446
Smoking, %				<0.001
Never-smoker	58.7	31.6	82.7	
Ex-smoker	29.8	50.1	11.9	
Current smoker	11.5	18.2	5.4	
Alcohol consumption, %				<0.001
Never-drinker	38.7	18.6	56.6	
Ex drinker	8.7	9.4	8.1	
Moderate consumption	44.5	59.7	31.0	
Excessive consumption	8.0	12.2	4.3	
Mediterranean diet[a], %	16.3	16.1	16.4	0.864
Leisure time physical activity, MET –hours/week, median (SD)	25.6 (0.7)	25.6 (0.7)	18.0 (0.4)	<0.001
Overall physical activity, %				<0.001
Inactive	45.6	51.3	40.5	
Moderately inactive	33.4	25.7	40.2	
Moderately active	15.3	14.5	15.9	
Active	5.8	8.5	3.4	
Television, hours/week	18.5 ± 0.3	17.5 ± 0.4	19.3 ± 0.4	
General obesity,%	34.4	32.4	36.2	0.098
Abdominal obesity,%	59.7	52.1	66.4	<0.001
Hypertension,%	67.7	69.7	66.0	0.090
Hypercholesterolemia,%	70.5	60.8	79.0	<0.001
Diabetes,%	17.4	19.7	15.3	0.015
Metabolic syndrome,%	41.2	39.9	42.4	0.317
Cardiovascular disease, %	5.7	5.9	5.5	0.734
Cardiovascular risk[b]	3.1 (0.06)	4.5(0.10)	1.8 (0.03)	<0.001

Unless otherwise indicated, data are expressed as mean ± standard deviation.
a MEDAS (Mediterranean Diet Adherence Screener) score ≥9.
b Risk of fatal cardiovascular disease, estimated using the SCORE equation for low-risk countries and assuming all subjects are 60 years old.

Table 2: Association between educational level and main cardiovascular risk factors in older adults in Spain, by Sex

	Total Educational level				Men Educational Level				Women Educational Level				
	≤Primary OR[a]	Secondary OR[a] (95% IC)	University OR[a] (95% CI)	P - trend	≤Primary OR[a]	Secondary OR[a] (95% CI)	University OR[a] (95% CI)	P - trend	≤Primary OR[a]	Secondary OR[a] (95% CI)	University OR[a] (95% CI)	P - trend	P-Interact.[b]
Smoking													
Ex-smoker	1.00	**2.07 (1.54;2.80)**	**2.60 (1.92;3.52)**	**<0.01**	1.00	1.47 (1.00;2.16)	**1.65 (1.15;2.35)**	**<0.01**	1.00	**3.36 (2.07;5.45)**	**5.28 (3.24;8.60)**	**<0.01**	
Current smoker	1.00	**2.17 (1.48;3.18)**	**2.53 (1.67;3.83)**	**<0.01**	1.00	1.58 (0.98;2.54)	1.52 (0.93;2.47)	0.06	1.00	**3.03 (1.54;5.97)**	**5.28 (2.66;10.49)**	**<0.01**	**<0.01**
Alcohol consumption													
Ex-drinker	1.00	1.06 (0.68;1.65)	0.74 (0.47;1.17)	0.31	1.00	0.92 (0.49;1.71)	0.75 (0.42;1.37)	0.32	1.00	0.98 (0.52;1.85)	0.47 (0.20;1.07)	0.13	
Moderate	1.00	**1.46 (1.11;1.91)**	**1.40 (1.06-1.87)**	**<0.01**	1.00	0.98 (0.62;1.54)	0. 91 (0.58;1.41)	0.67	1.00	**1.86 (1.32;2.61)**	**2.11 (1.48;3.01)**	**<0.01**	
Excessive	1.00	1.41 (0.90;2.20)	1.08 (0.67;1.75)	0.47	1.00	0.90 (0.48;1.69)	0.75 (0.41;1.36)	0.37	1.00	**2.10 (1.07;4.12)**	1.35 (0.49;3.68)	0.18	**<0.05**
Mediterranean Diet (MEDAS ≥ 9)	1.00	1.01 (0.75;1.36)	1.06 (0.78;1.45)	0.72	1.00	0.82 (0.53;1.26)	0.82 (0.54;1.26)	0.32	1.00	1.21 (0.81;1.81)	1.42 (0.91;2.22)	0.08	0.08
Leisure time physical activity. MET –h/week[c]	1.00	**2.32 (0.66;3.99)**	**5.44 (3.42;7.46)**	**<0.01**		1.73 (-0.99;4.45)	**5.40 (2.42;8.36)**	**<0.01**		**2.98 (1.03;4.94)**	**5.28 (2.68;7.88)**	**<0.01**	0.82
Television, hours/week[c]	1.00	**-1.87 (-3.04;-0.71)**	**-5.44 (-6.73;-4.16)**	**<0.01**		**-2.63 (-4.14;-1.11)**	**-6.50 (-8.04;-4.97)**	**<0.01**		-1.18 (-2.95;0.58)	**-4.19 (-6.44;-1.95)**	**<0.01**	0.37
General obesity	1.00	**0.58 (0.45;0.75)**	**0.43 (0.33;0.56)**	**<0.01**	1.00	0.84 (0.60;1.18)	**0.59 (0.43;0.82)**	**<0.01**	1.00	**0.40 (0.27;0.59)**	**0.28 (0.18;0.45)**	**<0.01**	**<0.01**
Abdominal obesity	1.00	**0.57 (0.45;0.73)**	**0.53 (0.42;0.68)**	**<0.01**	1.00	0.85 (0.62;1.18)	**0.70 (0.51;0.96)**	**<0.05**	1.00	**0.38 (0.27;0.54)**	**0.39 (0.27;0.55)**	**<0.01**	**<0.01**
Overall physical activity													
Moderately inactive	1.00	1.16 (0.90;1.51)	1,18 (0,90;1,56)	0.15	1.00	1.36 (0.93;2.00)	1.41 (0.97;2.05)	**<0.05**	1.00	1.04 (0.73;1.49)	1.00 (0.66;1.50)	0.94	
Moderately active	1.00	**1.48 (1.06;2.07)**	**1,80 (1,27;2,55)**	**<0.01**	1.00	1.48 (0.90;2.43)	1.63 (1.00;2.66)	**<0.05**	1.00	1.43 (0.92;2.22)	**1.95 (1.20;3.17)**	**<0.01**	
Active	1.00	1.49 (0.89;2.50)	**1,89 (1.13;3.14)**	**<0.05**	1.00	1.29 (0.69;2.39)	**2.13 (1.17;3.90)**	**<0.05**	1.00	2.10 (0.86;5.12)	1.01 (0.35;2.97)	0.39	0.32

	Total Educational level			P -trend	Men Educational Level			P -trend	Women Educational Level			P -trend	P-Interact.[b]
	≤Primary OR[a]	Secondary OR[a] (95% IC)	University OR[a] (95% CI)		≤Primary OR[a]	Secondary OR[a] (95% CI)	University OR[a] (95% CI)		≤Primary OR[a]	Secondary OR[a] (95% CI)	University OR[a] (95% CI)		
Hypertension	1.00	0.84 (0.67;1.05)	0.87 (0.68;1.11)	0.16	1.00	1.02 (0.74;1.41)	1.16 (0.83;1.62)	0.39	1.00	**0.73 (0.53;1.00)**	**0.60 (0.43;0.86)**	**<0.01**	**<0.01**
Hypercholesterolemia	1.00	0.88 (0.68;1.12)	0.91 (0.70;1.17)	0.35	1.00	0.82 (0.59;1.13)	0.87 (0.63;1.20)	0.32	1.00	0.97 (0.65;1.45)	0.95 (0.62;1.45)	0.80	0.92
Metabolic syndrome	1.00	**0.70 (0.55;0.89)**	**0.56 (0.43;0.72)**	**<0.01**	1.00	1.13 (0.83;1.56)	0.80 (0.57;1.12)	0.28	1.00	**0.43 (0.29;0.63)**	**0.37 (0.25;0.54)**	**<0.01**	**<0.01**
Diabetes mellitus	1.00	**0.72 (0.53;0.99)**	**0.68 (0.49;0.94)**	**<0.05**	1.00	1.10 (0.73;1.65)	1.00 (0.66;1.51)	0.95	1.00	**0.40 (0.23;0.69)**	**0.31 (0.16;0.63)**	**<0.01**	**<0.01**
Cardiovascular disease	1.00	**0.83 (0.52;1.33)**	**0.51 (0.29;0.90)**	**<0.05**	1.00	0.84 (0.43;1.64)	0.61 (0.30;1.25)	0.18	**1.00**	**0.84 (0.44;1.60)**	**0.35 (0.14;0.88)**	**<0.05**	0.64
Cardiovascular riskc	1.00	0.03 (-0.21;0.28)	0.11 (-0.20;0.43)	0.48	1.00	0.10 (-0.37;0.56)	0.22 (-0.32;0.76)	0.42	1.00	-0.02 (-0.18;0.14)	-0.02 (-0.17;0.14)	0.79	0. 70

CI: confidence interval; MEDAS, Mediterranean Diet Adherence Screener; OR, odds ratio.
Statistically significant results (P<0.05)
a Adjusted for age (also for sex in the total)
b by sex
c Linear regression coefficient (95% CI)

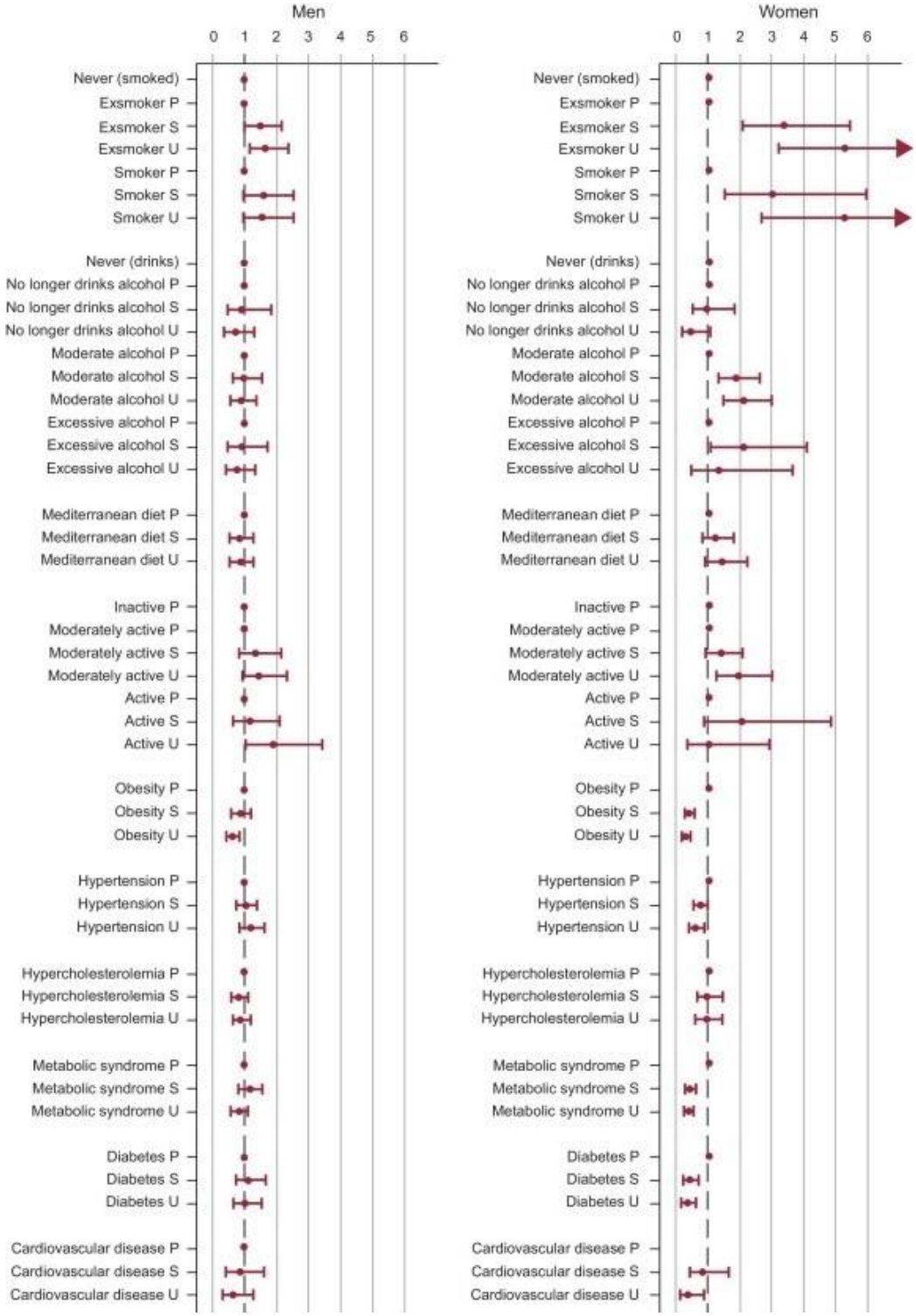


Figure 11: Odds ratio and 95% confidence interval of the association between educational level and the main cardiovascular risk factors in older adults in Spain. P. primary education, S. secondary education, U. university education.

