ISSN 1831-9424

European Commission

JRC TECHNICAL REPORT

Demographic microsimulation of long-term care needs in the European Union

Prototype for a microsimulation model projecting the demand for long-term care up to 2070

Belmonte, M., Grubanov-Boskovic, S., Natale, F., Conte, A., Belanger, A., Sabourin, P.

2023

Joint Research Centre

EUR 31739 EN

Contact information
Name: Martina Belmonte
Address: Via Enrico Fermi 2749 I-21027 Ispra/Italy
Email: martina.belmonte@ec.europa.eu
Tel.: +39 0332 789821

EU Science Hub
https://joint-research-centre.ec.europa.eu

JRC135303

EUR 31739 EN

Print	ISBN 978-92-68-09581-2	ISSN 1018-5593	doi:10.2760/373981	KJ-NA-31-739-EN-C
PDF	ISBN 978-92-68-09582-9	ISSN 1831-9424	doi:10.2760/941182	KJ-NA-31-739-EN-N

Luxembourg: Publications Office of the European Union, 2023

How to cite this report: Belmonte, M., Grubanov-Boskovic, S., Natale, F., Conte, A., Belanger, A. and Sabourin, P., *Demographic microsimulation of long-term care needs in the European Union*, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/941182, JRC135303.

Contents

Abstract

This study presents a prototype microsimulation demographic model that projects the risk of developing long-term care needs for the over-50 population in selected European countries from 2011 to 2070. It uses the Survey of Health, Ageing and Retirement in Europe (SHARE) microdata and a dynamic demographic microsimulation model based on CEPAM-Mic. The model considers demographic and risk factors associated with the prevalence of disability, such as sex, age, country of residence, immigration status, education, chronic disease, smoking, and obesity.

The results indicate a persistent trend of an increasing proportion of the population with long-term care needs and chronic diseases, largely due to demographic factors and aging. Alternative scenarios with significant reductions in smoking and obesity are shown to be not enough to offset this trend. Preventing age-specific long-term care needs will have limited impact and comprehensive interventions are needed to address the health and long-term care challenges posed by an aging population. The study also emphasizes the importance of considering education as a key factor in population health and the need for health promotion and disease prevention efforts.

Acknowledgements

We express our gratitude to Susanna Ulinski, Flaviana Teodosiu, Eliska Kolinkova, Diana Eriksonaite, Barbara Lypszyc (DG EMPL), Lucian Agafitei, Estefania Alaminos Aguilera (ESTAT), Santiago Alvaro Calvo Ramos (DG ECFIN), Claudio Bosco, Nina Kajander, Paola Salari (JRC) and other colleagues from JRC E5 for the various inputs received during the preparation of this report and for the supporting story of the Atlas of Demography on Long-term care published in September 2022.

Authors

Belanger Alain,*** Belmonte Martina,* Conte Alessandra,* Sara Grubanov-Boskovic*, Natale Fabrizio,* Sabourin Patrick****

*JRC

**OECD. Sara Grubanov-Boskovic She completed this research project during her period of work at the European Commission, Joint Research Centre. The opinions expressed and arguments employed are solely those of the authors and should not be reported as representing the official position or opinion of the OECD nor its Member countries. OECD nor any person acting on behalf of the OECD is responsible for the use that might be made of this publication.

*** Quebec Institut National de la Recherche Scientifique (INRS-Urbanisation Culture Société)

****Bank of Canada

1 Introduction

In September 2022 **the European Commission has launched a new European Care Strategy** accompanied by two proposals for Council Recommendations (adopted by the Council in December 2022) for Member States on the revision of the Barcelona targets on early childhood education and care, and on access to affordable high-quality long-term care. The concept of long-term care (LTC) adopted in the Council Recommendation refers to a range of services and assistance for people who for mental or physical frailty, disease and/or disability over an extended period of time depend on support for daily living activities and/or are in need of some permanent nursing care, such as eating or dressing, or preparing meals or using the phone (Council Recommendation, 2022.[1]

According to this wide definition, LTC covers a variety of situations and cuts across age groups. People may have a reduction in their autonomy due to an illness or an accident; the reduction may be temporary or permanent; and set to improve or deteriorate. Moreover, the capacity to perform daily activities depends on the health condition of the person as well as on the surrounding environment that facilitates or hampers such activity. As a result, the same health condition may result in different degrees of LTC needs.

Common knowledge and evidence indicate that the prevalence of people with activity limitations is higher among older age groups. Figure 1 shows the share of people that reported having experienced longstanding[2] severe limitations with usual activities due to health issues. This share progressively increases with age, both for men and for women and is consistent across time. While age in itself is not a determinant of LTC needs, it is associated with other factors that increase the likelihood of an autonomy loss (European Commission 2021).

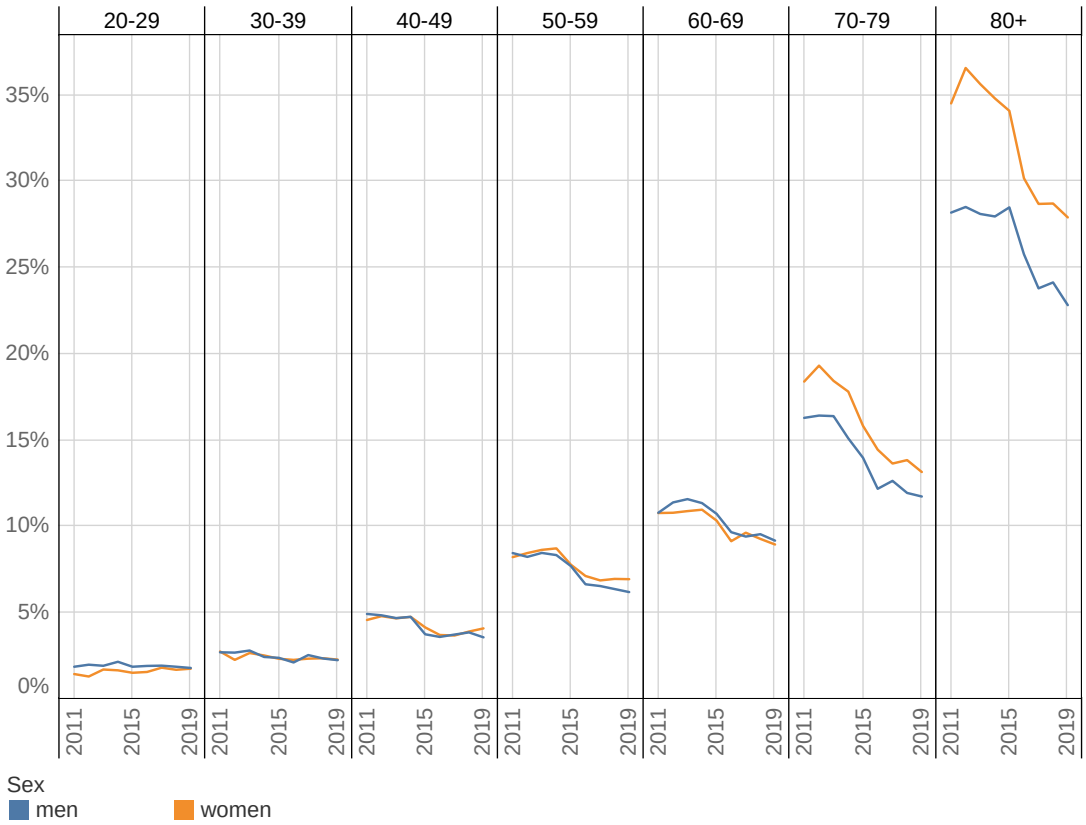


Figure 1 - Share of the population with a severe level of activity limitation by age group (2011-2019). Source: own elaboration of EU-SILC, 2011-2019, PH030.

[1] In this paper we use LTC needs and disability interchangeably. See Chapter 2 for more details on the definitions and EU data sources to measure LTC needs)

[2] For at least the past 6 months or more.

When seen in a future perspective and in the context of an ageing population the high prevalence of activity limitations among the older age groups implies an increase of LTC needs in the EU purely driven by demographic factors. The EU Ageing Report projects of an increase of long-term care in the EU-27 of more than 7 million people to reach 38.1 million by 2050[3]. These projections are based on a fixed prevalence rate of activity limitation by age groups which is applied to the demographic projections formulated by Eurostat. By assuming a constant relation between age and activity limitations, future needs are only determined by the evolution of the age structure of the EU population.

The evidence from past trends of the prevalence within age groups seems to indicate that the share of people to report activity limitation is decreasing over time, at least at an aggregated EU level (Figure 1).[4] This may point at some cohort-related factors that affect the likelihood of developing LTC needs, related for instance to a healthier lifestyle, more prevention, or wider access to health care. Similarly, the indicator of healthy life years at 65 registers a gradual increase at the aggregate EU level (from 8 years in 2009 to 9.7 in 2021)[5]. However, research is not conclusive on the weather added years are spent in good health and without additional activity limitations (WHO 2015, pg. 65, OECD 2007), and this trend is not common to all MS.

Besides age, other socio-demographic and economic dimensions seem to have a fundamental role in determining the evolution of LTC needs.

Lager shares of **women** tend to have more LTC needs than men (European Commission and Social Protection Committee, 2021). In the EU population, 32% of women aged 65 or over experience severe difficulties with personal care or household activities, compared to 19% of men. This is true for all age groups above 55, but markedly for the group 75+ where the gap widens, reaching 18 percentage points (Figure 2). This tendency is clearly visible in the total EU population, and it is common to most countries.

LTC needs decrease on the basis of the level of **income**, so that larger shares of people in lower income groups experience severe difficulties than in higher income groups. In the EU population aged 65 or above, the level of difficulties is the highest in the first income quantile (36%) and the lowest in the fifth income quantile (17%) (Figure 2). At the same time, because of the more limited financial means, people with lower level of income face more obstacles in accessing LTC. On the supply side, workers in the LTC sector tend to be paid well below the national average wages. Salaries are particularly low when the care workers are employed the care receivers themselves, without intermediation (Eurofound 2020).

[3] European Commission and Economic Policy Committee, 2021, The 2021 Ageing Report – Economic and budgetary projections for the 27 EU Member States (2019-2070)

[4] To be noted that in 2015 Germany reported a break in time series (due to a change in the wording of GALI).