Table 3 shows the results according to occupation type. Compared with manual workers, non-manual workers consumed alcohol more frequently, did more physical activity, and were less sedentary. In addition, non-manual workers had a lower frequency of obesity, hypertension, metabolic syndrome, and diabetes. There were some differences between the sexes regarding the association between occupation and CVRF prevalence. Among non-manual workers, men had a lower frequency of current smokers, but women had a higher percentage of ex-smokers and current smokers (*P*-interaction < 0.01). As with educational differences, the occupational differences for various CVRF were greater in women than in men, in particular for obesity, hypertension, and metabolic syndrome (*P*-interaction < 0.05 in all cases). In women, the relative difference in the prevalence of these factors between manual and non-manual occupations was greater than 30%.

To examine if the association between occupation and prevalence of CVRF was independent of educational level (usually reached before occupation), the analysis was repeated with additional adjustment for education. Most of the associations showed a reduced magnitude; however, in the total sample, there remained a statistically significant association between non-manual occupation and being a current smoker (OR = 0.66; 95% CI; 0.46 to 0.95), being a moderate drinker (OR = 1.27; 95%CI: 1.00 to 1.63), and having a moderate physical activity level (OR = 1.65; 95% CI; 1.21 to 2.25).

The results according to father's occupation showed the same direction as for own occupation, but the magnitude of the associations and the differences between sexes were smaller (Table 4). That did not preclude the finding that women whose fathers had a non-manual occupation were more frequently ex-smokers, consumed more alcohol, did more physical activity, and had a lower prevalence of obesity, hypertension, metabolic syndrome, and CVD than those whose fathers had a manual occupation. The relative difference in the prevalence of these cardio metabolic disorders between these 2 social categories was generally 30% or more.

Table 3: Association between occupation and main cardiovascular risk factors in older adults Spain by sex

	Total		Men		Women		P-Interact[b]
	Manual occupation OR[a]	No-manual occupation OR[a] (95% CI)	Manual occupation OR[a]	No-manual occupation OR[a] (95% CI)	Manual occupation OR[a]	No-manual occupation OR[a] (95% CI)	
Smoking							
Never-smoker	1.00						
Ex-smoker	1.00	**1.34 (1.06;1.68)**	1.00	0.94 (0.70;1.27)	1.00	**2.13 (1.36;3.31)**	**<0.01**
Current smoker	1.00	1.03 (0.75;1.42)	1.00	**0.66 (0.44;0.99)**	1.00	**2.08 (1.16;3.74)**	
Alcohol							
Never-drinker	1.00						
Ex-drinkers	1.00	0.73 (0.51;1.05)	1.00	0.70 (0.41;1.21)	1.00	0.71 (0.43;1.17)	0.43
Moderate	1.00	**1.40 (1.12;1.75)**	1.00	1.26 (0.87;1.82)	1.00	**1.46 (1.10;1.95)**	
Excessive	1.00	1.30 (0.98;2.08)	1.00	1.11 (0.66;1.87)	1.00	**2.21 (1.16;4.21)**	
Mediterranean Diet (MEDAS ≥ 9)	1.00	1.00 (0.79;1.28)	1.00	0.77 (0.54;1.10)	1.00	1.27 (0.92;1.75)	**<0.05**
Leisure time physical activity. MET –h/week[c]		1.21 (-0.20;2.62)		0.88 (-1.72;3.48)		1.51 (0.08;2.95)	0.70
Television, hours/week[c]		**-2.18 (-3.18; -1.19)**		**-2.60 (-4.05;-1.14)**		**-1.81 (-3.15;-0.46)**	0.47
General obesity	1.00	**0.66 (0.54;0.80)**	1.00	0.77 (0.58;1.01)	1.00	**0.58 (0.45;0.76)****	0.15
Abdominal obesity	1.00	**0.72 (0.59;0.87)**	1.00	0.86 (0.65;1.13)	1.00	**0.60 (0.46;0.79)****	0.07
Overall physical							
Inactive	1.00		1.00		1.00		
Moderately inactive	1.00	1.10 (0.89;1.35)	1.00	1.26 (0.90;1.76)	1.00	0.98 (0.75;1.28)	0.51
Moderately active	1.00	**1.87 (1.40;2.49)**	1.00	**2.24 (1.41;3.56)**	1.00	**1.60 (1.11;2.32)**	
Active	1.00	1.00 (0.65;1.54)	1.00	1.15 (0.67;2.00)	1.00	0.80 (0.39;1.64)	
Television, hours/week[c]		**-2.18 (-3.18; -1.19)**		**-2.60 (-4.05;-1.14)**		**-1.81 (-3.15;-0.46)**	0.47
General obesity	1.00	**0.66 (0.54;0.80)**	1.00	0.77 (0.58;1.01)	1.00	**0.58 (0.45;0.76)****	0.15
Abdominal obesity	1.00	**0.72 (0.59;0.87)**	1.00	0.86 (0.65;1.13)	1.00	**0.60 (0.46;0.79)****	0.07
Hypertension	1.00	0.82 (0.68;1.00)	1.00	1.07 (0.81;1.42)	1.00	**0.67 (0.51;0.87)****	**<0.05**
Hypercolesterol.	1.00	0.99 (0.80;1.21)	1.00	0.87 (0.66;1.15)	1.00	1.15 (0.84;1.56)	0.21
Metabolic syndrome	1.00	**0.79 (0.65;0.95)**	1.00	0.92 (0.70;1.22)	1.00	**0.69 (0.54;0.89)***	0.13
Diabetes mellitus	1.00	**0.60 (0.47;0.77)**	1.00	**0.72 (0.51;1.03)**	1.00	**0.50 (0.34;0.72)****	0.15
Cardiovascular disease	1.00	0.76 (0.52;1.12)	1.00	0.94 (0.52;1.70)	1.00	0.63 (0.38;1.05)	0.31
Cardiovascular risk[c]	1.00	-0.15 (-0.37;0.07)	1.00	-0.38 (-0.84;0.08)	1.00	0.05 (-0.07;0.16)	0.08

CI95%: Confidence Interval 95%; MEDAS: Mediterranean Diet Adherence Screener; OR: Odds ratio.
Statistically significant results (P<0.05)
a Adjusted for age (also for sex in the total); b by sex; c Linear regression coefficient (95% CI)

Table 4: Association between father´s occupation and main cardiovascular risk factors in older adults in Spain, by sex

	Total		Men		Women		P-Interacti[b]
	Manual Occup. OR[a]	No-manual Occup. OR[a] (95% CI)	Manual Occup. OR[a]	No-manual Occup. OR[a] (95% CI)	Manual Occup. OR[a]	No-manual Occup. OR[a] (95% CI)	
Smoking							
Never-smoker	1.00						
Ex-smoker	1.00	1.19 (0.95; 1.49)	1.00	0.91 (0.68 ; 1.21)	1.00	**1.65 (1.08 ;2.51)**	**<0.05**
Current smoker	1.00	0.98 (0.71; 1.36)	1.00	0.69 (0.46 ; 1.04)	1.00	1.68 (0.92 ;3.08)	
Alcohol consumption							
Never-drinker	1.00						
Ex-drinker	1.00	**0.68 (0.48 ; 0.96)**	1.00	**0.48 (0.28 ; 0.82)**	1.00	0.85 (0.53 ; 1.38)	0.17
Moderate	1.00	1.04 (0.83 ; 1.30)	1.00	0.92 (0.64 ; 1.32)	1.00	1.03 (0.77 ; 1.38)	
Excessive	1.00	1.25 (0.86 ; 1.82)	1.00	0.93 (0.56 ; 1.55)	1.00	**2.00 (1.06 ; 3.79)**	
Mediterranean Diet (MEDAS ≥ 9)	1.00	1.05 (0.82 ; 1.33)	1.00	1.05 (0.73 ; 1.52)	1.00	1.03 (075 ; 1.42)	0.91
Leisure time physical activity MET –h/week[c]		1.42 (-0.07 ; 2.90)		1.37 (-1.33 : 4.06)		1.53 (0.00;3.06)	0.89
Overall physical activity							
Inactive	1.00		1.00		1.00		
Moderately inactive	1.00	1.19 (0.96;1.47)	1.00	1.35 (0.98;1.87)	1.00	1.10 (0.83;1.46)	0.34
Moderately active	1.00	**1.61 (1.20;2.14)**	1.00	1.53 (1.00;2.34)	1.00	**1.66 (1.12;2.46)**	
Active	1.00	1.20 (0.77;1.88)	1.00	1.00 (0.58;1.74)	1.00	1.88 (0.84;4.17)	
Television, hours/week[c]		-0.52 (-1.59 ; 0.56)		-0.80 (-2.31; 0.72)		-0.20 (-1.72 ; 1.32)	0.54
General obesity	1.00	**0.79 (0.66 ; 0.95)**	1.00	0.91 (0.69 ;1.19)	1.00	**0.72 (0.56 ; 0.93)**	0.26
Abdominal obesity	1.00	0.91 (0.75 ; 1.10)	1.00	1.19 (0.91 ;1.56)	1.00	**0.70 (0.53 ; 0.94)**	**<0.05**
Hypertension	1.00	0.89 (0.73 ; 1.09)	1.00	1.16 (0.85 ; 1.58)	1.00	**0.73 (0.55 ;0.96)**	**<0.05**
Hypercholesterol.	1.00	1.20 (0.97; 1.49)	1.00	1.12 (0.84 ; 1.48)	1.00	1.33 (0.97; 1.83)	0.39
Metabolic syndrome	1.00	0.83 (0.68 ; 1.00)	1.00	1.05 (0.78 ; 1.41)	1.00	**0.68 (0.52 ; 0.90)**	0.05
Diabetes mellitus	1.00	0.80 (0.62 ; 1.05)	1.00	0.87 (0.59 ; 1.28)	1.00	0.75 (0.52; 1.09)	0.64
Cardiovascular disease	1.00	0.75 (0.52 ; 1.10)	1.00	1.40 (0.78 ; 2.51)	1.00	**0.44 (0.27; 0.74)**	**<0.01**
Cardiovascular risk[c]	1.00	-0.03 (-0.23; 0.17)	1.00	-0.06 (-0.47;0.35)	1.00	-0.00 (-0.13;0.12)	0.81

CI%, Confidence Interval. MEDAS, Mediterranean Diet Adherence Screener. OR, odds ratio.
Statistically significant results (P<0.05)
a Adjusted for age (also for sex in the total) b By sex
c Linear regression coefficient (95% CI)

4.2 Results article 2: Housing conditions and physical function limitations among older adults

Overall, in 2012 the mean age of studied participants was 71.9 years (range: 62-97). Among the study participants, 986 (49.0%) lived in a walk-up building, 91 (4.5%) lived in a home without heating, and 127 (6.3%) frequently felt cold at home. Around 21% of participants lived in a rural area, defined as a Census statistical tract with fewer than 10,000 people. Table 5 shows the distribution of participant´s characteristics according to the number of poor housing conditions. Compared to those living in homes with no poor conditions, those with ≥2 were more likely to be current smokers, heavy drinkers and obese, as well as suffering from diabetes, osteomuscular or CVD and taking more medications. Moreover they more often have lower educational level and a manual occupation.