[5] Indicator "healthy life years", source: Eurostat, online data code: hlth_hlye_h

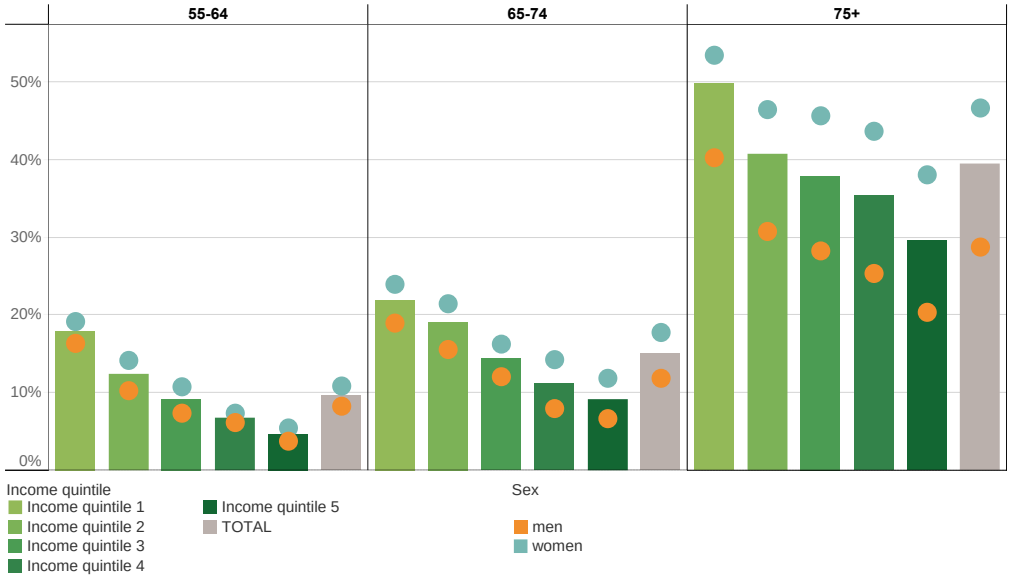


Figure 2– Share of people with a severe level of difficulty with personal care or household activities by age, sex and income quintile (2019). Source: own elaboration of EHIS, 2019 hlth_ehis_tai.

Among the main factors that could shape different trajectories of LTC needs and a different evolution of the relation between age and activity limitation it is important to consider the role of active ageing policies, health and social protection policies. This is the case when health issues are protracted so to entail a long-term need of assistance. Preventing such health issues to arise or mitigating their effect at an early stage has the potential of reducing or delaying the LTC needs. Promoting healthy ageing means "maintaining the older population in good physical, social and mental health, facilitating their autonomy and independence for as long as possible, throughout their remaining years" (OECD 2021). The United Nations Economic Commission for Europe (UNECE) and the European Commission (2018) defined an Active Ageing Index to "measure the level to which older people live independent lives, participate in paid employment and social activities as well as their capacity to actively age". It includes 22 indicators in the domains of employment (e.g. employment rate), participation in society (e.g. voluntary services), independent, healthy and secure living (e.g. physical exercise), and capacity and enabling environment for active ageing (e.g. social connectedness). These are all areas where the ambitious actions on health promotion and disease prevention that are called for in the Council Recommendation can be implemented to ensure that people remain in good mental and physical health.

The main objective of this report is to complement the projections of LTC for the EU formulated in the EU Ageing Report by relaxing the assumption of fixed prevalence of activity limitations by age. By adopting a methodological approach based on demographic microsimulations we are considering more complex dynamics and interactions between age, sex and education and the health risks of smoking and obesity as predisposing factors for the activity limitations and severe chronic disease.

Our modelling scheme considers effect of sociodemographic characteristics of age, sex and education on the health risks of smoking, obesity, and chronic disease and how these effects translate in future LTC needs. Through a set of scenarios, we perturbate the baseline projections to explore how policy actions on healthy ageing and in particular on the reduction of smoking and obesity (**Healthier life-style**) could reduce the prevalence of activity limitation in the EU population. Furthermore, we evaluate the relevance of education (**Reduction in Education**) and explore the increase of needs purely arising from an increase in life expectancy keeping all the rest constant (**Longer life expectancy without health gains**).

The report is only looking at the demand side of LTC and how needs are determined by the interaction between demographic factors and health conditions. Despite the fact that some influences from economic factors are indirectly captured by education dimension, our exercise remains demographic and is therefore not able to simulate a possible reduction of needs arising for change in income distribution within the EU population. Furthermore, our exercise is not considering how needs can be met or left unaddressed based on different forms of LTC provision.

The report is structured in the following sections:

- Chapter 2 gives an overview of definitions, indicators and data sources to measure LTC needs;
- Chapter 3 describes the main approaches to project LTC needs;
- Chapter 4 describes the microsimulation model and its specifications;
- Chapter 5 describes the scenarios we have implemented in the projections;
- Chapter 6 describes the results of simulations in terms of LTC needs;
- The Annexes provide more details on the model results for smoking, obesity and chronic disease under each scenario and a validation of the baseline.

2 Definitions, indicators and data sources to measure LTC needs

The definition of LTC needs refers to the support for daily living activities and/or permanent nursing. **Its measurement however is more complicated**. This is due to the fact that a met or a pre-empted need may no longer be experienced as such. The environment a person lives affects the need, as it makes a condition an obstacle to carrying out certain activities. Finally, there is an inherent subjectivity in self-perception metrics that hampers comparability

One strategy to measure LTC needs is to rely on the number of people benefitting from LTC. Indeed, this is misleading as the number will depend not only on the actual number of people in need (demand side), but also on the availability of the LTC services (supply side). These vary by country, both in terms of delivery modes and in terms of coverage. Relying on the number of people benefitting from LTC would therefore lead to a likely underestimation of the number of people in need of LTC and to comparability issues across countries or, within countries, across groups who have different access to LTC (e.g. by income or gender).

Another strategy is to focus on the demand side only. There are several interlinked concepts used in the literature to assess LTC needs, with different operationalisation outcomes. Along a line that measures the generality of a concept in a decreasing order, we find the concepts of health – which is very general and comprehensive –, the concept of frailty, the concept of dependency, and finally morbidity/physical condition of impairment.

- LTC is linked to people's **health**. People with a good health status are less likely to need (or do not need at all) LTC. Health is a comprehensive and general concept defined by the World Health Organisation (WHO) as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (WHO Constitution).[6] Health is the product of various factors, ranging from biology, individual behaviour, socio-economic characteristics of the person, and the environment the person lives in. Poor health conditions are related to LTC as predictors or as consequences. People with health issues need health care, but not necessarily on a long-term basis. At the same time, as health conditions tend to deteriorate as the age progresses, so the need for LTC increases.

  To measure a person's health status in a comprehensive and objective manner, Marois and Aktas (2021) propose to measure health as a continuous variable from 0 to 100, measuring the capacity of a person to *function* in various domains to assess the capability of people to meet their basic needs; learn, grow and make decisions; be mobile; build and maintain social relationships; and contribute to society.

- Linked to health and age, there is the concept of **frailty**. It is defined as "a clinically recognizable state in older people who have increased vulnerability, resulting from age-associated declines in physiological reserve and function across multiple organ systems, such that the ability to cope with everyday or acute stressors is compromised" (WHO 2017). Frailty is a precursor of disability and includes dimensions linked to a deteriorating health status. It may be reversible with preventive action, so that the person does not end up in need of LTC.

  Frailty can be measured by using the phenotype (e.g. weaknesses, slowness, low level of physical activity, exhaustion and weight loss) (WHO 2017). This is for instance used by Santos-Eggimann et al. (2009) who uses the answers to the Survey of Health, Aging and Retirement in Europe (SHARE) to measure the level of frailty of a person. Another measurement is the frailty index that focuses on age-related signs, symptoms, diseases and impairments that can be linked to frailty (called deficits). The deficits that a person reports are then divided by the potential deficits considered after a clinical evaluation (WHO 2017). This method is for instance used by Campitelli et al. (2016) to measure the frailty of the population in Ontario.

- At the opposite end of the line of generality, we find concepts related to a physical condition or impairment. This is for instance the definition of **disability** which was used by WHO until 2001 (see next paragraph for more recent definition), **linked to impairment**. This referred to disability as "restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being".[7] It is also used in the 2021 Ageing Report which defines disability as a functional impairment. This definition however is too restrictive to measure LTC needs. These do not only or not necessarily depend on a physical condition, but also on the social environment the person lives in. As noted

[6] Constitution of the World Heath Organization, available at http://apps.who.int/gb/bd/PDF/bd47/EN/constitution-en.pdf?ua=1
[7] International Classification of Impairments, Disabilities, and Handicaps, WHO 1976 https://apps.who.int/iris/handle/10665/41003

in the Ageing Report, disability in this narrow sense is not the same as dependency, as some people with an impairment can live lives without depending on others' help.

- The more recent WHO definition of **disability** focuses on the **interaction of a physical, mental, intellectual or sensory impairment, with the environment**, that thus hinders the persons' participation in the society on an equal basis with others. WHO (2015) proposes a framework where the focus to measure health is not on comorbidity but rather on functions.

  This is linked to the concept of **activity limitation**, in particular limitation with activities of daily living (ADLs) or with instrumental activities of daily living (iADLs).[8] These have been first validated by Kats (1983) and are today widely used to measure long term care (OECD 2007, OECD 2021, Atella et al. 2017, European Commission and Social Protection Committee 2021). ADLs refer to basic activities, namely eating, dressing, walking, taking care of one's own personal hygiene, dressing, getting out of bed, eating. iADLs refer to activities that require more complex abilities, like doing shopping, cleaning, managing money, taking medications, lifting weights, cleaning the house, etc.

  ADLs are often used to indicate *severe* disabilities, as they refer to more basic functions. They are more likely to be reported by survey respondents, and less prone to subjective assessment (European Commission and Social Protection Committee, 2021, OECD 2007).

  We refer to this definition of activity limitation to measure LTC needs.

  Large scale surveys often ask questions that test difficulties with ADLs and iADLs. All indicators are derived from self-reported data and could therefore be influenced by the subjective perception of the respondents and their social and cultural background. Table 1 reports the surveys available to study LTC needs. Surveys differ in the target population and in the questions asked.

  Table 1 – Sources to quantify LTC needs using (i)ALDs in Europe.

Survey	Main characteristics	Questions
Survey of Health, Ageing and Retirement in Europe (SHARE)	Survey on the effects of health, social, economic and environmental policies over the life-course of European citizens and beyond. Data are available for a subset of European countries and for waves 1 to 7, corresponding to the period between the years 2004-2017. It focuses only on the population aged over 50 and is also administered in residential care facilities.	Difficulties lasting more than three months with a list of (i)ADLs due to of a physical, mental, emotional or memory problem.
European Health Interview Survey (EHIS)	Survey conducted in all EU Member States and focused on the main aspects of the population health status and utilisation of health services. The EHIS does not cover the institutionalised population, e.g. people living in health and social care institutions, who are more likely to be limited than the population living in private homes. It is therefore likely that, to some extent, the EHIS underestimates the share of the population subject to limitations. Target population aged 55 and above	Difficulties with (i)ADLs and level of such difficulties (some, a lot, cannot do at all). Temporary problems are excluded.
European Union Statistics on Income and Living Conditions (EU-SILC)	Survey conducted in all EU Member States and focused on living conditions. Data on the population with limitations in daily activities (variable PH030)	The activity limitation variable is operationalised by using the global activity limitation indicator (GALI) to observe the limitation of activities that people habitually carry out due

[8] This is linked to a sub-set of difficulties that person with disabilities face in trying to "participate in the society on an equal basis with others" that require LTC. The other difficulties (e.g. access to training or job) need other social policies / support in addition to LTC.

	The core part[9] of the European Statistics of Income and Living Condition (EU-SILC) survey contains a small module on health, consisting of 3 variables on health status and 4 variables on unmet health care needs. The reference population includes all private households and their current members who are residing in the territory of the countries at the time of the data collection. All household members are surveyed, but only those aged 16 or older are interviewed.	to one or more health problems. The limitation must have lasted for at least the last six months. Three response categories are possible: "severely limited", "limited but not severely limited" or "not at all limited".