Among study participants, the mean (standard deviation) SPPB score was 8.5 (2.3). In total, 1095 (54.4%) individuals had agility limitations, 967 (48.1%) were pre-frail, 163 (8.1%) were frail, and 168 (8.3%) had IADL disability. Among men with IADL limitations (n=73), 63.0% had limitations in one domain, 24.7% in two and 12.3% in 3 or more, while among women with IADL limitations (n=138), 52.9% had limitations in one domain, 19.6% in two and 27.5% in 3 or more. In comparison to those who lived in homes without poor conditions, those with ≥2 poor housing conditions showed lower scores in the SPPB (Beta= -1.02; 95% CI; -1.39 to 0.66) and a higher frequency of agility limitation (OR= 1.62; 95%CI; 1.00 to 2.61), pre-frailty (OR= 2.15; 95%CI; 1.31 to 3.53) and frailty (OR= 8.78; 95%CI; 3.00 to 25.60) (model 1). These associations were slightly attenuated after adjustment for educational level (model 2) and turned somewhat stronger after adjustment for occupation (model 3) and after adjustment for both education and occupation (model 4) (Table 6).

Table 5. Age and sex-adjusted characteristics of study participants in 2012, by housing conditions (n=2012)

	Poor housing conditions*			
	None	1	≥ 2	P-value
	n=935	n=959	n=118	
Age, years	72.1 (0.2)	71.7 (0.2)	71.5 (0.6)	0.29
Men, %	50.4	47.3	41.2	0.11
Smoking status, %				
Never smoker	56.7	64.6	66.4	
Ex-smoker	34.6	27.5	23.4	
Current smoker	8.7	7.9	10.2	0.01
Drinking status, %				
Never drinker	20.0	21.9	30.6	
Ex-drinker	6.0	7.0	9.5	
Moderate drinker**	67.8	67.1	52.9	
Heavy drinker	6.2	4.0	7.0	0.02
Physical activity, MET-h/week	53.5 (0.9)	58.6 (0.9)	53.6 (2.6)	<0.01
Watching TV, hours/week,	19.2 (0.3)	19.8 (0.3)	20.2 (1.0)	0.34
Mediterranean Diet Adherence	4.4 (0.1)	4.3 (0.1)	4.1 (0.2)	0.10
Body mass index, kg/m^2, %				
<25	24.5	18.5	19.1	
25-29.9	46.8	45.5	41.7	
≥30	28.7	36.0	39.2	<0.01
Diabetes, %	15.6	18.9	23.6	0.04
Cardiovascular disease, %	5.7	5.2	11.3	0.03
Osteomuscular disease, %	44.2	52.0	62.5	<0.01
Number of drug treatments	3.7 (0.1)	4.0 (0.1)	5.1 (0.3)	<0.01
Educational level, %				
Primary or less	43.2	62.9	64.0	
Secondary	28.5	21.1	22.9	
University	28.3	16.0	13.1	<0.01
Occupational level, manual, %	24.1	40.7	34.8	<0.01

For continuous variables, mean (standard deviation) is provided.
**The alcohol intake threshold between moderate and heavy drinking is 40 g/day in men and 24 g/day in women.

The association between each poor housing condition and the studied outcomes is presented in table 10. In full adjusted analyses (model 4), individuals living in walk-up buildings showed an increased frequency of frailty (OR= 1.90; 95%CI; 1.03 to 3.53) and a non-significant increased frequency of IADL disability (OR= 1.33; 95%CI; 0.87 to 2.03), while those who lacked heating at home had a lower score in the SPPB (Beta= -1.61; 95%CI; -2.00 to -1.21) and a higher frequency of pre-frailty (OR= 2.68; 95%CI;1.53 to 4.71) and frailty (OR= 6.40; 95%CI; 1.74 to 23.51). Additionally, a non-statistically significant increased prevalence of agility limitations (OR=1.35; 95%CI; 0.87 to 2.11) was observed among individuals who felt frequently cold.

Table 6. Association between housing conditions and limitations in physical function in older adults

	SPPB Beta (95% CI)	Mobility limitations OR (95% CI)	Agility limitations OR (95% CI)	Frailty		IADL disability OR (95% CI)
				Pre-frail (vs robust) OR (95% CI)	Frail (vs robust) OR (95% CI)	
Model 1						
No poor conditions	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1 poor condition	0.03 (-0.19; 0.19)	0.94 (0.76;1.16)	0.95 (0.77;1.17)	1.00 (0.81;1.23)	1.35 (0.76;2.38)	1.55 (1.04;2.31)
≥ 2 poor conditions	**-1.06 (-1.46; -0.65)**	1.08 (0.68;1.73)	1.62 (1.00;2.61)	2.15 (1.31;3.53)	**8.78 (3.00;25.6)**	1.09 (0.50;2.39)
p-trend	<0.01	0.84	0.41	0.08	<0.01	0.15
Model 2 (adjusted as model 1 plus education)						
No poor conditions	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1 poor condition	0.04 (-0.15;0.23)	0.90 (0.72;1.12)	0.93 (0.75;1.14)	0.99 (0.81;1.22)	1.24 (0.70;2.21)	1.52 (1.01;2.27)
≥ 2 poor conditions	**-1.02 (-1.42;-0.61)**	1.04 (0.65;1.67)	1.57 (0.97;2.53)	2.12 (1.28;3.45)	**8.22 (2.75;24.56)**	1.07 (0.49;2.35)
p-trend	<0.01	0.61	0.56	0.10	<0.01	0.19
Model 3 (adjusted as model 1 plus occupation)						
No poor conditions	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1 poor condition	-0.00 (-.21;0.19)	0.93 (0.74;1.17)	0.95 (0.76;1.18)	0.98 (0.79;1.22)	1.30 (0.68,2.48)	1.27 (0.82;1.96)
≥ 2 poor conditions	**-1.24 (-1.66;-0.84)**	1.09 (0.68;1.76)	1.64 (1.01;2.67)	2.37 (1.43;3.94)	**15.81 (4.72,53.04)**	1.12 (0.50;2.51)
p-trend	<0.01	0.86	0.38	0.06	<0.01	0.43
Model 4 (adjusted as model 1 plus education and occupation)						
No poor conditions	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
1 poor condition	0.02 (-0.18;0.22)	0.91 (0.72;1.14)	0.93 (0.74;1.16)	0.99 (0.79;1.23)	1.26 (0.66;2.41)	1.29 (0.83;2.00)
≥ 2 poor conditions	**-1.21 (-1.63;-0.81)**	1.07 (0.66;1.72)	1.61 (0.99;2.63)	2.35 (1.41;3.90)	**15.21 (4.51;51.36)**	1.15 (0.51;2.57)
p-trend	<0.01	0.71	0.47	0.06	<0.01	0.39

IADL: Instrumental activities of daily living. OR: Odds ratio; CI: Confidence interval .Model 1 is adjusted for age, sex, tobacco (never-, ex-, current-smoker) alcohol consumption (never-, ex- moderate-, heavy-drinker), physical activity (MET-h/week), watching TV (hours/week), total energy intake (kcal/day), MEDAS score, body mass index (<25, 25-29.9, ≥30 kg/m^2), cancer, diabetes, cardiovascular disease, osteomuscular disease, chronic respiratory disease, and number of drug treatments.

Table 7 shows the results for the association between housing conditions and each component of the SPPB and each frailty criterion. When compared with participants who lived in homes without poor conditions, those with a greater number of poor conditions showed lower scores in the walking speed and sit-to-stand tests, as well as greater frequency of all frailty criteria (p-for trend <0.01). When housing conditions were considered separately, similar results were observed for living in a home without heating, which showed a strong negative association with all SPPB tests and frailty criteria (except weight loss). Feeling frequently cold was also linked to a lower score in the sit-to-stand test and with a higher prevalence of exhaustion. In sensitivity analyses, effect modification by sex was observed for the association between housing conditions and the SPPB score and frailty. Although both men and women with ≥2 poor housing conditions showed a lower SPPB score and increased frequency of frailty than their counterparts, these associations were stronger among women (Table Supplementary).

Table 7. Association between each type of poor housing condition and limitations in physical function in older adults

Housing Conditions	SBBP Beta (95%CI)	Mobility limitations OR (95%CI)	Agility limitations OR (95%CI)	Pre-frail (vs. robust) OR (95%CI)	Frail (vs. robust) OR (95%CI)	IADL disability OR (95%CI)
No elevator	-0.02 (-0.22;0.18)	0.90 (0.72;1.13)	0.97 (0.78;1.21)	1.03 (0.83;1.28)	**1.90** **(1.03;3.53)**	1.33 (0.87;2.03)
No heating	**-1.83** **(-2.27;-1.39)**	1.01 (0.60;1.71)	1.23 (0.73;2.08)	**2.68** **(1.53;4.71)**	**6.40** **(1.74;23.5)**	0.81 (0.34;1.91)
Frequently feeling cold	-0.25 (-0.64;0.14)	1.14 (0.73;1.79)	1.35 (0.87;2.11)	1.31 (0.84-2.05)	1.79 (0.58;5.52)	1.08 (0.51;2.30)

IADL: Instrumental activities of daily living. OR: Odds ratio; CI: Confidence interval.
Models are adjusted as in model 4, table 6. Statistically significant results are presented in bold

Table 8. Association between housing conditions and each component of the Short Physical Performance Battery and each criterion of frailty in older adults

	Short Physical Performance Battery			Frailty				
	Standing balance	**Walking speed**	**Sit-to-stand performance**	**Weight loss**	**Exhaustion**	**Slow walking speed**	**Low physical activity)**	**Weakness**
	Beta (95% CI)	**Beta (95% CI)**	**Beta (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Housing conditions								
No poor conditions	-	-	-	1.00	1.00	1.00	1.00	1.00
1 poor condition	-0.02 (-0.09;0.05)	0.03 (-0.08;0.14)	0.02 (-0.07;0.10)	1.28 (0.86;1.89)	1.19 (0.86;1.65)	1.10 (0.79;1.53)	**2.02 (1.49-2.74)**	0.88 (0.69;1.11)
≥ 2 poor conditions	-0.30 (-0.45;-0.15)	**-0.39 (-0.62;-0.17)**	**-0.48 (-0.65;-0.31)**	1.63 (0.85;3.10)	**2.44 (1.44;4.15)**	**3.02 (1.78;5.10)**	**4.48 (2.71;7.42)**	1.46 (0.92;2.32)
p-trend	**<0.01**	0.08	**<0.01**	0.10	**<0.01**	**<0.01**	**<0.01**	0.75
No elevator	-0.01 (-0.09;0.07)	0.02 (-0.08;0.13)	-0.03 (-0.10;0.04)	1.37 (0.94;1.99)	1.23 (0.91;1.67)	1.31 (0.96;1.80)	2.42 (1.81;3.25)	0.94 (0.75;1.19)
No heating	**-0.74 (-0.92;-0.56)**	**-0.63 (-0.88;-0.39)**	**-0.32 (-0.48;-0.16)**	1.32 (0.65;2.66)	**1.81 (1.02;3.22)**	**3.39 (2.01;5.69)**	**2.39 (1.41;4.07)**	**1.77 (1.07;2.93)**
Frequently feeling cold	-0.04 (-0.20;0.12)	-0.08 (-0.29;0.14)	**-0.16 (-0.30;-0.03)**	1.24 (0.66;2.33)	**1.86 (1.12;3.09)**	0.92 (0.50;1.71)	1.09 (0.64;1.86)	1.00 (0.64;1.56)

OR: Odds ratio; CI: Confidence interval
Poor conditions: lacking an elevator, lacking heating or the individual feels cold frequently.
Models are adjusted as in model 4, table 6. Statistically significant results are presented in bold

4.3 Results article 3: Housing conditions and risk of physical function limitations: a prospective study of community-dwelling older adults

Information at baseline (2008-2010) and the first wave of follow-up (2012) of study participants has been presented in tables 1 and 5 from the present .From 2012 to 2015, 55 individuals (4.2%) developed incident frailty and 107 (7.2%) incident disabilities. Mean (SD) SPPB values at baseline and at follow-up were 8.5 (2.5) and 8.6 (2.4), respectively.

After multivariate adjustment, participants who lived in homes with ≥1 poor condition showed similar SBBP scores at follow-up than those who lived in homes where the three services were present (beta= 0.01, 95%CI; -0.20 to 0.21); however, higher risks of frailty (OR=2.02; 95% CI; 1.09 to 3.75) were observed among those living in home with ≥1 poor condition (Table 9).

Table 10 shows the association between housing conditions and risk of each frailty criterion among individuals who were robust, or pre-frail but free of the specific criterion of interest, at baseline. Older adults living in homes with ≥1 poor condition showed an increased risk of low physical activity (OR: 1.42; 95% CI; 1.00 to 2.03), mainly due to their homes lacking an elevator and adequate temperature control. Individuals living in homes with no heating also showed an increased risk of exhaustion (OR: 2.34; 95% CI; 1.00 to 5.48).

Results from table 11 show that the presence of ≥1 poor housing condition was associated with an increased risk of transportation disability (OR: 3.50; 95% CI; 1.38 to 8.88) among older adults who were free from IADL disabilities at baseline. In particular, those frequently feeling cold showed the highest risks of transportation disability (OR: 3.31; 95% CI: 1.07 to 10.21).

Table 9. Association between housing conditions and risk of limitations in physical function among older adults followed from 2008-2010 to 2015 in Spain.

		SPPB (n=1602)			**Frailty** (n=1311)			**IADL** (n=1494)		
		n	**Model 1** Beta (95%CI)	**Model 2** Beta (95%CI)	**events/ total**	**Model 1** OR (95%CI)	**Model 2** OR (95%CI)	**events/ total**	**Model 1** OR (95%CI)	**Model 2** OR (95%CI)
Number of poor housing conditions	0	767	Ref.	Ref.	19/624	Ref.	Ref.	45/723	Ref.	Ref.
	≥1	835	-0.01 (-0.21;0.20)	0.01 (-0.20;0.21)	36/687	**1.81 (1.00;3.26)**	**2.02 (1.00;3.75)**	62/771	1.31 (0.86;2.00)	1.33 (0.87;2.05)
Living in a walk-up building	No	837	Ref.	Ref.	24/687	Ref.	Ref.	51/787	Ref.	Ref.
	Yes	765	-0.07 (-0.27;0.14)	-0.06 (-0.26;0.14)	31/624	1.50 (0.85;2.65)	1.65 (0.91;2.99)	56/707	1.24 (0.81;1.88)	1.26 (0.82;1.92)
Lacking heating	No	1533	Ref.	Ref.	51/1256	Ref.	Ref.	103/1431	Ref.	Ref.
	Yes	69	0.23 (-0.27;0.73)	0.21 (-0.28;0.70)	4/55	1.89 (0.65;5.56)	1.88 (0.62;5.76)	4/63	0.85 (0.30;2.43)	0.85 (0.29;2.49)
Frequently feeling cold	No	1503	Ref.	Ref.	48/1227	Ref.	Ref.	98/1405	Ref.	Ref.
	Yes	99	-0.10 (-0.51;0.32)	-0.00 (-0.41;0.41)	7/84	2.25 (0.97;5.26)	2.22 (0.92;5.33)	9/89	1.49 (0.71;3.14)	1.38 (0.64;2.99)

SPPB: Short Physical Performance Battery; IADL: Instrumental activities of daily living; CI: Confidence interval; OR: Odds ratio.
Beta coefficients and their 95% confidence intervals were obtained from multivariate lineal regression models. Odds ratios and their 95% confidence intervals were obtained from multivariate logistic regression models.
Model 1 is adjusted for age, sex, educational level (≤primary, secondary, university). Linear regression models were also adjusted for the baseline SPPB score.
Model 2 is adjusted as model 1 plus smoking status (never, ex-smoker, current-smoker), physical activity (MET-h/week), watching TV (hours/week), BMI (<25, 25-29.9, ≥30 kg/m^2), and comorbidities (cancer, diabetes, cardiovascular disease, osteomuscular disease, chronic respiratory disease).
Statistically significant results are presented in bold.

Table 10. Association between housing conditions and risk of each criterion of frailty among Spanish older adults who were free of the criterion of interest at baseline.

		Frailty criteria									
		Weight loss (n=1221)		**Exhaustion** (n=1201)		**Slow walking speed** (n=1156)		**Low physical activity** (n=1077)		**Weakness** (n=1123)	
		events/ total	**OR (95% CI)**	**events/ total**	**OR (95% CI)**	**events/ total**	**OR (95% CI)**	**events/ total**	**OR (95% CI)**	**events/ total**	**OR (95% CI)**
N of poor housing conditions	0	46/591	Ref.	46/577	Ref.	45/553	Ref.	69/537	Ref.	57/521	Ref.
	≥1	50/630	0.99 (0.64;1.53)	52/624	0.91 (0.58;1.41)	48/603	1.02 (0.65;1.60)	91/540	**1.42 (1.00;2.03)**	73/602	1.19 (0.81;1.75)
Living in a walk-up building	No	53/648	Ref.	54/629	Ref.	50/607	Ref.	80/590	Ref.	62/571	Ref.
	Yes	43/573	0.89 (0.58;1.38)	44/572	0.77 (0.50;1.21)	43/549	1.03 (0.65;1.61)	80/487	1.32 (0.93;1.88)	68/552	1.22 (0.83;1.80)
Lacking heating	No	103/1243	Ref.	90/1154	Ref.	93/115	Ref.	151/1036	Ref.	124/1083	Ref.
	Yes	4/54	0.86 (0.26;2.91)	8/47	**2.34 (1.00;5.48)**	0/41	-	9/41	1.55 (0.71;3.38)	6/40	1.48 (0.59;3.74)
Feeling cold	No	97/1213	Ref.	92/1135	Ref.	87/1079	Ref.	150/1014	Ref.	123/1052	Ref.
	Yes	10/84	1.22 (0.56;2.66)	6/66	1.07 (0.43;2.64)	6/77	1.04 (0.42;2.56)	10/63	1.03 (0.51;2.10)	7/71	0.78 (0.34;1.77)

CI: Confidence interval; OR: odds ratio.
Odds ratios and their 95% confidence intervals were obtained from multivariate logistic regression models. All models adjusted as model 2 in table 9.
Statistically significant results are presented in bold.

Table 11. Association between housing conditions and risk of each disability in instrumental activities of daily living (IADL) among Spanish older adults free of IADL disabilities at baseline

		Disabilities in Instrumental Activities of Daily Living													
		Transportation (n=1267)		**Shopping** (n=1301)		**Taking medications** (n=1301)		**Managing finances** (n=1301)		**Housework**[a] (n= 649)		**Meal preparation**[†] (n= 649)		**Laundry**[†] (n= 649)	
		events/ total	**OR (95% CI)**	**events/ total**	**OR (95% CI)**	**events/ total**	**OR (95% CI)**	**events/ total**	**OR (95% CI)**	**events/ total**	**OR (95% CI)**	**events/ total**	**OR (95% CI)**	**events/ total**	**OR (95% CI)**
	0	7/617	Ref.	32/617	Ref.	12/617	Ref.	2/617	Ref.	4/299	1.00	11/299	1.00	3/299	1.00
N of poor housing conditions[b]	≥ 1	22/684	**3.50 (1.38;8.88)**	44/684	1.25 (0.75;2.07)	11/684	0.81 (0.34;1.93)	4/684	1.66 (0.20;14.19)	4/350	1.32 (0.20;8.67)	8/350	0.50 (0.18;1.38)	10/350	2.70 (0.67;11.04)
Living in a walk-up building	No	11/677	Ref.	36/677	Ref.	13/677	Ref.	3/677	Ref.	5/326	Ref.	12/326	Ref.	4/326	Ref.
	Yes	18/624	2.07 (0.93;4.76)	40/624	1.23 (0.75;2.03)	10/1301	0.81 (0.33;1.95)	3/624	1.11 (0.13;9.13)	3/323	1.20 (0.18;8.16)	7/323	0.47 (0.16;1.33)	9/323	2.52 (0.65;9.82)
Lacking heating	No	27/1243	Ref.	74/1243	Ref.	23/1243	Ref.	6/1243	Ref.	8/619	Ref.	19/619	Ref.	12/619	Ref.
	Yes	2/58	2.11 (0.43;10.4)	2/58	0.51 (0.12;2.24)	0/58	-	0/58	-	0/30	-	0/30	-	1/30	3.20 (0.32;32.4)
Frequently feeling cold	No	24/1219	Ref.	4/1219	Ref.	20/1219	Ref.	4/1219	Ref.	7/605	Ref.	18/605	Ref.	11/605	Ref.
	Yes	5/82	**3.31 (1.07;10.2)**	2/82	5.12 (0.37;70.9)	3/82	1.93 (0.52;7.21)	2/82	5.12 (0.37;70.9)	1/44	1.36 (0.03;64.1)	1/44	0.76 (0.09;6.59)	2/44	2.24 (0.32;15.7)

CI: Confidence interval; OR: odds ratio.
Odds ratios and their 95% confidence intervals were obtained from multivariate logistic regression models.
All models adjusted as model 2 in table 9.
Statistically significant results are presented in bold.
[a] Meal preparation, housework and laundry are excluded in men.
[b] The item "ability to use the telephone" has been excluded from the table because only one individual had limitations in this item.

4.4 Results article 4: Socioeconomic inequalities in disability in Europe: contribution of behavioral, work-related and living conditions.

Our analysis includes 27,895 participants from 19 European countries, with mean age of 51.7 years old, 52.0% of whom were female, 51.6% were in lowest educated group, 30.3% in the middle and 18.1% in the highest. Regarding behavioral factors 30.5% were smokers, 33.0% consumed alcohol less than once a month in the last 12 months, 55.9% consumed vegetables and fruit at least once a day (except juice and potatoes), 24.3% did sports or other physical activity, 2 or 3 days in the last week and 39.7% were overweight. Additionally, 46.9% had frequent financial conflicts while growing up and more than 27.0% were ever exposed to more than two material or ergonomic hazards (Table 12).

The prevalence of disability was higher in females, increased with age and was higher in low educated groups. In males it was 25.1% (95% CI: 24.3% to 25.8%) and 29.0% (28.2-29.7%) in females. Among the low educated, the prevalence of disability was 32.0% (95% CI 30.9-33.1%) in males and 36.0% (95% CI 34.9-37.1%) in females, and among the high educated it was 15.4% (95% CI 14.0-16.9%) in males and 18.9% (95% CI 17.3-20.4%) in females (Figure 12) (Table supplementary1).

In an analysis stratified by country, the age-standardized prevalence of disability varied between 16.4% in Ireland to 39.0% in Slovenia, and in almost all countries disability was higher for women and the low educated group. Slovenia and Lithuania showed the highest prevalence of disability for both genders, while Ireland and Spain had the lowest. Countries with the largest educational inequalities in disability were Lithuania, Estonia and Slovenia. In addition, Estonia was the country with the largest difference between men and women in educational inequalities in disability. On the other hand, countries with the smallest inequalities in disability were Ireland, the United Kingdom and the Nordic countries. The Czech Republic does not have a significantly different prevalence of disability between the high and low educated (Figure 12) (Appendix 1).

In an analysis adjusted for age, the frequency of disability was higher among females, daily smokers, persons who consume alcohol frequently and those who do not consume fruits and vegetables at least once a day, in obese females and underweight males, and in persons physically inactive (who do not do physical activity at least once per week).