An indicator of activity limitation, as a proxy of LTC need scan then be derived in different ways: 1) by building a binary variable if at least one difficulty with ADL is reported by the surveyed person (OECD 2007); 2) by building a numerical variable that sums all the ADLs and/or iALDs that the person experiences difficulties in (Heger and Kolodziej 2015); and 3) by using a categorical variable by level of reported difficulty in at least one ADL/iADL (e.g. Eurostat, indicator hlth_ehis_tai).

[9] The European Statistics of Income and Living Conditions (EUI-SILC) collects annually some health variables, three on health status (PH010, PH020, PH030) and four on unmet health care needs (PH040, PH050, PH060, PH070). In addition, from 2022, EU-SILC collects every three years a module on "health", with 19 variables on health care, health determinants and details on health status and disability

3 Review of long-term care needs projection approaches

Once measures for LTC needs have been identified, it is possible to quantify the share of people with LTC needs today. Using these different metrics, the number of people suffering from severe activity limitations, and hence in need of LTC, ranges from 13% in the 50+ population (SHARE, 2004-2017, own calculation on waves 1-7), to 16% in the 65+ population (EU SILC, 2022),[10] and 20% in the 55+ population (EHIS, 2019)[11], with income, gender, and age differences (see also Atlas of Demography, Story on Long-term care, demand side[12]).

The second question is how the population with LTC needs will evolve in the future. The literature has used two methodological approaches to do this: macro- and microsimulation. **Macrosimulation** assumes that the share of people with LTC needs will be constant across demographic groups over time. This approach grafts the descriptive analysis of the current LTC needs distribution across demographic groups on the population projections.

- In Europe, the reference publication is the Ageing report produced by the Economic Policy Committee and the Commission - DG ECFIN (EC, 2021). If focuses on projecting up to year 2070 public expenditure on LTC as well as pensions, health care, education and unemployment benefits. To do so, it includes the projection of the demand for LTC. This is divided into the size of the people with LTC needs, calculated on the basis of the 4 year average activity limitation as captured by the EU-SILC global activity limitation indicator (Section 2), and the recipients of formal care (home, residential/institutions, cash benefits) with data provided by the MS. These are used to calculate the activity limitation rates by age groups that are then applied to the projected population by Eurostat.

  The report presents the simulation under various scenarios. In the demographic scenario, the share receiving LTC does not change by age cohort. In the higher life expectancy scenario, the life expectancy at birth is 2 years higher. The heathy ageing scenario assumes that LTC needs decreases over time for the same age groups so that the LTC needs of an age group is equal to the one of younger cohorts. Finally, in the AWG reference scenario, the increase in longevity that is projected is assumed to be spent by half in good health, i.e. without dependency. This means that for 50% of the population, the activity limitation rates are shifted along the age profile.

The second approach is based on **microsimulation.** This methodological approach allows to explore the interaction of various characteristics (e.g. risk factors and socio-demographic characteristics)_with the probability of developing LTC needs at the individual level.

- For the US, Goldman et al. (2013) used the dynamic microsimulation and multimorbidity Future Elderly Model (FEM) to compare the impact of different 'disease-specific' scenarios with a hypothetical 'delayed ageing' scenario on longevity, disability and the cost of care programmes for the elderly population. Guzman-Castillo et al. (2017) developed the IMPACT-Better Ageing Model for the UK, a probabilistic model that predicts life expectancy and disability burden on trends in cardiovascular disease, dementia, disability and mortality in the population aged 35-100 years. Foreman et al. (2018) used data from the Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) 2016 to develop a model predicting life expectancy, mortality, and causes of death in 195 countries from 2016 to 2040, considering the interplay between risk factors and health outcomes.
- For Europe, various models have been developed to examine ageing, caregiving, and health issues. One example is the SESIM model by Flood (2008) for Sweden.
- Vanella (2020) presented a stochastic outlook on long-term care insurance in Germany until 2045, forecasting the future number of frail persons who could claim insurance services by severity level using Monte Carlo simulations. The study concluded that the increase in severe disabilities in Germany due to demographic development is unavoidable, while changes in age-specific care risks do not significantly impact the outcome.
- Michaud et al. (2011) use an extended FEM Model to compare the longevity gap between elderly Americans and their Western European peers up to 2050, using dynamic interactions between several individual outcomes, including health status and economic behaviour.

[10] Eurostat, HLTH_SILC_06, https://ec.europa.eu/eurostat/databrowser/view/HLTH_SILC_06__custom_6839148/default/table?lang=en
[11] Eurostat, Ehis_ehs_tai, https://ec.europa.eu/eurostat/databrowser/view/HLTH_EHIS_TAI__custom_6839049/default/table?lang=en
[12] https://migration-demography-tools.jrc.ec.europa.eu/atlas-demography/stories/AoD/2/S3.8

- Atella et al., (2021) use FEM models for several European countries to predict the evolution of the prevalence of chronic diseases, life expectancy, disability-free life years and health expenditure in the population. The authors controlled for gender and education but found evidence of an increasing link between health and socio-economic status of the elderly patients.
- Atella et al. (2017) used the Europe Future Elderly Model (EuFEM) to analyse the future of European public LTC systems, drawing on SHARE data to capture trends in care demand by age, gender, and other demographic and social factors.
- Finally, Marois and Aktas (2021) present a dynamic microsimulation model to project the health of individuals for the period 2015-2060 in several European countries, considering interactions between sociodemographic characteristics, health, mortality, biomedical and behavioural risk factors. Using SHARE microdata, the authors illustrate the effects of risk factors and education on future health trajectories, concluding that better education could result in each future generation being healthier than the previous one at the same age.

The added value of the microsimulation is the dynamic interaction of determinants of LTC needs with the evolution of the population. Determinants can be broad and include epidemiological, genetics, demographic, and socio-economic characteristics, environmental factors, as well as individual habits. The speed at which LTC needs incur will depend also on the access to and effectiveness of preventive healthcare.

To identify a model that takes into account all these determinants is challenging. In this report, **we focus only on a subset of characteristics**: demographic (age, gender, education and migration status), epidemiological (chronic diseases and obesity), and habits, like smoking. We will then look at their interplay with microsimulation modelling.

- **Chronic health conditions**, including arthritis/rheumatism, hypertension, back problems, diabetes, and dementia, increase the likelihood of functional disability in the older population, leading to a higher need for long-term care (Raina et al, 2020). Heger and Kolodziej (2016), using SHARE data, found that disability levels in Europe have increased due to population ageing and a rise in the prevalence of diseases, while the negative impact of health conditions on disability levels has remained constant over time, suggesting that the extended lifespan is associated with an extension of morbidity.
- **Obesity** has also been shown to significantly increase the likelihood of disability. Applied to an analysis of the older American population, Sturm et al. (2004) suggest that if current trends in obesity continue, disability rates will increase by 1 percent per year more in the 50-69 age group. The 2022 WHO European Regional Obesity Report found that overweight and obesity affects 60% of adults in the European region and is the leading risk factor for disability, causing 7% of total years lived with disability.
- **Smoking** is also linked to increased rates of disability in Europe, as smokers are at higher risk of chronic diseases like cardiovascular diseases, respiratory diseases, and cancer, which can result in disability. Studies suggest that smoking is a major contributor to these health problems, increasing the likelihood of decreased quality of life and disability (Serrano et al, 2019; Timmermans et al., 2018).
- Among those, **education** has been identified as a key determinant of LTC needs. Higher education is generally linked to lower disability and LTC needs (Heger & Kolodziej, 2016; Marois et al., 2021), due to factors such as higher income, healthier lifestyles, and better health. According to the OECD (2021), adults with higher education (tertiary attainment) report better self-assessed health and longer expected lifespan compared to those with lower education (below upper secondary). The positive relationship between education and health is supported by vast research, which suggests that education improves health by increasing access to health information and promoting healthier lifestyle choices (Brunello et al., 2015, Goldman et al., 2015). Moreover, education has both direct and indirect effects on an individual's health and social outcomes. Lower education levels are associated with higher rates of smoking and obesity, even when controlling for other factors, while higher education is linked to improved health and increased lifespan (OECD, 2015, 2021).

4 Microsimulation model

In this section we present our microsimulation model to project the evolution in LTC needs up to 2070 on the basis of the demographic evolution of the population. **The model is demographic in nature**, in the sense that it mainly considers the demographic determinants of LTC needs and how they are expected to evolve over time. It includes the traditional demographic characteristics of the population, i.e., age, sex, country of residence, migration status, as well as education. It also considers the presence of chronic diseases[13] (dichotomous variable) and the likelihood to develop them, as these are strong predictors for LTC needs. The model includes other two risks factors on the basis of the literature (Section 3): smoking and obesity. A person is considered smoker if s/he has ever smoked on a daily basis, while it is considered as obese if the body mass index is equal or greater than 30. These are important to project how LTC needs would evolve in the future if policies to reduce the degree of obesity and smoking in the society were implemented.

Other variables could potentially be included the model, such as alcohol consumption, physical activity. We limit our models to two health risks and chronic disease for two reasons. Firstly, for simplicity we opted to limit this first testing of the model to few variables. Secondly, not all variables offered retrospective data, i.e. information on the time before the LTC needs occur. For instance, in SHARE interviewees report when the chronic disease appeared for the first time. SHARE also asks questions on physical activity, but not on physical activity before the LTC need arose. Similarly, the variable of alcohol consumption covers the current alcohol consumption and the frequency of events with high alcohol consumptions in the past three months. This would make it difficult to assess the impact of physical activity or alcohol consumption on the risk of developing LTC needs.

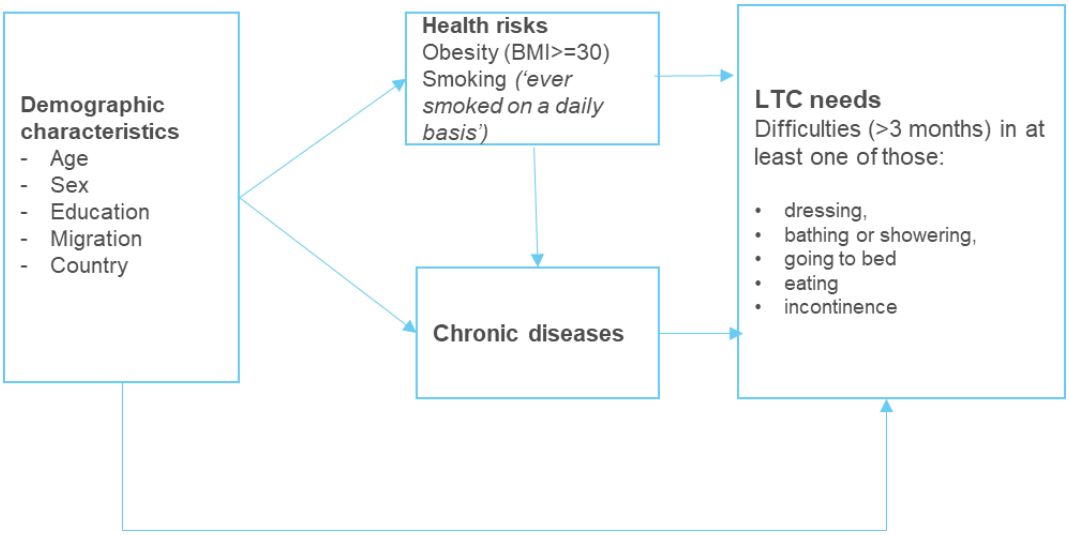


Figure 3 – The model for micro simulating the evolution of LTC needs

The microsimulation model is a time-based approach that simulates the yearly evolution of each individual. This allows for the considerations of **interactions between individuals and the use of contextual variables in calculating event probabilities**. This model operates in continuous time, dynamically updating individual characteristics in 'real time', unlike discrete-time models which update at predefined time intervals.[14] It projects both demographic characteristics (age, sex, place of residence, immigrant status), [15] and socioeconomic characteristics (education, labour participation) and take into account changes over a lifetime and intergenerational transfers (such as certain characteristics from mother to child). The demographic

13 Heart attack or other heart problems, high blood pressure, high blood cholesterol, stroke or cerebral vascular disease, diabetes, chronic lung disease, asthma, arthritis or rheumatism, osteoporosis, cancer or malignant tumour, stomach, duodenal or peptic ulcer, Parkinson disease, Alzheimer's disease, rheumatoid arthritis, osteoarthritis, or other rheumatism, chronic kidney disease.

14 In a continuous-time model, the event duration is calculated in three instances: at simulation start, upon changes in variables in the time function, and after the event occurs. Modgen manages changes in the event queue. Age influences multiple events in the model. Each time the actor's age changes, the risks of death, birth, relocation, emigration, obtaining a degree, and labour market activity/inactivity are re-evaluated and the waiting queue updated.

15 With regard to immigration, the model considers age at immigration and length of residence in the country for immigrants.

projections are based on microsimulations, since individuals in the base populations are simulated one by one, rather than being projected as aggregate population groups. The occurrence of events that model future populations depend on a selection of individual characteristics that may vary by event type and country. Due to its flexibility, this microsimulation model can be used to evaluate a variety of EU population characteristics, as done in Bélanger et al. (2020, 2022) to project the economic and fiscal impact of migrants in Europe over the coming decades.[16]

The assumptions concerning the future evolution of demographic components (fertility, mortality, migration) and educational attainments are based on the CEPAM-Mic model's baseline scenario.[17] This is designed to project the diversity of the European population, starting from 2011.[18] It uses interconnected prediction models to simulate demographic and socio-economic events, such as birth, ageing, migration, graduating, employment, and death, affecting individuals and their descendants. The base population is derived from the EU-Labour Force Survey microdata, and supplemented by the European Social Survey, to include individual characteristics not included in the EU-LFS. All CEPAM scenarios are developed using the Shared Socioeconomic Pathways (SSP2)[19] **medium scenario assumptions** for future fertility, mortality, and education in EU-28 countries, as documented in Lutz et al. (2018). It is important to note that these assumptions, which determine the size and age structure of the projected population, are based on pre-pandemic demographic trends observed in advanced economies[20], and reflect: a) low and persistent fertility below replacement levels (2.1 child per women), b) a slow and steady increase in life expectancy (mostly at older ages), c) a high immigration level and d) rising overall education levels.

Due to the absence of health status information in the baseline population, such as smoking habits, obesity, chronic diseases, and activity limitation, information from the SHARE microdata was integrated into the baseline population for individuals over 50 years using multinomial models. The Health Microsimulation Model is a dynamic projection model **based on the SHARE survey microdata** (waves 1-7 pooled)[21]. SHARE has been selected as, compared to other surveys, it follows people who are transferred into residential care (Section 2), thus limiting the underestimation of people with LTC needs. In addition SHARE contains information on people's life histories allowing to include in the model historical information on chronic diseases of the surveyed population, e.g. age at which the chronic disease was first diagnosed.

The Health Microsimulation Model projects the LTC needs of the population aged 50 or more in 19 European Union Member States[22] which presented a sufficient number of observations, over the next few decades. This experimental model considers two key risk factors, **smoking and obesity**, which influence the likelihood of **chronic disease** and subsequent **activity limitation**.[23] It's worth noting that the model relies on self-reported behavioral and health risk factors, which may not always be accurate, as individuals may under- or over-report their weight and smoking habits.

This microsimulation model makes the population over 50 evolve over time on a yearly basis. At the beginning of the simulation (t0, which corresponds to 2011 in the CEPAM-Mic model), the population over 50 has specific demographic characteristics as derived by the EU-Labour Force Survey microdata, and supplemented by the European Social Survey, as well as other characteristics (smoking, obesity, chronic disease), as derived by SHARE. For each age group, the activity limitation rate is estimated on the basis of the coefficients from the model based on SHARE data. As time passes (although the microsimulation is annual, for simplicity here we refer to 10-year periods), part of the population gets older (in Figure 4, the cells with the same colour refer to the same population that gets older), part of the population dies (not present in Figure 4),

16 For a comprehensive examination of the parameters affecting event generation modules, refer to Belanger et al. (2019). For more information on the education and fertility components, consult Marois et al. (2019b) and Potančoková and Marois (2020).

17 https://pure.iiasa.ac.at/id/eprint/15942/1/demographic_online_20190527.pdf

18 Developed by Bélanger et al. (2019), this microsimulation model analyzes the socioeconomic and cultural consequences of demographic changes in Europe. See also https://iiasa.ac.at/projects/iiasa-jrc-centre-of-expertise-on-population-and-migration-cepam

19 The Shared Socioeconomic Pathways (SSP) scenarios describe plausible future societal changes in demographics, human development, economy, institutions, technology, and environment in the context of sustainable development; SSP2 is a middle-of-the-road scenario (O'Neill et al. 2014). KC and Lutz (2014) detail the demographic components of SSPs.

20 https://www.europarl.europa.eu/RegData/etudes/STUD/2022/729461/EPRS_STU(2022)729461_EN.pdf

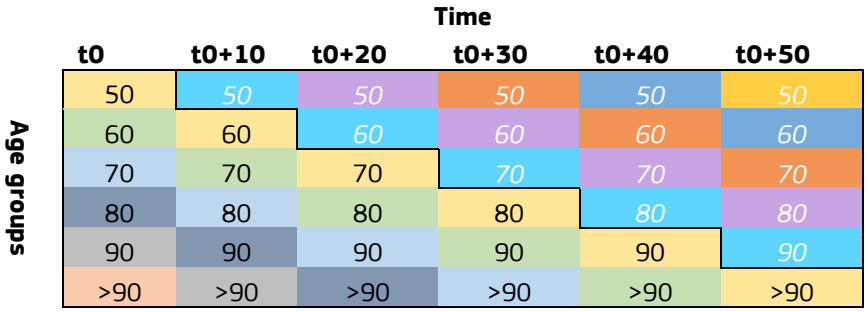
21 Small numbers and data quality make it difficult to analyze relatively rare events longitudinally. We pooled successive waves of SHARE data to increase sample size. It should be noted that this comes at the expense of understanding dynamics at play that may only be understood using longitudinal surveys.

22 These countries are: Austria, Belgium, Czech Republic, Germany, Denmark, Estonia, Spain, France, Greece, Croatia, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Sweden and Slovenia. The results therefore are on the population of these countries.

23 It is important to keep in mind that the model was designed as a prototype, using a limited selection of predictors simple to implement.

and part of the population enters the microsimulation at 50 (in Figure 4**Error! Reference source not found.**, the population entering and evolving in the simulation is the one above the step-shaped line in white). The activity limitation rate prevalence of the population at the second point in time (t0+10) is estimated by using the interplay between the demographic assumptions and the probabilities from SHARE of developing disabilities on the basis of the risk factors and the demographic characteristics, as projected in the CEPAM-Mic model's baseline scenario. Box 1reports the details of the model specification.

Figure 4 – Schematic description of the evolution of the population.



Box 1- Model specifications.

At the start of the simulation in 2011, obesity, smoking and chronic disease attributes are assigned to the entire projected population aged 50 and older. As the simulation progresses, health variables are automatically attributed to individuals turning 50. The attribution model employs a multinomial logit model (Greene 2018). This links nominal outcome variables – here defined as the eight possible combinations of obesity status (BMI greater than or equal to 30, or less than 30), smoking status (ever smoked or never smoked) and chronic disease status (has had a chronic disease or not) – and the independent variables, i.e. gender, age, education level, migrant status and country of residence (see Annex 1).

Smoking (as measured by the variable 'ever smoked') is considered an "absorbing state variable" in our model, meaning that once a person is classified as smoker (either currently or in the past), she/he cannot leave this status. To account for this, we assumed that no one starts smoking after the age of 50. It follows that in the baseline scenario, the proportion of smokers can only change in the future due to the arrival of new cohorts with varying portion of smokers. It is possible to create alternative scenarios to modulate the proportion of smokers in cohorts reaching 50 during the projection (see Section 5.1.2.1).

Obesity, as measured using the Body Mass Index (BMI), is a condition that may change over a lifetime.[24] An obese person can leave this status if she/he loses weight and, conversely, a non-obese person can gain weight and becomes obese. In the baseline scenario, the proportion of obese individuals among those who reach the age of 50 during the simulation remains constant and is estimated based on the 50-54 age group in 2020. Alternative scenarios can be created to consider changes in obesity status over time (see Section 5.1.2.1). However, unlike smoking, this modulation factor can be applied to all age groups, and not just for those reaching the age of 50, as individuals can lose weight at any point in their lifetime.

The projection model accounts for **chronic diseases** contracted during the simulation for the population aged 50 and above. The risk of contracting a chronic disease was estimated using a Cox model based on the SHARE data. A Cox model investigates the relationship between the time for an event to occur (in this case, the chronic disease) and independent variables. Gender, country of residence, and obesity status were used as independent variables. Since smoking affects the probability of developing a chronic disease, losing independence (disability) and dying, the models were stratified by smoking status. This means that smokers and non-smokers have separate parameters for the risk of chronic disease incidence (see Annex 2).

The **activity limitation status** (present, absent) is estimated through a multinomial logit regression model (Cox 1958) using the SHARE data. Also the activity limitation model is stratified according to smoking status, meaning that smokers and non-smokers have distinct parameters to determine their risk of losing the ability to perform daily activities. The risk factors are age, sex, country of residence, obesity and chronic diseases (see Annex 3).

24 The BMI is a measure of a person's weight relative to height and correlates with body fat. BMI is considered the most useful indicator of obesity in adults when only weight and height data are available. The index is calculated by dividing body weight (in kilograms) by height (in metres) squared. Index values above 30 indicate an obese condition.

The relative **mortality risks** were estimated using Cox survival logit regression models. The basic risk of death in the CEPAM-Mic model varies based on factors such as sex, age, education level, and country of residence. In this new health model, baseline risk of death is also modulated according to smoking status, activity limitation status and immigrant status, which also accounts for the "Healthy Immigrant Effect".[25] The response variable for this analysis is the survival of adults over the age 50 years (see Annex 4).

25 The 'Healthy Immigrant Effect' (HIE) refers to the health advantage of immigrants over the native-born, which diminishes with longer residency. This is due to the direct and indirect selection process during immigration, leading to a lower death rate for immigrants shortly after arrival (McDonald and Kennedy, 2004).