Table 12: Characteristics of the study population for European countries (age 30-79)

Characteristics	Country																			
	Austria	**Belgium**	**Czech Republic**	**Denmark**	**Estonia**	**Finland**	**France**	**Germany**	**Hungary**	**Ireland**	**Lithuania**	**Netherlands**	**Norway**	**Poland**	**Slovenia**	**Spain**	**Sweden**	**Switzerland**	**United Kingdom**	**All (pooled)**
Female (%)	51,7	50.1	54.4	50.9	61.0	50.6	51.5	48.2	57.1	54.8	62.2	55.4	46.0	55.1	54.2	47.6	50.3	50.6	54.5	**52.2**
Mean Age	52.7	52.3	51.7	53.2	53.8	54.8	52.9	54.3	54.0	52.8	54.8	54.3	52.4	52.4	54.3	51.6	54.1	52.5	53.9	**51.7**
Low educated (%)	69.5	38.4	41.9	46.0	14.1	19.3	48.6	50.7	49.7	44.5	24.0	55.3	34.9	57.0	42.8	62.5	32.3	53.3	43.7	**51.6**
Smoking (current %)	30.5	26.7	30.6	24.1	29.0	24.3	29.4	31.3	34.0	23.4	31.1	25.9	22.9	30.1	27.8	30.5	14.9	25.6	20.6	**30.5**
Drinking < once month (%)	29.3	26.9	39.6	48.1	39.2	34.9	29.0	34.8	31.9	24.6	41.0	25.2	39.8	39.3	34.1	28.0	31.7	32.2	23.6	**33.3**
Vegetables & fruit at least once/day (%)	47.7	63.1	36.3	61.5	59.4	64.1	63.9	58.3	29.1	69.0	47.5	62.6	65.2	60.6	73.1	52.8	57.7	68.5	64.3	**55.9**
Physical activity 2-3 days (%)	31.0	23.1	26.7	27.8	22.5	28.2	24.8	26.3	21.4	22.2	25.0	26.1	32.1	17.3	23.5	18.2	27.2	29.8	20.7	**24.3**
Overweight (%)	40.6	35.6	48.5	34.9	37.7	38.6	33.3	38.9	46.6	41.4	44.8	38.1	43.5	38.5	40.0	39.4	39.4	34.1	37.3	**39.7**
≥1 problems with housing (%)	7.4	15.8	8.3	13.2	18.2	9.7	20.0	12.2	9.6	9.2	22.2	12.6	8.1	11.3	16.5	18.4	7.4	9.4	17.3	**14.2**
Financial Strain (%)	13.3	23.2	38.3	6.0	32.9	12.0	22.2	10.2	42.8	26.2	37.3	14.2	6.1	27.5	19.5	27.3	7.1	11.8	18.3	**22.4**
Almost never have social meetings (%)	15.9	14.1	26.6	10.2	38.2	16.0	12.4	18.9	55.4	31.9	44.2	8.4	10.6	42.8	30.0	13.8	8.2	12.2	21.6	**23.1**
Freq. Childhood financial difficulties (%)	37.3	30.0	49.1	31.4	66.5	53.0	41.7	39.4	56.0	54.5	69.7	27.4	23.9	59.1	53.7	37.3	30.2	34.0	49.8	**46.9**
Freq. Household conflicts in childhood (%)	36.4	36.5	33.8	35.1	51.1	49.9	35.1	45.6	42.1	28.9	54.7	38.3	26.8	36.5	38.1	15.8	39.5	38.9	32.8	**39.3**
≥ 2 material hazards (%)	22.5	23.1	14.8	32.3	26.2	41.1	27.1	30.2	18.8	15.8	13.0	21.7	29.9	30.7	31.8	34.1	33.9	20.8	27.6	**27.6**
≥ 2 ergonomic hazards (%)	25.8	24.4	12.9	33.0	26.8	40.9	30.7	31.5	25.9	14.9	18.6	23.6	32.8	24.5	26.1	30.5	36.0	20.0	23.9	**28.4**
High job control (%)	25.1	29.6	19.0	38.7	24.8	37.1	33.2	28.3	14.0	32.7	20.5	29.4	45.0	26.1	28.6	41.2	36.5	37.1	33.2	**29.4**

Source: European Social Survey Round 7. 2014
Notes: Statistics present are unweighted except the total

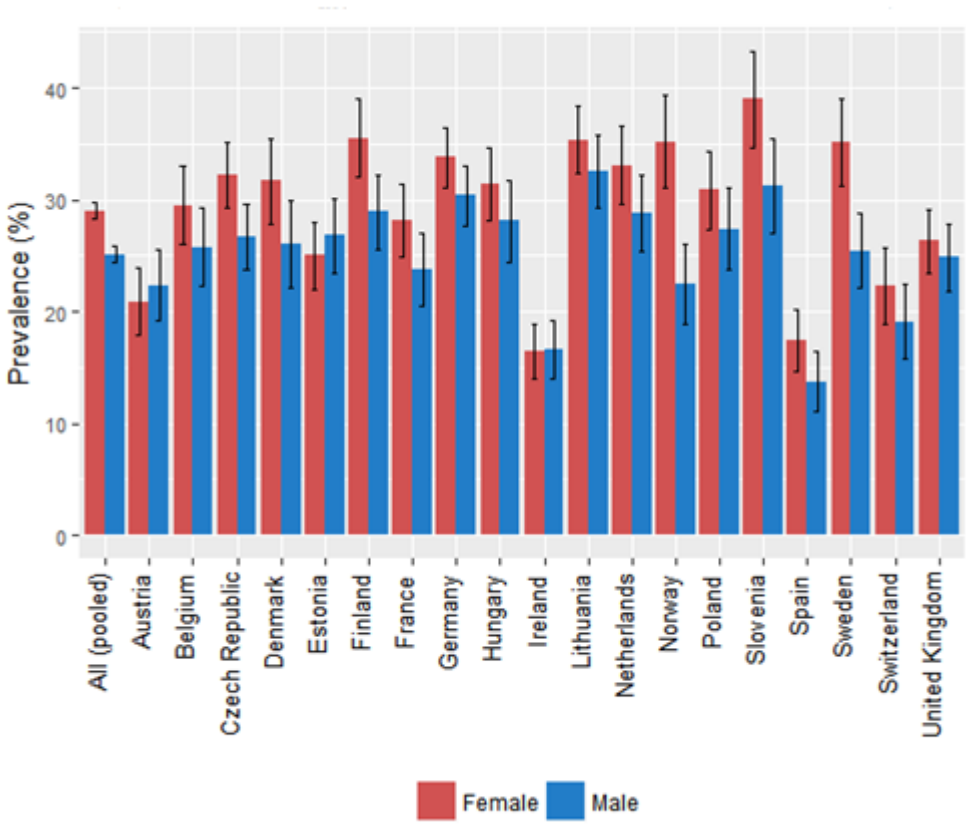


Figure 12 Prevalence of disability by country and gender (age 30-79)

In addition, the frequency of disability was higher in participants exposed to two or more material and ergonomic hazards and in those with low capacity to influence activities of the work organization. Moreover, disability was higher in persons who reported frequent financial difficulties and household conflict while growing up, in persons who live in poor conditions, in persons with financial strain and in persons who almost never have social contacts. (Table 13).

Table 14 presents the contribution of different groups of factors to the educational inequalities in disability relative to the reference model. The reference model was adjusted only by age (model 0) and showed higher odds of being disabled for the low educated group in comparison with the high educated group for both males (OR 1.97; 95% CI 1.74-2.23) and females (OR 1.89; 95% CI 1.69-2.12). These ORs for disability were attenuated when behavioral factors, work-related factors or living conditions were added simultaneously to the model. Separate analyses showed that for males, smoking status attenuated the ORs the most. For females, frequency of alcohol consumption and overweight and obesity were the behavior factors that reduced the ORs the most.

Similarly, ergonomic hazards for both males and females were the work-related factors that attenuated the ORs the most. Psychosocial factors, specifically financial strain. were the living conditions that contributed the most to attenuate the ORs for both females and males.

In the analysis including several factors simultaneously, we found that behavioral factors among females and work-related conditions among males were the determinants that contributed most to explaining educational inequalities in disability. In addition, we found that adjusting simultaneously for work-related conditions and behavioral factors reduced the ORs by at least 23.0% more than in the analysis with individual factors. The highest reduction in ORs was obtained when we adjusted simultaneously for the three groups of factors. This reduced the ORs by more than 77.0% among males and more than 67.0% among females.

Table 13: Frequency of disability according social determinants, by gender

		Disability	
	Total	Males	Females
Behavioral Factors	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**
Smoking status (%)			
Current regular (daily smoker)	33.8 (32.4-35.2)	30.3 (28.6-32.1)	37.1 (34.9-39.2)
Ex-smoker	29.3 (28.1-30.5)	28.4 (26.9-30.0)	29.3 (27.5-31.2)
Never smoker	25.9 (25.0-26.7)	22.5 (21.2-23.8)	28.6 (27.5-29.7)
Occasional smoker	26.1 (22.9-29.4)	22.5 (18.2-26.9)	29.4 (24.6-34.3)
Alcohol consumption			
Never	26.1 (24.9-27.3)	25.6 (23.7-27.5)	27.1 (25.6-28.6)
Less than once a month	25.9 (24.8-27.1)	22.6 (21.1-24.2)	29.3 (27.6-31.0)
Once a month	24.5 (22.9-26.1)	23.2 (21.2-25.1)	25.9 (23.3-28.5)
Once a week	26.7 (24.9-28.4)	26.1 (23.9-28.3)	26.5 (23.7-29.3)
Daily or almost daily	30.0 (25.7-34.3)	29.2 (24.6-33.9)	28.2 (19.0-37.4)
Frequency of physical activity			
Daily	26.2 (24.9-27.4)	24.2 (22.4-25.9)	28.0 (26.1-29.8)
4-6 times a week	22.8 (21.5-24.1)	20.0 (18.2-21.7)	25.5 (23.5-27.4)
2-3 times a week	24.5 (23.3-25.7)	23.5 (21.8-25.2)	25.3 (23.7-27.0)
Once a week	26.6 (24.7-28.5)	25.0 (22.2-27.8)	28.0 (25.3-30.8)
Never	39.1 (37.8-40.5)	37.1(35.1-39.1)	41.0 (39.1-42.8)
Consumes vegetables & fruit at least once a day			
Yes	25.8 (25.0-26.6)	23.5 (22.4-24.7)	27.9 (26.9-28.9)
No	32.0 (31.0-33.0)	29.2 (28.0-30.5)	34.6 (33.1-36.1)
Body Mass Index [kg/m^2] classification			
Underweight (10-18.4)	35.0 (29.7-40.2)	43.7 (30.2-57.2)	34.8 (29.0-40.6)
Normal (18.5-24.9)	24.8 (23.8-25.7)	25.3 (23.8-26.7)	24.9 (23.7-26.2)
Overweight (25-29.9)	26.5 (25.6-27.5)	23.5 (22.3-24.7)	29.7 (28.2-31.2)
Obese (30-70)	39.5 (37.9-41.0)	34.6 (32.5-36.8)	44.1 (41.8-46.4)