5 Scenarios

With this microsimulation model, we run different scenarios to assess the dynamic influence of risk factors, such as smoking, obesity, education, and chronic diseases, on the prevalence of LTC needs among individuals over 50 years old. The model can be run using the "default" (baseline) set of parameters or modified to generate various "what if" scenarios and answer policy questions, such as the effect of reducing obesity and smoking rates. Each scenario generates population counts by year that can be disaggregated by age, sex, education level, country of residence, immigrant status, smoking, obesity, chronic disease status, and activity limitation status up to 2070.

5.1.1 Baseline scenario

We use the parameters estimated through the multivariate models described in the previous section to build the baseline scenario. This scenario projects the health characteristics of the population based on our modelling assumptions and recent (pre-pandemic) health and demographic trends as seen in the SHARE survey (waves 1 to 7). The projection parameters remain constant throughout the projection exercise. While the parameters are held constant over time in the baseline scenario, changes in health status of the population can still occur due to shifts in the underlying determinants of health: age structure, gender, education level, and geography. A summary of the baseline scenario's health parameters can be found in Appendix 0.

5.1.2 Alternative scenarios

To generate alternative scenarios, parameters modulating existing probabilities of smoking or being obese are added to the model. An additional parameter is introduced to modulate the probability of death, enabling simulations of alternative scenarios on life expectancy. As life expectancy is expected to increase for many decades still,[26] mortality rates[27] are declining based on factors such as age, sex, education, and country of residence, and the death rate parameter allows for further extension of life expectancy projections. All parameters are accessible from the Modgen interface,[28] and the user can modify simulation parameters and create customized scenarios. The following sections provide a more in-depth analysis of each scenario and its modulation parameters, including obesity, smoking, and mortality. A summary of the scenarios and assumptions is provided in Table 2. It is important to keep in mind that these scenarios are hypothetical but credible, aimed at predicting the possible effect of public health interventions such as reducing smoking and obesity on population's health status.

Table 2 – Description of baseline and alternative scenarios.

Baseline	Healthier lifestyle	Longer life expectancy without health gains	Reduction in Education
Projection parameters constant throughout the projection exercise (up to 2070)	5% decrease in the overall obesity prevalence in Europe in 2040 compared to 2011. 80% decrease in the probability of having ever smoked for those reaching age 50 in 2040 (with linear decrease over the years until 2040).	Additional gain in life expectancy of 2 years in 2050.	Removing protective effect of education: all individuals are assumed to have the same risk of activity limitation as those with the lowest level of education.

[26] The COVID-19 pandemic has stalled or even reversed recent progress in life expectancy for many countries. Nevertheless, assuming no other detrimental global event, life expectancy is expected to recover and continue its increase once the pandemic is under controll (UNDESA 2022)..

[27] See Lutz, Wolfgang, William P. Butz, and KC ed Samir, eds. "World population & human capital in the twenty-first century: An overview." (2017).

[28] Modgen (Microsimulation MODelling GENerator) is a C++ meta-language developed and maintained by Statistics Canada for microsimulation modeling. It is used for the creation and manipulation of models through a graphical interface. Modgen models are coded and implemented using Microsoft Visual Studio software and take the form of a stand-alone executable file (.exe) after compilation.

5.1.2.1 Healthier lifestyle

We aim to create alternative scenarios where the probability of obesity and smoking is lower compared to the baseline scenario.

Obesity

Obesity has increased in the past 40 years. There is general consensus that obesity will increase in the short run notwithstanding the WHO target to reach the 2010 obesity levels by 2015. Projections are available (often based on linear extrapolation from past estimates produced by Abarca-Gómez et al. 2017) up to 2025 (World Obesity 2020, OECD 2009, Pineda et al. 2018).

However, there is less consensus on the share of obesity changes in the long run. Applying linear extrapolation on the long run would lead to a future with the entire population obese, a highly unlikely hypothesis. Some researchers (e.g. Jannssen et al. 2020) propose a wave-shared obesity epidemic model or a four-stage obesity transition model. According to Jaacks et al. (2019), although the model relies on a limited number of observations, the fourth phase sees the decline in obesity levels. Janssen et al. propose a model whereby the speed of change of the logit of obesity prevalence declines linearly. According to this model, obesity will peak around 2035 and will then decrease up to 2100 to the 1975 levels.

In this scenario, the share of population who has BMI equal to or greater than 30 obese is decreased by an approximately 5 percentage points in the next 20 years. We set this parameter because 5 percentage points is the highest increase observed in an EU MS in the last 10 years. The idea is that if people can gain that much BMI, they can also lose it. However, reducing the BMI is more difficult and would require longer time – so the decrease is distributed on 20 rather than 10 years.

To model this reduction, we introduce two parameters into the model: *TargetObeseReduction* and *TargetYearObeseReduction*. The first parameter represents the proportion of obesity in the model that we wish to change to non-obese, with a value between 0 and 1 in alternative scenarios and 0 in the baseline scenario. The second parameter contains the year in which the desired reduction in obesity is fully achieved, through a linear decrease of obesity every five years from the beginning of the simulation in 2011 to the target year of the projected period.

It is important to note that these scenario parameters reduce the probability of being obese for an individual, and not the prevalence of obesity at the population level. For example, if we want to reduce the total prevalence of obesity by 5 percentage points in all EU countries, starting with a 19% obesity rate in 2011 for those over 50, we will need to apply a reduction of 26% (5/19=0.26) to the probability of obesity in the baseline scenario. The target year for this scenario would be 2040, when the overall obesity rate reaches 14%. The probability of obesity will decrease linearly (with 5 years step) until the target year and then remain constant for all age groups. This constitutes one alternative scenario proposing a decrease of 5 percentage points in the overall obesity prevalence in Europe in 2040 compared to 2011.[29] This scenario aligns with the EU public health policy priorities, which aim to reduce obesity rates and improve the health and well-being of its citizens.

Smoking

Simulating alternative smoking scenarios is more challenging than for obesity. In the model, a smoker is defined as a person who currently smokes or has smoked in the past. Since past behavior cannot be altered, decreasing the number of smokers in the base population (age 50+ at the start of the simulation) would be unrealistic. Nevertheless, it is possible to simulate scenarios with assumptions regarding the smoking habits of younger cohorts entering the simulation at age 50, by gradually reducing the prevalence of smoking in these groups. Whatever the alternative scenario, we should keep in mind that the model reflects the lasting effects of smoking on health, so any changes in population health outcome will only become apparent over time.

In the model, the modulation parameter *SmokeFactor* controls the prevalence of smoking in cohorts turning 50 during the simulation. This parameter is a time vector where the user specifies the decrease in the probability (value between 0 and 1) of ever having smoked for each period of the simulation. In the baseline scenario, *SmokeFactor* defaults to 0 (not decrease) for all periods. In the proposed alternative scenario, we wish to achieve an 80% decrease in the probability of having ever smoked for those reaching age 50 in 2040. The

[29] Both parameters can be modified in the Modgen interface of the model, so that the decline in obesity may be larger or smaller and may occur faster or slower.

decrease is linear over the years until 2040, and smoking rates remain constant thereafter. Thus, the *SmokerFactor* will take the following values: 0 for 2020-25, 0.2 for 2025-30, 0.4 for 2030-35, 0.6 for 2035-40, 0.8 for 2040-45, and will remain at 0.8 for all subsequent periods. This scenario is aligned with the EU policy priorities in Europe's Beating Cancer Plan, which recognises the significant health risks associated with smoking by committing to reduce smoking rates so that less than 5% of the population uses tobacco by 2040.

5.1.2.2 Longer life expectancy without health gains

The baseline scenario already assumes a potential future decrease in mortality rates as determined by expert panels.[30] In the baseline scenario, life expectancy at age 50 for European men increases from 30.7 years in 2015-2020 at the start of the projection to 35.8 years in 2045-2050, resulting in a gain of 5.1 years. Women also see an increase of 3.9 years in life expectancy, from 34.8 years to 39.6 years over the same projection period. These gains in life expectancy apply to the entire projected population but may vary by country and education level.

The alternative scenario projects an even greater decrease in mortality rates resulting in an additional gain in life expectancy of 2 years in 2050, that could be determined, for instance, by some policy interventions such as improving access to healthcare, strengthening public health systems, encouraging healthy behaviours or reducing risk factors. This is in line with the scenario developed for the Ageing Report 2021[31] (see Section 3). The additional life expectancy is lived with the same probabilities of LTC needs as seen with the life expectancy in the baseline scenario. In other words, the extra years are not healthier. To account for the observed trend of greater relative decline in mortality rates at younger ages, the model uses projected mortality rates and life tables to modulate age- and sex-specific mortality rates. These parameters are stored as *MortalityModulation* in the model.

5.1.2.3 Exploring the effect of education on the risk of developing LTC needs

Education is widely assumed to be a strong predictor of good health (see Section 3), with more educated people having lower risk of dying and being disabled, both of which are implemented in our health model. As the population aged 50+ continues to become more educated, with younger generations being generally better educated, we expect the number of people with LTC needs to decrease.

To investigate the relationship between education and LTC needs, we remove the protective effect of education in our activity limitation equation (see Appendix 0). Under this scenario, all individuals are assumed to have the same risk to develop LTC needs as those with the lowest level of education. As a result, it is expected that there will be more people with LTC needs in this scenario compared to the baseline scenario. Unlike the previous scenarios, this scenario does not describe a realistic situation for policy intervention. It does not simulate that the educational level of the population will decrease over time, but rather disregard the effect of the education variable in the probabilities that individuals have of developing LTC needs. It is rather a methodological scenario that highlights the role played by education when associated with LTC needs.

30 See Lutz, Wolfgang, William P. Butz, and KC ed Samir, eds. "World population & human capital in the twenty-first century: An overview." (2017).

31 To note that compared to the Ageing Report our baseline already sees higher life expectancy due to the effect of education that the Eurostat population projection do not model.

6 Results

Figure 5 presents the key results of the simulations for the main outcome variable of LTC needs/activity limitation, from the start of the simulation (2011 population) up until 2070.[32] In particular, the left panel in Figure 5 shows the projections of the prevalence of LTC needs in the EU population above 50 years; the panel at the centre presents the evolution of the population 50+ with LTC needs in absolute terms, and the right panel considers percentage variation in respect of the prevalence level recorded at the start of the simulation.