Work-related conditions	Total % (95% CI)	Disability Males % (95% CI)	Females % (95% CI)
Material hazards			
No hazards	23.6 (22.8-24.4)	21.0 (19.7-22.2)	26.2 (25.2-27.3)
One hazard	30.6 (29.2-32.0)	26.8 (24.8-28.7)	34.0 (32.1-36.0)
Two or more	36.8 (35.5-38.1)	31.6 (30.2-33.1)	42.6 (40.2-45.0)
Ergonomic hazards			
No hazards	21.6 (20.8-22.4)	19.2 (18.0-20.4)	23.9 (22.8-25.0)
One hazard	30.1 (29.0-31.3)	26.3 (24.6-27.9)	33.6 (32.0-35.2)
Two or more	38.1 (36.8-39.4)	33.5 (32.0-35.1)	42.7 (40.5-44.8)
Job control (capacity to influence activities of the organization)			
Low control	32.1 (31.2-33.1)	30.9 (29.4-32.3)	33.5 (32.2-34.7)
Moderate control	25.7 (24.5-26.9)	23.8 (22.1-25.5)	27.4 (25.7-29.2)
High control	25.5 (24.4-26.6)	23.1 (21.7-24.5)	27.8 (26.1-29.5)
Living circumstances			
Frequency of financial conflicts while growing up			
Almost never	23.7 (22.9-24.5)	22.0 (21.0-23.1)	25.2 (24.1-26.4)
Frequently	33.7 (32.8-34.7)	31.5 (30.1-32.8)	35.8 (34.4-37.1)
Frequency of conflict between people in household when growing up			
Almost never	24.1 (23.4-24.9)	22.6 (21.6-23.6)	25.5 (24.4-26.5)
Frequently	35.0 (34.0-36.1)	32.7 (31.1-34.2)	37.1 (35.7-38.6)
Problems with housing (poor housing conditions)			
Yes	39.2 (37.4-41.1)	36.4 (33.6-39.1)	41.7 (39.2-44.2)
No	26.7 (26.1-27.3)	24.9 (24.1-25.8)	28.3 (27.4-29.2)
Financial Strain (feeling about the household income)			
Yes	42.8 (41.4-44.3)	41.5 (39.3-43.6)	44.2 (42.3-46.2)
No	24.4 (23.8-25.1)	22.7 (21.8-23.6)	26.0 (25.1-26.9)
Frequency of social meetings (social network)			
Almost never	33.3 (32.0-34.6)	31.5 (29.7-33.4)	35.0 (33.2-36.8)
Sometimes	26.0 (25.1-26.9)	24.1 (22.9-25.4)	27.7 (26.4-29.0)
Frequently	28.2 (27.1-29.2)	25.9 (24.4-27.3)	30.3 (28.8-31.8)

Source: European Social Survey Round 7. 2014.
Percentages are weighted for 19 countries.

Table 14: Educational inequalities in disability among males and females (age 30-79), before and after adjustment for social determinants and OR change percent

	Males				Females			
	Low Educated		Medium Educated		Low Educated		Medium Educated	
Model	**OR (IC 95%)**	**% change OR**	**OR (IC 95%)**	**% change OR**	**OR (IC 95%)**	**% change OR**	**OR (IC 95%)**	**% change OR**
Model 0: Age adjusted	1.97 (1.74-2.23)		1.52 (1.33-1.74)		1.89 (1.69 – 2.12)		1.48 (1.32 -1.66)	
Behavioral factors								
Smoking status	1.86 (1.64-2.11)	11	1.47 (1.29-1.69)	10	1.81 (1.61-2.03)	9	1.44 (1.28-1.62)	8
Frequency drinking	1.89 (1.66-2.16)	8	1.55 (1.34-1.78)	-6	1.74 (1.53-1.98)	17	1.47 (1.29-1.67)	2
Frequency of physical activity	1.88 (1.65-2.12)	9	1.51 (1.32-1.73)	2	1.78 (1.59-2.00)	12	1.45 (1.29-1.63)	6
Consumes vegetables & fruit at least once a day	1.89 (1.67-2.14)	8	1.49 (1.30-1.71)	6	1.79 (1.60-2.01)	11	1.44 (1.28-1.61)	8
Body mass index (kg/m^2) classification	1.92 (1.70-2.18)	5	1.49 (1.30-1.70)	6	1.76 (1.56-1.98)	15	1.39 (1.24-1.57)	19
Model 1: Behavioral factors simultaneous	1.63 (1.42-1.88)	35 (28-54)	1.42 (1.23-1.65)	19 (2-42)	1.46 (1.28-1.67)	48 (41-71)	1.31 (1.14-1.50)	35 (19-65)
Work-related conditions								
Material hazards	1.71 (1.50-1.94)	27	1.39 (1.21-1.59)	25	1.78 (1.59-2.00)	12	1.45 (1.29-1.63)	6
Ergonomic hazards	1.57 (1.38-1.79)	41	1.3 (1.13-1.49)	42	1.68 (1.49-1.89)	24	1.38 (1.22-1.55)	21
Job control	1.86 (1.63-2.11)	11	1.48 (1.29-1.70)	8	1.82 (1.62-2.04)	8	1.43 (1.27-1.62)	10
Model 2: Work-related conditions simultaneous	1.45 (1.27-1.67)	54 (44-67)	1.25 (1.08-1.44)	52 (35-74)	1.62 (1.44-1.83)	30 (25-43)	1.35 (1.20-1.53)	27 (16-43)

Model	Males				Females			
	Low Educated		Medium Educated		Low Educated		Medium Educated	
	OR (IC 95%)	% change OR	OR (IC 95%)	% change OR	OR (IC 95%)	% change OR	OR (IC 95%)	% change OR
Living conditions								
Childhood financial difficulties	1.80 (1.59-2.05)	18	1.43 (1.24-1.63)	17	1.77 (1.58-1.99)	13	1.4 (1.24-1.57)	17
Household conflicts in childhood	1.90 (1.68-2.16)	7	1.48 (1.30-1.70)	8	1.89 (1.68-2.18)	0	1.47 (1.31-1.66)	2
Poor housing conditions	1.91 (1.68-2.16)	6	1.48 (1.30-1.70)	8	1.82 (1.62-2.04)	8	1.47 (1.30-1.65)	2
Financial strain	1.65 (1.45-1.87)	33	1.39 (1.21-1.59)	25	1.60 (1.43-1.80)	33	1.33 (1.18-1.50)	31
Frequency of social meetings	1.96 (1.73-2.22)	1	1.52 (1.33-1.74)	0	1.87 (1.67-2.10)	2	1.45 (1.29-1.63)	6
Model 3: Living conditions simultaneous	1.56 (1.37-1.78)	42 (33-51)	1.33 (1.16-1.53)	37 (22-51)	1.56 (1.38-1.76)	37 (29-46)	1.31 (1.16-1.49)	35 (20-48)
Model 4: Behavioral + Work-related	1.2 (1.03-1.40)	79 (67-100)	1.16 (1.00-1.36)	69 (43-99)	1.26 (1.09-1.46)	71 (61-95)	1.2 (1.04-1.39)	58 (37-94)
Model 5: Behavioral + Living	1.41 (1.22-1.63)	58 (47-75)	1.3 (1.12-1.51)	42 (21-67)	1.33 (1.15-1.53)	63 (51-84)	1.23 (1.07-1.42)	52 (51-84)
Model 6: Work-related + Living	1.21 (1.05-1.39)	78 (66-93)	1.12 (0.97-1.30)	77 (45-92)	1.4 (1.24-1.59)	55 (64-90)	1.23 (1.08-1.40)	52 (34-72)
Model 7: behavioral + Work-related + Living	1.08 (0.92-1.26)	92 (77-100)	1.09 (0.93-1.28)	83 (52-100)	1.18 (1.02-1.37)	80 (67-100)	1.13 (0.98-1.32)	73 (46-100)

Source: European Social Survey Round 7. 2014.

All models were adjusted by age. High educated was the reference category
Model 0: age-adjusted
Model 1: Model 0 + smoking status + frequency drinking + frequency of physical activity + consumes vegetables & fruit at least once a day + body mass index(kg/m2)
Model 2: Model 0 + material hazards + ergonomic hazards + job control
Model 3: Model 0 + childhood financial difficulties + household conflicts in childhood + poor housing conditions + financial strain + frequency of social meetings
Model 4: Model 1 + Model 2
Model 5: Model 1 + Model 3
Model 6: Model 2 + Model 3
Model 7: Model 1 + Model 2 + Model 3
% Change in Odds Ratio were calculated by: [(OR (Model adjusted by age) – OR (Model adjusted by social determinants)) / (OR (Model adjusted by age) – 1)] x 100

5. DISCUSSION

5.1 What does this thesis adds?

Article1: Social Inequalities in Cardiovascular Risk Factors among Older Adults in Spain: The Senior-ENRICA Study

- The cardiovascular health of older adults in Spain in 2008-2010 is worse in those with primary or below education than in those with a university education and in manual workers than in non-manual workers.
- Among older adults in Spain, educational level, Occupation, and as well father´s occupation, are inversely associated with behavioral CVRF such as smoking, harmful consumption of alcohol and lack of physical activity. Biological factors such as obesity, metabolic syndrome, high blood pressure, diabetes and cardiovascular disease are likewise associated.
- Health inequalities are greater in women than in men.
- Reducing these inequalities, bringing the levels of cardiovascular risk factors in people from lower socioeconomic levels in line with those in higher levels, would substantially reduce the prevalence of CVRF in older adults.

Articles 2 and 3: Housing conditions and physical function limitations among community-dwelling older adults: cross-sectional and prospective analyses.

- Housing conditions play a significant role in limitations in physical function, frailty and disability among older adults in Spain.
- Poor housing conditions, particularly lack of an elevator and lack of heating, are strongly associated with development of limitations in physical function and frailty in older adults.
- Our results reveal serious inequalities in functional status among older adults in Spain.
- Prevention programs targeting functional limitations and disability in older people should ensure that older adults live in homes that are accessible to the street and have adequate heating systems.

Article 4: Socioeconomic inequalities in disability in Europe: contribution of behavioral, work-related and living conditions.

- The prevalence of disability was higher among women and in less educated, in almost all European countries analyzed.
- These results add quantitative estimates of the contribution of main risk factors to social inequalities in disability.
- Work-related conditions among men and behaviour factors among women may be the factors that contribute the most to develop disability in European countries.

5.2 Strengths and limitations of the current thesis

There are several strengths in methodological aspects of this thesis worth mentioning. First, to analysed inequalities in CVRF, we used a representative sample of the non-institutionalized Spanish population with multiple measures of socioeconomic position. This study also includes a greater set of CVRF than most previous studies (94). Second, we used validated measures of physical function in older adults and physical performance test were conducted by trained staff under standardised conditions. Third, the longitudinal study supported the role of poor housing conditions in the development of functional limitations and frailty. Fourth, to study inequalities in disability, we used GALI as only indicator of disability. which has been validated and harmonized across European countries (90, 91). Fifth, we conducted individual-level and simultaneous analyses for different groups of determinants to analyse the contribution of each group in the generation or persistence of social inequalities in disability in European countries. And finally, all of our analyses were adjusted for a large number of potential confounding, minimising the probability of residual confounding.

Regarding limitations of this thesis, we can mention the following: Because some of these studies were cross-sectional design, it was not possible to establish causal inferences. However, this design has not prevented us from observing important inequalities in CVRF, functional limitations and disability. The low prevalence of exposures of interest (i.e. lack of pipe hot water at home) and the lack of temperature measures could have prevented us from detecting some existing associations. And the other hand, the fact that some study outcomes such frailty and disability were self-reported may explain the variability in reporting between countries and socioeconomic

groups, as a result of cultural differences and in health literacy. This potential bias may depend on demographic, cultural and social characteristics of populations (40, 95, 96). In addition, the variation in response rates between countries also may explain differences in disability rates, especially in the case of countries with the lowest responses rates. Other limitation is the exclusion from the analysis of individuals with missing data on the variables of interest. It is difficult to know the effect that had these aspects of the sample analysed on the study results.

5.3 Implications for public health policy

Results of this thesis showed the persistence of socioeconomic inequalities in health among the elderly in Spain, as well among people aged 30-79 from other European countries. These results contribute to a better understanding of role of social determinants in chronic conditions such as CVD, functional limitations and disability among older adults. Inequalities in disability are a major challenge for public health in most European countries. Our findings suggest that inequalities in these chronic conditions can be avoided or reduced if preventive actions are taken and focus on improving housing conditions, health-related behaviors and working conditions.

6. CONCLUSIONS

6.1 Conclusions related to objective one

- There are significant inequalities in CVRF in older adults in Spain, especially among women.
- Social inequalities affect both behavioral CVRF such as smoking, alcohol consumption, physical activity and sedentary lifestyle, and biological CVRF, especially those linked to lifestyle, such as obesity, metabolic syndrome and diabetes.
- These inequalities are more marked for educational level and occupation than for father's occupation.
- Bringing the CVRF levels in people from lower SELs in line with those in higher SELs could substantially reduce the prevalence of CVRF in older adults in Spain.