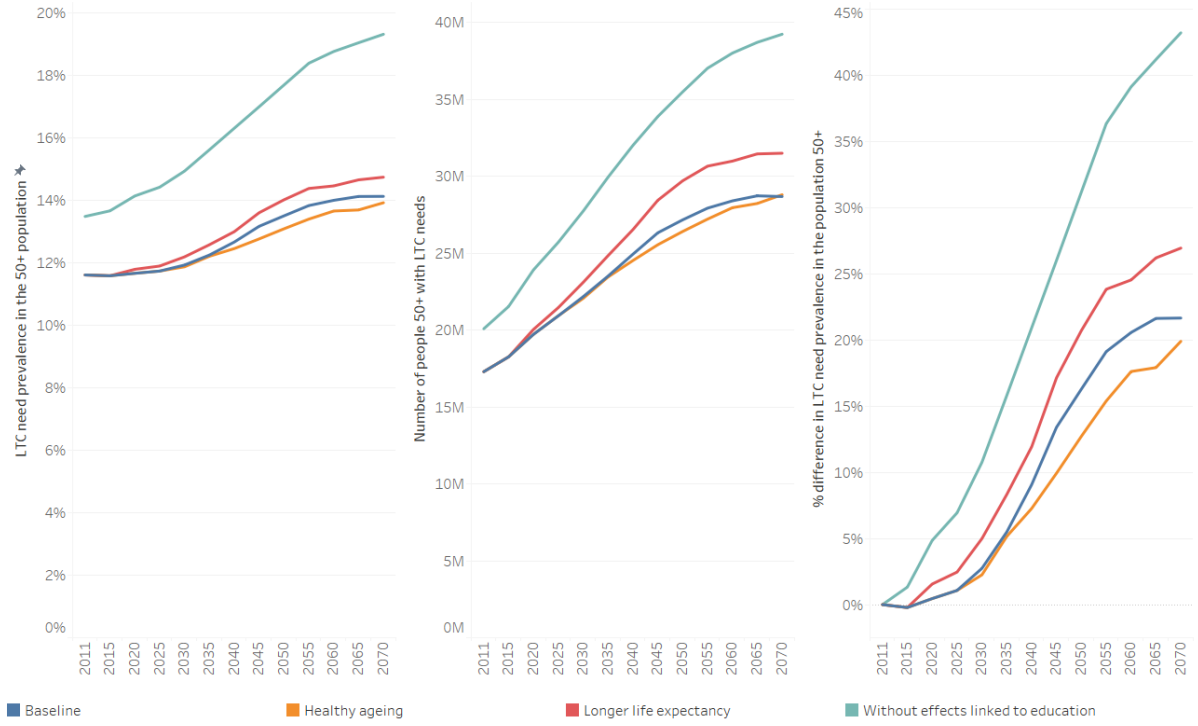


Figure 5 – Results of the simulation for the four scenarios and for the main outcome variable of activity limitation and for population of more than 50 years of age (2011-2070).

According to the baseline scenario (blue line in Figure 5),[33] **the prevalence of LTC needs is expected to increase from 11.6% in 2020 to 14.1% in 2070.** This represents an increase of around 21% in respect of the level in 2020. In absolute terms the people with LTC needs in the 19 EU countries[34]s would increase from 19.7 million in 2020, to 20.9 million in 2025, 27.1 million 2050 and 28.7 million in 2070.

In the baseline projection the increase in the prevalence of LTC needs at the aggregate level is driven by changes in the age distribution of the population above 50 years of age, characterised by a higher share of population in older age groups. This purely demographic explanation is proven by the fact that the evolution of prevalence of LTC needs within each age group is either constant or decreasing, especially among older age groups (Figure 6). This means that within each age group above 55, the LTC needs are expected to decrease over time. However, older age groups will consistently have higher LTC needs than younger groups and will represent larger share of the total population. Therefore, the overall prevalence of LTC needs is expected to increase.

[32] See Appendix for more results in relation to the other intermediate steps in the simulations and the other three outcome variables of obesity, smoking and chronic diseases.

[33] See Appendix for more details on the comparison with population projections of total population and disability projections in the Ageing Report.

[34] Austria, Belgium, Czech Republic, Germany, Denmark, Estonia, Spain, France, Greece, Croatia, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Sweden and Slovenia

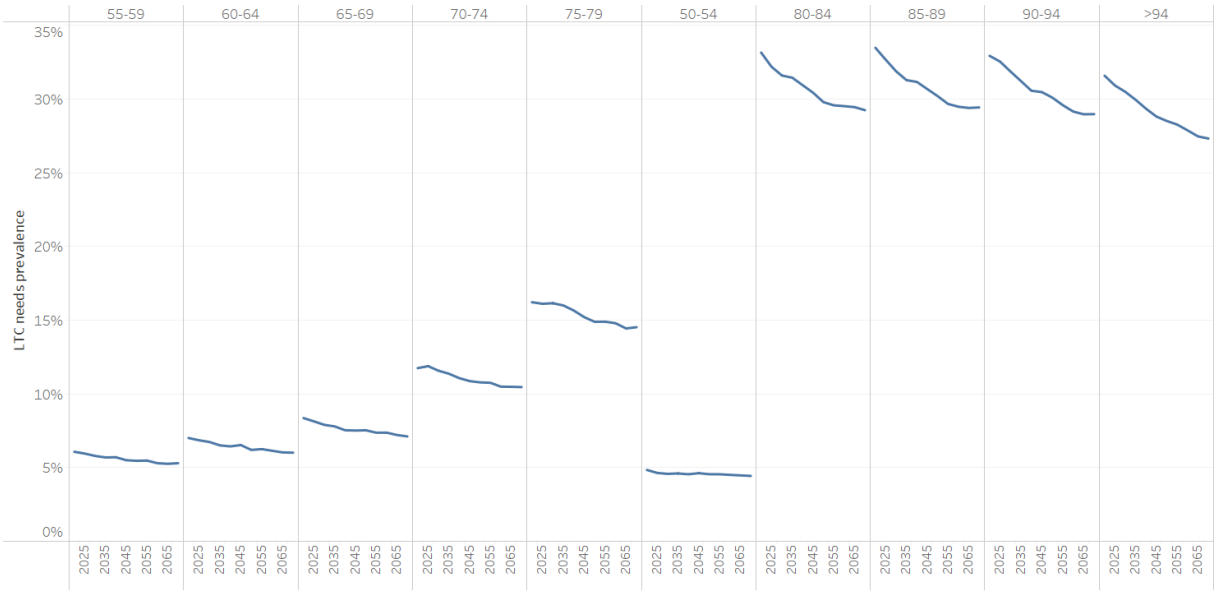


Figure 6 - Evolution of the prevalence of LTC needs within age groups according to the baseline scenario (2020-2070).

Under these conditions, **the slight decrease in prevalence of LTC needs recorded over time within age groups can be explained by the cohort effects**, i.e. the entry in the simulation of individuals from younger generations with different characteristics in respect of their parents at the same age.

Simulations provide also addition insights that allow better understanding the cohort effect: Figure 7 shows the trend in obesity, smoking status (proxied as 'ever smoked') and chronic disease for each age cohort over the period of the simulation (Figure 7), while Figure 9 and Figure 10 show the distribution by education levels over time, respectively within each cohort and across age groups.

- As for **obesity**, new cohorts entering the simulation show lower obesity rates for all age groups up to 80-85. This reduction is even more marked in the healthy ageing scenario. Yet, looking the obesity rate across age groups (Figure 8), we see that at the beginning of the simulation the obesity prevalence curve is hump-shaped, increasing up to 60-69, and then decreasing afterward. Over time, the projection results show that this curve seems to move rightwards, reaching its peak at older age groups and then becoming progressively flatter. This is indeed due to the cohort effect as new cohorts entering the age groups have lower obesity rates.
- The **ever-smoked** rate does not decrease in the baseline within age groups, but on the contrary, for some age groups, it increases. Similarly, the prevalence of **chronic disease** does not decrease, but it appears quite flat or it tends to go upward. Therefore no-cohort effect can be attributed to the smoking or the chronic disease variables.
- Within all age groups there is a clear trend in the evolution of the **education** level of the population: the share of people with low educational level substantially decreases, while the share of people with high educational level substantially increases. This is true for all age groups. This is one of the demographic assumptions of the microsimulation model: the population gets more and more educated over time. So while over time older age groups will have lower levels of education than younger age groups, the proportion of people with higher level of education within each group increases with the progression of the simulation, as new cohorts are more educated.

Cohort effects are thus associated with decreasing obesity rates and increasing educational level. Education is a demographic parameter that is explicitly changed in all scenarios, as the population is expected to have higher education levels. On the contrary, the obesity rates among those who reach the age of 50 during the simulation remains constant in the baseline scenario and is estimated based on the 50-54 age group in 2020. This means that, considering obesity rates only, within the age group 50-54, we should not expect changes in the obesity rates over time.

However, the advantage of the microsimulation is that it does not consider individuals characteristics in isolation, but it takes into account how they affect each other. In this case, the education impacts obesity rates

as obesity rates are consistently lower in higher education groups (Figure 11). The alternative scenarios modify these two parameters and thus provide further insights on their role in affecting prevalence of LTC needs.

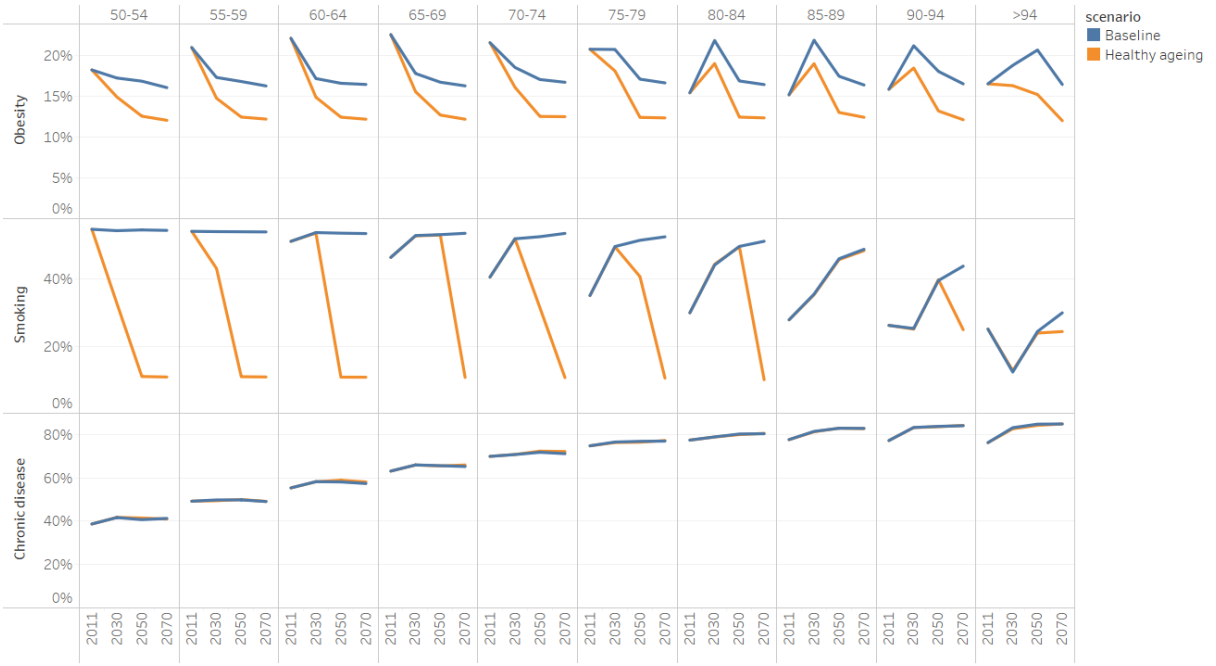


Figure 7 – Prevalence in obesity, ever-smoked status, chronic disease within each group over the period of the simulation, in the baseline and healthy ageing scenario.

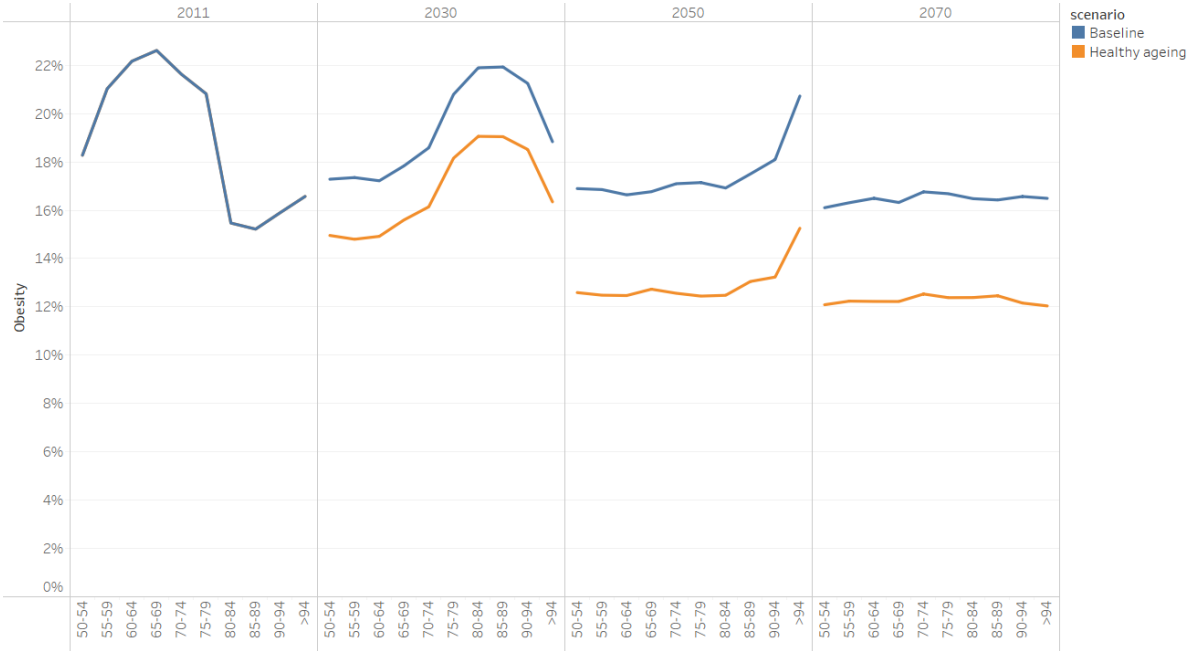


Figure 8 – Prevalence in obesity across age groups for selected years of the simulation, in the baseline and healthy ageing scenario.

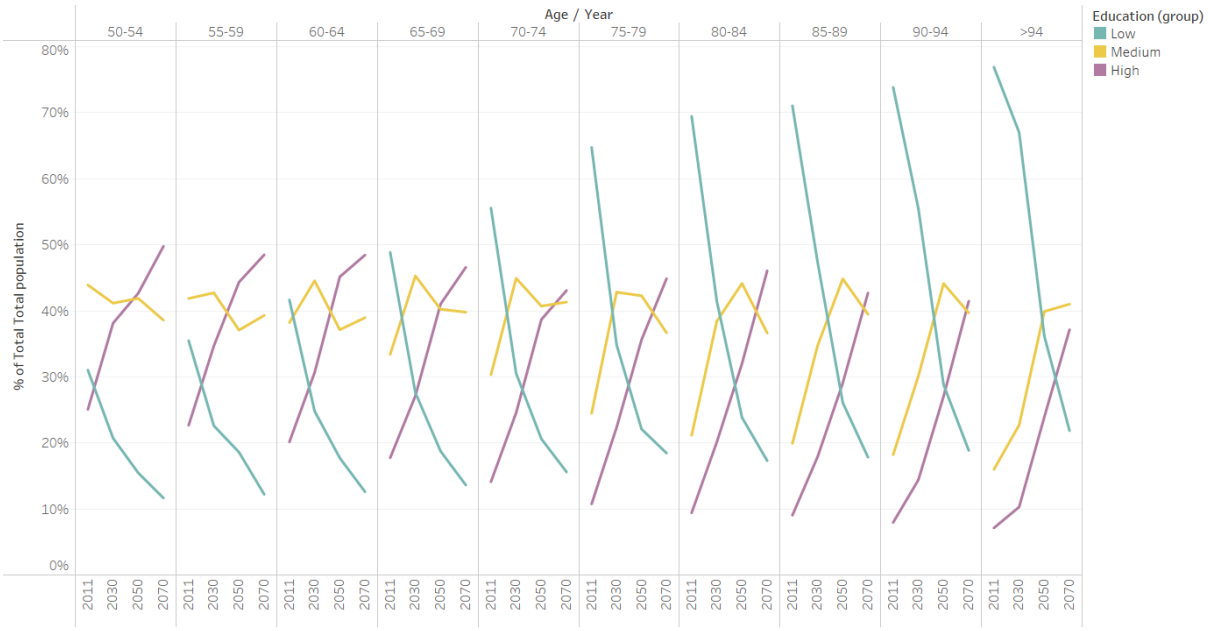


Figure 9 – Distribution of the population by level of education, within each group over the period of the simulation, in the baseline scenario.

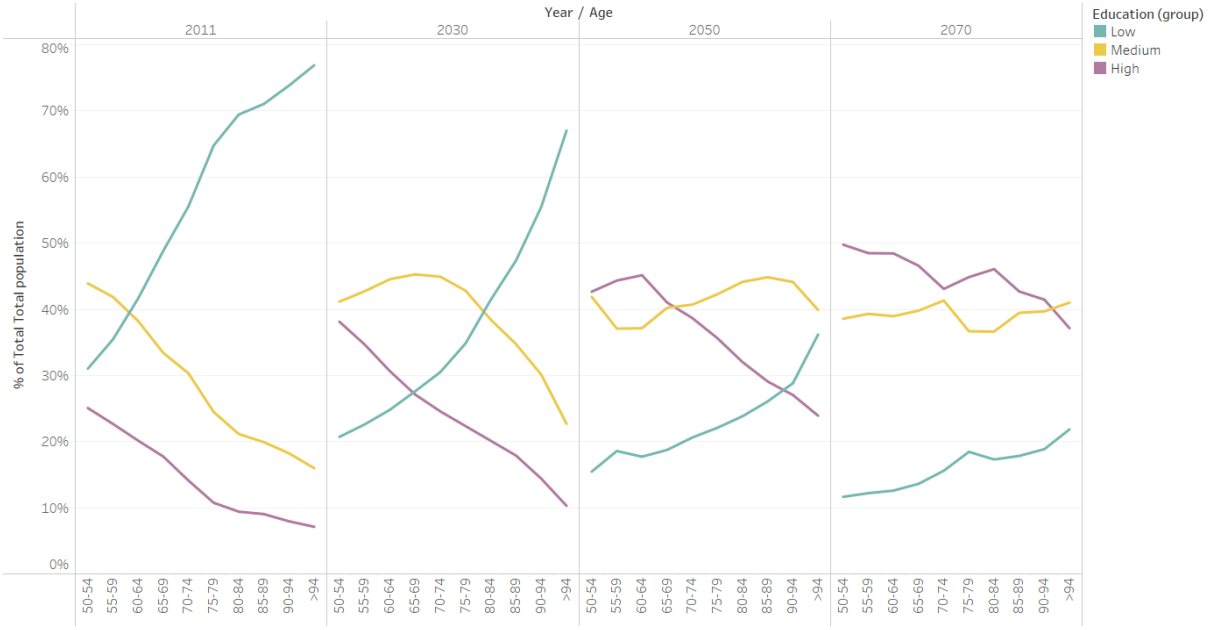


Figure 10 - Distribution of the population by level of education, across age groups for selected years of the simulation, in the baseline and healthy ageing scenario.

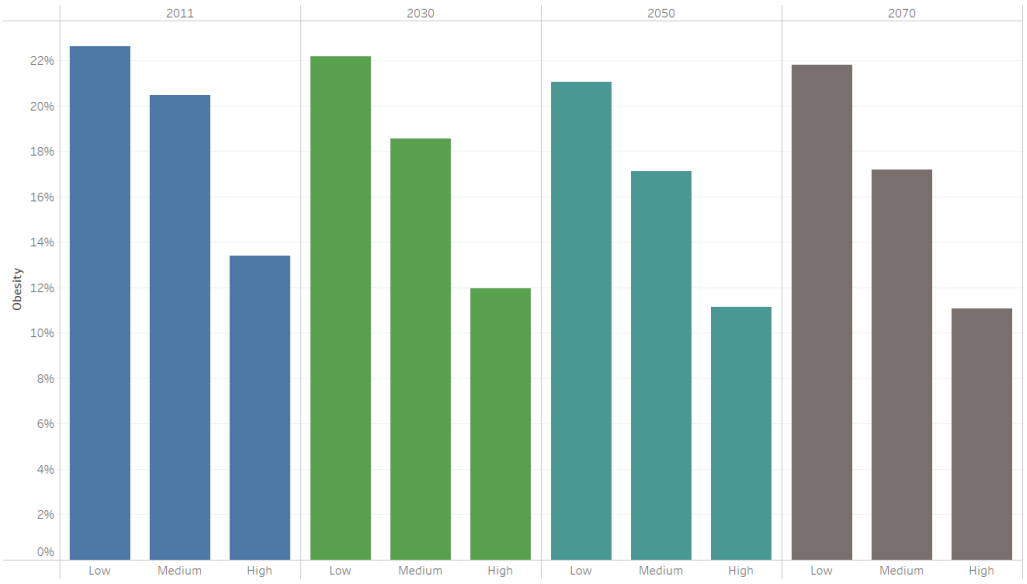


Figure 11 – Obesity prevalence by educational level in selected simulation years.

In the **healthy ageing scenario** (orange line in Figure 5), which accounts for the improvement in obesity and smoking rates, simulations indicate an increase of 20% in the prevalence of LTC needs between 2011 and 2070 (validation in Appendix 0 and 0). This corresponds to 2 percentage point lower prevalence of LTC needs in respect of the increase foreseen under baseline scenario. While going in the expected direction this improvement is not large, especially if compared with the overall scale of demographic changes under the baseline scenario. While demographic inertia plays an important role, other modelling choices may explain why the reduction is so limited.

- The lack of sensitivity to smoking reduction in the healthy ageing scenario, for instance, is probably due to the use of the variable 'ever smoked', defined as an absorbing state that people cannot leave. The scenario affects therefore only new cohorts entering the simulation model. Even a significant decrease in smoking rates for new generations entering the model turns out to have little effect at the population level because these new generations represent only a small part of the population. Moreover, the regressions performed on SHARE data generated little differences in terms of relative risks for smokers and non-smokers in developing a chronic disease after age 50, and hence LTC needs. Furthermore, a reduction in smoking can have opposing effect at the population level. One the one hand, less smoking reduces the occurrence of chronic disease. On the other hand, less smoking reduces mortality, which increases the probability of people moving to higher age groups where the occurrence of chronic disease is higher.
- The lack of sensitivity of the model to variations in obesity could result from the approach based on the prevalence of the phenomenon rather than its occurrence and duration. Other variables, such as physical activity, may also have added to the impact of obesity.

The **longer life expectancy scenario** has the opposite effect of increasing the prevalence of LTC needs by 27% in respect of 2020 which corresponds to 5 percentage points more than what foreseen by the baseline scenario (validation in Appendix 0). This scenario is simulating improvements in life expectancy of 2 years by 2050 with no changes in the main factors of smoking and obesity leading to the onset of LTC needs. A longer life implies a higher share of population in older age groups and is therefore contributing to the increase in LTC needs by enhancing the effects of ageing already modelled in the baseline scenario.