6.2 Conclusions related to objective two

- Poor housing conditions, particularly lack of heating are cross-sectionally associated with the prevalence of limitations in physical function in older adults, independently of educational or occupational level.
- In prospective analyses, poor housing conditions are associated with the development of frailty. However, the results do not support a prospective relationship between housing conditions and risk of poor lower extremity performance or IADL disability.
- Public health departments should foster healthy ageing by improving existing housing and developing new and more suitable forms of housing for older adults.

6.3 Conclusions related to objective three

- In most European countries the prevalence of disability is higher among women and among those with lower education levels
- Work-related conditions and behavioral factors contribute most to explain social inequalities in disability among men and women, respectively; however there are large variations between countries.
- Inequalities in disability can be tackled by preventive actions focusing on health-related behaviors and working conditions and should target individuals in lower socioeconomic groups.

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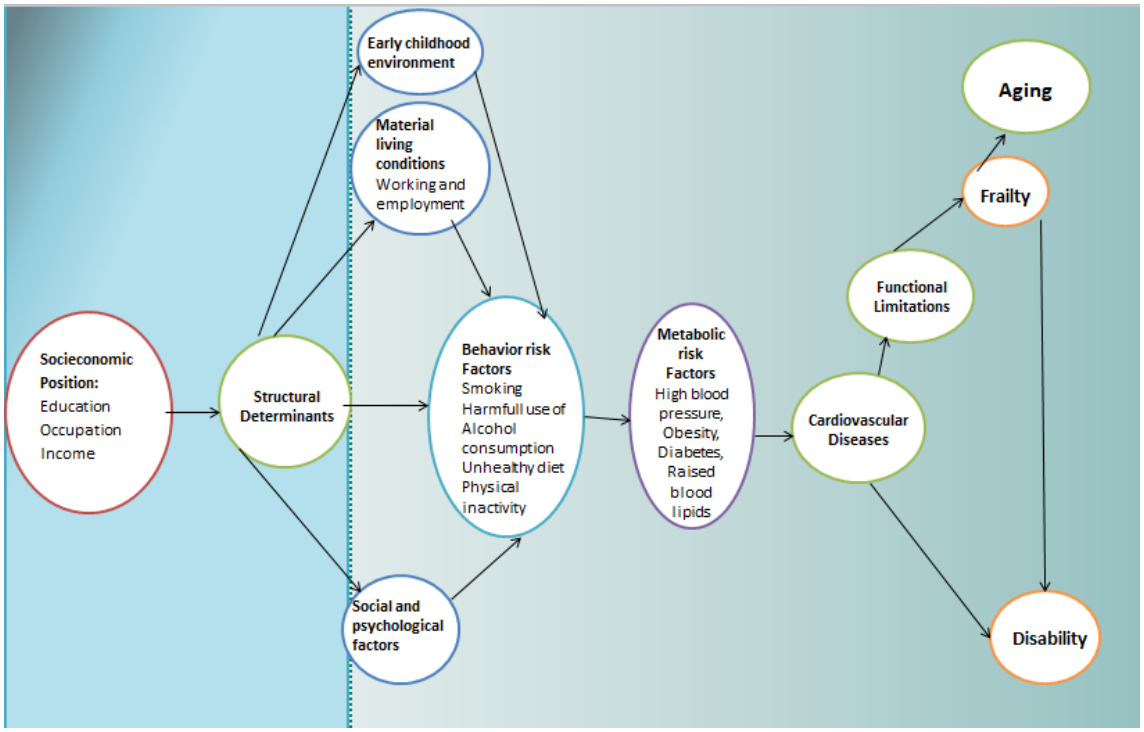
ANNEXES

Annex 1: Social determinants of CVD, functional limitations and disability



Annex 2: Supplementary material: Article 1

Table 1. Comparison of subjects included and excluded in the analysis

	Total (n=3518)	Included (n=2699)	Excluded (n=819)	P Value
Age. mean years (SD)	69.5(0.2)	69.2 (0.2)	69.8 (0.1)	0.001
Men	45.3	47.0	41.1	0.050
Education Level. %				0.059
Primary or less	59.3	58.0	62.6	
Secondary	22.9	23.2	22.2	
University	17.8	18.8	15.1	
Non-manual occupation. %	61.8	62.3	59.5	0.285
Non-manual father's occupation. %	59.6	61.3	55.3	<0.001
Smoking. %				0.361
Never smoker	58.7	58.7	58.6	
Ex-smoker	29.3	29.9	27.9	
Current smoker	12.0	11.4	13.5	
Alcohol consumption. %				0.077
Never-drinker	38.0	38.8	35.3	
Exdrinker	8.5	8.8	7.5	
Moderate consumption	45.9	44.4	51.3	
Excessive consumption	7.5	8.0	5.9	
Mediterranean diet[a]. %	22.0	16.3	35.9	<0.001
Leisure time physical activity. MET –hours/week. median (SD)	21.4 (0.3)	21.5 (0.4)	20.9(0.6)	0.152
Overall physical activity. %				<0.050
Inactive	47.6	45.7	52.4	
Moderately inactive	31.9	33.3	28.2	
Moderately active	15.1	15.2	14.9	
Active	5.4	5.8	4.4	
Television. hours/week	18.8 (0.3)	18.5 (0.3)	19.6 (0.6)	0.064
General obesity,%	33.9	34.4	32.4	0.370
Abdominal obesity,%	58.7	59.7	55.4	0.091
Hypertension,%	62.0	67.7	47.9	<0.001
Hypercholesterolemia,%	69.9	70.4	68.6	0.417
Diabetes,%	18.1	17.4	20.0	0.136
Metabolic syndrome,%	41.3	41.3	41.4	0.953
Cardiovascular disease. %	6.0	5.7	6.8	0.299
Cardiovascular risk. mean (SD)[b]	3.1(0.06)	3.1(0.06)	2.7(0.10)	<0.050

Unless otherwise indicated, the data are expressed as mean ± standard deviation.
[a] MEDAS (Mediterranean Diet Adherence Screener) score ≥9.
[b] Risk of fatal cardiovascular disease, estimated using the SCORE equation for low-risk countries and assuming all subjects are 60 years old.

Table 2. Characteristics of study participants. by educational level

	Total (n=2699)	Primary or less (n=1527)	Secondary (n=627)	Universitary (n=545)	P Value
Age. mean years (SD)	69.2(0.2)	70.2(0.2)	67.7(0.3)	67.9(0.3)	<0.001
Men %	47.0	38.4	54.8	63.9	<0.001
Non-manual occupation. %	62.3	46.1	73.8	98.2	<0.001
Non-manual father's occupation. %	61.3	52.9	68.2	78.8	<0.001
Smoking. %					<0.001
Primary or less	58.7	69.6	47.5	39.2	
Secondary	29.9	22.5	36.8	43.8	
University	11.4	7.9	15.7	16.9	
Alcohol consumption , %					<0.001
Never-drinker	38.8	44.6	31.3	30.1	
Ex drinker	8.8	9.9	8.1	6.2	
Moderate consumption	44.4	38.6	50.5	54.8	
Excessive consumption	8.0	6.9	10.0	8.9	
Mediterranean diet[a]. %	16.3	16.0	16.5	17.1	0.877
Leisure time physical activity. MET–hours/week. median (SD)	21.5(0.4)	19.2(0.4)	23.1(0.8)	26.8(0.9)	<0.001
Overall physical activity. %					<0.001
Inactive	45.7	48.7	41.8	40.9	
Moderately inactive	33.3	34.2	33.4	30.6	
Moderately active	15.2	12.8	17.7	19.6	
Active	5.8	4.2	7.1	8.9	
Television. hours/week	18.5(0.3)	20.2(0.4)	17.6(0.5)	14.1(0.5)	<0.001
General obesity,%	34.4	40.6	28.5	22.8	<0.001
Abdominal obesity,%	59.7	67.0	50.9	48.2	<0.001
Hypertension,%	67.7	69.7	64.4	65.8	0.066
Hypercholesterolemia,%	70.4	72.2	68.5	67.3	0.117
Diabetes,%	17.4	19.4	14.8	14.5	<0.050
Metabolic syndrome,%	41.3	46.2	36.6	31.8	<0.001
Cardiovascular disease,%	5.7	6.8	5.0	3.2	0.016
Cardiovascular risk. mean (SD)[b]	3.1(0.1)	2.8(0.1)	3.3(0.1)	3.6(0.2)	<0.001

Unless otherwise indicated,the data are expressed as mean ± standard deviation.
[a] MEDAS (Mediterranean Diet Adherence Screener) score ≥9.
[b] Risk of fatal cardiovascular disease, estimated using the SCORE equation for low-risk countries and assuming all subjects are 60 years old.

Table 3. Characteristics of study participants, by occupation

	Total (n=2699)	Manual (n=965)	Non Manual (n=1734)	P Value
Age. mean years (SD)	69.2(0.2)	69.4 (0.3)	69.0 (0.2)	0.349
Men %	47.0	42.9	49.5	0.010
Nivel de estudios. %				<0.001
Primarios o menos	58.0	83.0	42.9	
Secundarios	23.2	16.1	27.4	
Universitarios	18.8	1.0	29.7	
Non-manual father's	61.3	42.7	72.6	<0.001
Smoking. %				<0.010
Primary or less	58.7	63.3	56.0	
Secondary	29.9	25.4	32.6	
University	11.4	11.3	11.5	
Alcohol consumption, %				<0.001
Never-drinker	38.8	43.3	36.1	
Exdrinker	8.8	11.3	7.2	
Moderate consumption	44.4	38.6	48.0	
Excessive consumption	8.0	6.8	8.8	
Mediterranean diet[a]. %	16.3	16.2	16.4	0.916
Leisure time physical activity. MET–hours/week. median (SD)	21.5(0.4)	20.4(0.6)	22.2(0.5)	<0.010
Overall physical activity. %				<0.001
Inactive	45.7	48.8	43.8	
Moderately inactive	33.3	34.5	32.6	
Moderately active	15.2	10.8	17.9	
Active	5.8	6.0	5.7	
Television. hours/week	18.5 (0.3)	20.0(0.4)	17.6(0.3)	<0.001
General obesity,%	34.4	40.5	30.7	<0.001
Abdominal obesity,%	59.7	65.2	56.4	<0.001
Hypertension,%	67.7	70.4	66.1	<0.050
Hypercholesterolemia,%	70.4	71.2	69.9	0.557
Diabetes,%	17.4	21.9	14.6	<0.001
Metabolic syndrome,%	41.3	45.1	39.0	<0.010
Cardiovascular disease. %	5.7	6.7	5.1	0.151
Cardiovascular risk. mean (SD)[b]	3.1 (0.6)	3.1(0.1)	3.1(0.1)	0.939

Unless otherwise indicated, the data are expressed as mean ± standard deviation.
[a] MEDAS (Mediterranean Diet Adherence Screener) score ≥9.
[b] Risk of fatal cardiovascular disease, estimated using the SCORE equation for low-risk countries and assuming all subjects are 60 years old.

Annex 3: Supplementary material: Article 2

Table 4: Stratified analyses for the association between housing conditions and limitations in physical function in older adults

				Frailty		IADL disability
	Short Physical Performance Battery	Mobility limitations	Agility imitations	Pre-frail (vs. robust)	Frail (vs. robust)	
	Beta (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Men						
No poor conditions	-	1.00	1.00	1.00	1.00	1.00
1 poor condition	0.25 (-0.14;0.51)	0.71 (0.50;1.01)	0.78 (0.57;1.06)	0.81 (0.60;1.09)	0.54 (0.20;1.45)	1.03 (0.55;1.96)
≥ 2 poor conditions	**-1.03 (-1.62;-0.44)**	1.53 (0.75;3.14)	1.82 (0.91;3.63)	**3.15 (1.51;6.58)**	3.33 (0.38;29.01)	0.70 (0.14;3.59)
p-trend	0.32	0.81	0.96	0.19	0.91	0.81
Women						
No poor conditions	-	1.00	1.00	1.00	1.00	1.00
1 poor condition	-0.30 (-0.60;0.00)	1.08 (0.79;1.46)	1.12 (0.82;1.53)	1.22 (0.89;1.67)	2.28 (0.97;5.34)	1.55 (0.86;2.79)
≥ 2 poor conditions	**-1.45 (-2.02;-0.89)**	0.85 (0.47;1.54)	1.44 (0.74;2.81)	1.78 (0.89;3.55)	**36.2 (8.30;158.15)**	1.44 (0.56;3.67)
p-trend	<**0.01**	0.75	0.38	0.09	**<0.01**	0.75
P for interaction (men vs. women)	**0.02**	0.06	0.18	**0.05**	**0.04**	0.56

IADL: Instrumental activities of daily living. OR: Odds ratio; CI: Confidence interval.
Poor conditions: lacking an elevator, lacking heating or the individual feels cold frequently.
Models are adjusted as in model 2 in table 9. Statistically significant results are presented in bold

Annex 4: Supplementary material: Article 4

Table 5: Prevalence of disability by country, educational level and gender (age 30-79)

Country	Gender	Total % (CI 95%)	Low Educated % (CI 95%)	Medium Educated % (CI 95%)	Highly Educated % (CI 95%)	GALI differentials (high-low)% (CI 95%)
Austria	Male	22.3 (19.1 - 25.5)	23.3 (19.6 - 27.1)	13.7 (7.6 - 19.8)	20.7 (11.8 - 29.5)	2.7 (-8.1 - 6.4)
	Female	20.9 (17.9 - 23.9)	20.4 (17 - 23.8)	26.7 (17.5 - 36)	14 (7 - 21.1)	6.3 (-0.7 - 10.1)
Belgium	Male	25.8 (22.3 - 29.3)	32.5 (27.2 - 37.9)	21 (14.7 - 27.2)	11.8 (5.4 - 18.2)	20.7 (12.3 - 27.7)
	Female	29.5 (26 - 33)	35.4 (29.5 - 41.3)	27.1 (20.2 - 34.1)	26.4 (19.7 - 33.1)	9 (2.1 - 17.4)
Czech Republic	Male	26.7 (23.7 - 29.7)	27.2 (22.8 - 31.5)	27.2 (22.5 - 31.9)	28.1 (19.8 - 36.3)	-0.9 (-4.7 - 9.7)
	Female	32.2 (29.2 - 35.2)	36 (31.1 - 40.9)	29.1 (24.7 - 33.6)	43.3 (33.3 - 53.4)	-7.3 (-12.4 - 1.7)
Denmark	Male	26 (22.1 - 29.9)	27.5 (22.5 - 32.6)	21.3 (11.3 - 31.3)	20 (12.5 - 27.4)	7.5 (3.7 - 9.6)
	Female	31.7 (27.9 - 35.6)	37.9 (32.6 - 43.3)	39.7 (32.4 - 47)	15.4 (9 - 21.9)	22.5 (17 - 28.6)
Estonia	Male	26.8 (23.4 - 30.2)	39.9 (31.2 - 48.7)	24.7 (20.2 - 29.1)	21.3 (14.5 - 28)	18.7 (15.4 - 32.5)
	Female	25 (22.1 - 27.9)	37.5 (28.5 - 46.5)	26.4 (22.3 - 30.5)	14.8 (10.3 - 19.4)	22.7 (14.3 - 33.3)
Finland	Male	28.9 (25.6 - 32.2)	34.6 (28.2 - 41.1)	30.4 (25.4 - 35.4)	17.6 (11.5 - 23.6)	17.1 (5.9 - 27.9)
	Female	35.5 (32 - 39)	51.5 (46.4 - 56.7)	34.5 (29.5 - 39.6)	29.5 (22 - 36.9)	22.1 (3.6 - 35.9)
France	Male	23.8 (20.6 - 27)	27.8 (23.4 - 32.2)	18.9 (12.2 - 25.7)	17.2 (9 - 25.4)	10.6 (5.8 - 13.5)
	Female	28.1 (24.8 - 31.4)	29.9 (25.7 - 34.1)	30.3 (22.6 - 38.1)	9.1 (2.7 - 15.5)	20.8 (9.5 - 26.6)
Germany	Male	30.4 (27.6 - 33.1)	34 (30.3 - 37.7)	28.6 (22.7 - 34.4)	20.6 (14.8 - 26.5)	13.4 (11.6 - 16.2)
	Female	33.8 (31 - 36.5)	37 (33.4 - 40.6)	30.8 (23.4 - 38.2)	24 (16.4 - 31.6)	13 (10.7 - 21.5)
Hungary	Male	28.1 (24.4 - 31.8)	33.2 (28.3 - 38.2)	17.4 (10.5 - 24.3)	24.4 (15.5 - 33.3)	8.8 (3 - 11)
	Female	31.4 (28.1 - 34.7)	38.5 (34 - 43)	19.2 (13.3 - 25.1)	19.1 (10.6 - 27.6)	19.4 (13.9 - 26.9)
Ireland	Male	16.7 (14 - 19.3)	22.6 (18 - 27.2)	12.1 (8 - 16.2)	9.6 (4.8 - 14.5)	13 (9.7 - 20.5)
	Female	16.4 (13.9 - 18.9)	19.2 (14.8 - 23.5)	14 (10.2 - 17.9)	15.5 (8.8 - 22.1)	3.7 (-4.2 - 10.9)
Lithuania	Male	32.6 (29.4 - 35.8)	36.2 (29.7 - 42.6)	32.1 (27.4 - 36.8)	22 (13.2 - 30.8)	14.1 (3.5 - 24.1)
	Female	35.4 (32.4 - 38.4)	53.3 (44.7 - 62)	35.2 (30.9 - 39.4)	20.1 (12.2 - 27.9)	33.3 (16.4 - 43.2)
Netherlands	Male	28.7 (25.3 - 32.1)	33.8 (29.2 - 38.4)	30.3 (22.7 - 37.9)	18.2 (12.1 - 24.3)	15.6 (9.9 - 21.3)
	Female	33.1 (29.7 - 36.6)	35.7 (31.2 - 40.1)	34.9 (24.8 - 45)	26.9 (18.7 - 35.1)	8.8 (3.6 - 14.5)
Norway	Male	22.5 (19 - 26.1)	23.7 (18.2 - 29.3)	24.8 (18.2 - 31.4)	19.4 (11.9 - 26.9)	4.3 (-3.3 - 11.4)
	Female	35.2 (31.1 - 39.4)	40.7 (33.9 - 47.5)	38.5 (29.7 - 47.3)	21.8 (14.7 - 28.8)	18.9 (12.2 - 24)

Country	Gender	Total % (CI 95%)	Low Educated % (CI 95%)	Medium Educated % (CI 95%)	Highly Educated % (CI 95%)	GALI differentials (high-low)% (CI 95%)
Poland	Male	27.4 (23.7 - 31)	29.5 (25 - 34)	23.9 (16.4 - 31.3)	12 (5.3 - 18.7)	17.5 (13.2 - 21.6)
	Female	30.9 (27.3 - 34.4)	34.6 (29.6 - 39.5)	23.7 (17.5 - 29.9)	19.8 (14.4 - 25.3)	14.7 (9.5 - 22.8)
Slovenia	Male	31.2 (26.9 - 35.5)	33.2 (27.3 - 39.1)	28.7 (21.7 - 35.7)	31.3 (21.1 - 41.6)	1.9 (-0.9 - 4.2)
	Female	39 (34.7 - 43.3)	48 (41.3 - 54.6)	29.9 (23.2 - 36.6)	15.1 (6.4 - 23.7)	32.9 (26.2 - 38.5)
Spain	Male	13.7 (11.1 - 16.4)	15.1 (11.9 - 18.3)	7.3 (1.3 - 13.4)	8.5 (3.1 - 14)	6.6 (0.2 - 11.4)
	Female	17.5 (14.7 - 20.3)	18.8 (15.4 - 22.2)	12.8 (4.6 - 21)	3.3 (0.2 - 6.3)	15.5 (12.9 - 17)
Sweden	Male	25.4 (22.1 - 28.7)	26.2 (19.5 - 32.9)	28.5 (23 - 34.1)	15.6 (9.2 - 21.9)	10.7 (0.7 - 17.7)
	Female	35.1 (31.2 - 39)	52.5 (44.4 - 60.6)	35.6 (29.9 - 41.4)	27.6 (20.2 - 35)	24.9 (15.5 - 30.4)
Switzerland	Male	19.1 (15.8 - 22.4)	23.8 (18.4 - 29.1)	18 (12.1 - 24)	11.4 (5.5 - 17.2)	12.4 (8.4 - 18.3)
	Female	22.3 (18.9 - 25.7)	24.9 (20.4 - 29.5)	18.3 (11.4 - 25.2)	18.5 (10.8 - 26.2)	6.4 (-0.2 - 7.5)
United Kingdom	Male	24.8 (21.8 - 27.8)	31.9 (26.5 - 37.3)	26.9 (21.1 - 32.6)	12.9 (8.4 - 17.4)	19 (14 - 25.3)
	Female	26.3 (23.4 - 29.2)	29.1 (24.2 - 34)	25.4 (19.9 - 30.9)	25.3 (19.8 - 30.9)	3.8 (-5.9 - 12.6)
All (pooled)	Male	25.1 (24.3 - 25.8)	32 (30.9 - 33.1)	22.8 (21.5 - 24.1)	15.4 (14 - 16.9)	16.5 (15 - 18)
	Female	29 (28.2 - 29.7)	36 (34.9 - 37.1)	26.6 (25.3 - 27.9)	18.9 (17.3 - 20.4)	17.1 (15.6 - 18.6)

Source: European Social Survey Round 7. 2014
Prevalences rates were standardized to the 1976 European Standard Population

Table 6: Population and response rates by country

Country	Unweighted population	Weighted population	% Response Rates
Austria	1411	1323	51.6%
Belgium	1267	1230	57.0%
Czech Republic	1726	1540	67.9%
Denmark	1115	1070	51.9%
Estonia	1560	1428	59.9%
Finland	1588	1471	62.7%
France	1472	1373	50.9%
Germany	2368	2191	31.4%
Hungary	1348	1187	52.7%
Ireland	1878	1608	60.7%
Lithuania	1774	1561	68.9%
Netherlands	1517	1371	58.6%
Norway	1062	1043	53.9%
Poland	1187	1133	65.8%
Slovenia	934	849	52.3%
Spain	1459	1338	67.9%
Sweden	1307	1241	50.1%
Switzerland	1138	1114	52.7%
United Kingdom	1784	1649	43.6%
All	**27895**	**25720**	

Source: European Social Survey Round 7. 2014

Annex 5: Article 1

Pérez-Hernández B. García-Esquinas E. Graciani A. et al. Social Inequalities in Cardiovascular Risk Factors Among Older Adults in Spain:The Senior-ENRICA Study. Revista Española de Cardiología 2017;70:145-54. doi.org/10.1016/j.rec.2016.05.010

Annex 6: Article 2

García-Esquinas E. Pérez-Hernández B. Guallar-Castillón P. Banegas JR. Ayuso-Mateos JL. Rodríguez-Artalejo F. Housing conditions and limitations in physical function among older adults. J Epidemiol Community Health 2016:jech-2016-207183. dx.doi.org/10.1136/jech-2016-207183

Annex 7: Article 3:

Pérez-Hernández B. Lopez-García E. Graciani A. Ayuso-Mateos JL. Rodríguez-Artalejo F. García-Esquinas E. Housing conditions and risk of physical function limitations: a prospective study of community-dwelling older adults. Journal of Public Health 2018. doi.org/10.1093/pubmed/fdy004

Annex 8: Article 4:

Pérez-Hernández B. Rubio JR. Nusselder WJ. Mackenbach JP. Socioeconomic inequalities in disability in Europe: contribution of behavioral. work-related and living conditions. European Journal of Public Health 2018.