The third **scenario simulating a low level of education** across the entire population is producing the most striking difference in respect of the baseline results. At the start of the simulation the prevalence of LTC needs is 12% under the baseline scenario and 13% under the low education scenario. Under the low education scenario, the prevalence of LTC needs would increase in 2070 by 43% in respect of 2011 corresponding to 5 pp more than the baseline scenario.

The strong role played by education emerges also by looking in Figure 12 at the breakdown of prevalence of LTC needs by education level under each scenario. This breakdown shows that at the beginning of the simulation (2011) the highly educated population has around 10 percentage points lower prevalence of LTC needs than the low educated one. This gap persists across the entire simulation period, in the baseline scenarios, as well

as in the healthy ageing scenarios and longer-life expectancy scenarios. By neutralizing such large gap, the low education scenario still shows that the prevalence of LTC needs differs across education groups, but to a much smaller extent (between 5 and 2 percentage points). These results help to fully appreciate the beneficial role of education, partly compensating the increase in LTC needs caused by ageing.

Figure 12 - Prevalence of LTC needs by education level according to the baseline scenario (2011-2070)

7 Conclusions

In this study, we develop a micro simulations demographic model to project the needs of LTC of the EU population in 19 MS until 2070. The objective was to complement the macrosimulations of the Ageing Report and to test a prototype for a more complex microsimulation model of health and LTC. With micro simulation modelling we are able to account for more complex dynamics and cohort effects, and to refine the simplifying assumption of the macrosimulation made in the Ageing Report of a fixed prevalence of activity limitation by age groups across the simulation period.

The prototype we developed adopted a limited number of predictors to model the prevalence of chronic diseases and LTC needs in the population of 19 European countries. Specifically, we considered demographic characteristics like age, education, and sex; as well chronic diseases, obesity and smoking as intermediate risk factors leading to LTC needs.

These conclusions summarise the results of our exercise, highlight the policy implications we can already identify (in the bullet points), and point out the limitations of the study to be addressed with further research.

The results of our projections under the baseline scenario confirm that the LTC needs will increase in the future, largely due to the population ageing. In particular, the prevalence of LTC needs is expected to increase from 12% in 2020 to 14% in 2070. This represents +21% people in need of LTC in 2070 in respect of the level in 2020. These results are in line with the Ageing Report.

- **Policies addressing LTC should therefore adapt the supply of LTC services to an ever increasing demand**. Such adaptation can aim at improving of efficiency in provision of LTC; extending private, public or family-based delivery models in particular for home and community-based care; increasing financial resources for the health and social care sectors; and attracting human resources dedicated to LTC with pro-active labour market and immigration policies. The Council Recommendation on access to affordable high-quality long-term care proposed by the European Commission in the context of the Care Strategy works in this direction.

Looking at the LTC needs within each group, **we see that there is a decline over time, especially among older age groups.** This can be referred to as a cohort effect and shows that new cohorts entering the age group 50+ are less likely to develop LTC needs. The variable that substantially impacts the prevalence of LTC needs with new cohorts entering the microsimulation is **education**. The increase in educational levels over time is a demographic assumption of the simulation. The fact that education has an important impact on the LTC needs explains why LTC needs rates decreases over time within age groups. This is in line with the existing literature on LTC determinants reported in Section 3.

The role played by education can be appreciated in the baseline scenario, where LTC needs are lower in the high education group, as well as in the low education scenario. The education scenario neutralises the beneficial effect of education in reducing LTC needs. In this case, the share of the population with LTC needs would increase in 2070 by 43% in respect of 2011, corresponding to 5 pp more than the baseline scenario.

- **Policies aimed at increasing the level of education should continue and should be seen in the long-term context**. The benefits of education can be seen throughout the entire life course of an individual, even when it comes to reducing the likelihood of developing LTC needs at an older age. EU actions on improving the access to education and in building a European Education Area work in this direction. The Council Resolution on a strategic framework for European cooperation in education and training towards the and beyond for instance sets a minimum target of 45% in the share of 25-34 year-olds with tertiary educational attainment, by 2030.

Evidently, **education alone does not explain nor lead to lower LTC needs rates**. It is a proxy for other factors with a more immediate impact on LTC needs. Education may be associated with higher income, better information on and more access to healthcare care, healthier lifestyle (defined in different ways as the ones captured in the healthy ageing scenario, or to include other aspects, like healthier nutrition, more physical activity), residency (e.g. rural-urban). These are all factors that were outside our microsimulation models, but that can be analysed with future research. At the moment, we also do not know whether the effect of education is linear and how it interacts with other behavioural changes.

- The result of this further research can contribute to shaping policy intervention aimed at reducing the likelihood of developing LTC needs, and can help identify the policy intervention with the largest expected impact. This can include the promotion of healthier lifestyle, actions to make preventive care more accessible and affordable, information campaigns.

The results for the scenarios of **healthy ageing and longer life expectancy** are going in the expected direction – i.e. producing, respectively, decrease and increase in the LTC needs compared to the baseline results. The scenarios, however, show that changing the parameters alone – smoking and obesity rates; and life expectancy – has limited effect on the LTC needs, which changes of around 1 percentage point.

These results confirm the prevailing role of demographic inertia on the long-term trajectory for LTC needs, across different scenarios. This demographic inertia seems unavoidable and represents one of the largest implications of the demographic transition process. In particular, the scenario where people age in a healthier manner have counterintuitively only limited impact on reducing the insurgence of LTC needs. However, these results should be taken with caution. Further research should be done to further test different operationalisations of the obesity and smoking variables (e.g. taking into account the duration and the magnitude).

- Policy-wise, interventions aimed at reducing smoking and obesity rates in the population should be sustained and enhances as these have a wide range of well-documented health benefits. LTC is also affected by obesity and smoking, although it is currently not possible to confidently estimate the impact of reducing smoking and obesity on LTC needs.

This study was a first exploration of the use of demographic microsimulation to project the demand of LTC in the future. As such, it comes with some **limitations**. Given the complexity of developing a microsimulation method, in addition to demographic characteristics, our exercise accounts for only two relevant risk factors, obesity and smoking. To overcome this limitation, our prototype model should be further developed to include additional risk factors, such as alcohol consumption and physical activity, ideally with longitudinal data. Furthermore, since our model remains primarily demographic, it does not directly capture a possible reduction in LTC needs that could be achieved by addressing unmet needs and the unequal access to health and LTC due to low income, poverty and other socio-economic factors.

Finally, while capturing some signals of a reduction of prevalence of LTC needs over time due to differences across generations, we are not modelling other exogenous factors such as progress in preventive medicine, and improvements in the delivery of health and LTC which could also contribute to a decrease in prevalence of LTC or its severity needs over time within each age group.

References

Abarca-Gómez, L., Abdeen, Z. A., Hamid, Z. A., Abu-Rmeileh, N. M., Acosta-Cazares, B., Acuin, C., ... & Cho, Y. (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128· 9 million children, adolescents, and adults. *The lancet*, *390*(10113), 2627-2642.

Atella, V., Belotti, F., Kim, D., Goldman, D., Gracner, T., Piano Mortari, A. and Tysinger, B., 2021. The future of the elderly population health status: Filling a knowledge gap. Health Economics, 30, pp.11-29.

Crimmins, E. M., Garcia, K. & Kim, J. K. Are International Differences in Health Similar to International Differences in Life Expectancy? in International Differences in Mortality at Older Ages: Dimensions and Sources (National Academies Press, Washington, D.C., 2010).

Cedefop 2019 Care workers: skills opportunities and challenges (2019 update), webpage https://www.cedefop.europa.eu/en/data-insights/care-workers-skills-opportunities-and-challenges-2019-update#_key_facts visited on 10 July 2023

Campitelli MA, Bronskill SE, Hogan DB, Diong C, Amuah JE, Gill S, Seitz D, Thavorn K, Wodchis WP, Maxwell CJ. The prevalence and health consequences of frailty in a population-based older home care cohort: a comparison of different measures. BMC Geriatr. 2016 Jul 7;16:133. doi: 10.1186/s12877-016-0309-z. PMID: 27388294; PMCID: PMC4937594.

Council Recommendation (2022), on access to affordable high-quality long term care, 13948/22

Greene,W.H.2018.EconometricAnalysis.8thed.NewYork:Pearson.

EIGE (2021), Gender inequalities in care and consequences for the labour market

Eurofound (2020), Long-term care workforce: Employment and working conditions, Publications Office of the European Union, Luxembourg

European Commission and Social Protection Committee (2021), Long-term care report. Trends, challenges and opportunities in an ageing society, Vol. 1

European Commission (2022), COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS on the European care strategy

European Commission (2022a), Proposal for a COUNCIL RECOMMENDATION on access to affordable high-quality long-term care – COM(2022) 441 (2022)

European Commission (2022b), COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Attracting skills and talent to the EU

European Commission (2021), The 2021 Ageing Report. Economic & Budgetary projections for the EU Member States (2019-2070), Institutional Paper 148

European Commission (2018), Challenges in long-term care in Europe. A study of national policies

Flood, L. (2008). SESIM: A Swedish Micro-Simulation Model. In A. Klevmarken & B. Lindgren (Eds.), Simulating an Ageing Population: A Microsimulation Approach Applied to Sweden (Contributions to Economic Analysis, Volume 285) (pp. 55–83). Emerald Group Publishing Limited.

Foreman, K.J., Marquez, N., Dolgert, A., Fukutaki, K., Fullman, N., McGaughey, M., Pletcher, M.A., Smith, A.E., Tang, K., Yuan, C.W. and Brown, J.C., 2018. Forecasting life expectancy, years of life lost, and all-cause and cause-specific mortality for 250 causes of death: reference and alternative scenarios for 2016–40 for 195 countries and territories. The Lancet, 392(10159), pp.2052-2090.

Garibaldi, P., Martins, J. O., & van Ours, J. (Eds.). (2010). *Ageing, health, and productivity: The economics of increased life expectancy*. OUP Oxford.

Goldman, D.P., Cutler, D., Rowe, J.W., Michaud, P.C., Sullivan, J., Peneva, D. and Olshansky, S.J., 2013. Substantial health and economic returns from delayed aging may warrant a new focus for medical research. Health affairs, 32(10), pp.1698-1705.

Grubanov-Boskovic, S., Ghio, D., Goujon, A., Kalantaryan, S., Belmonte, M., Scipioni, M., Conte, A., Gómez-González, E., Gomez Gutierrez, E., Tolan, S., Martinez Plumed, F., Pesole, A., Fernandez Macias, E. and Hernandez-Orallo, J., Healthcare and long-term care workforce: demographic challenges and potential contribution of migration and digital technology, EUR 30593 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-30232-2, doi:10.2760/234530, JRC121698.

Guzman-Castillo, M., Ahmadi-Abhari, S., Bandosz, P., Capewell, S., Steptoe, A., Singh-Manoux, A., Kivimaki, M., Shipley, M.J., Brunner, E.J. and O'Flaherty, M., 2017. Forecasted trends in disability and life expectancy in England and Wales up to 2025: a modelling study. The Lancet Public Health, 2(7), pp.e307-e313.

Hennessy, D.A., Flanagan, W.M., Tanuseputro, P., Bennett, C., Tuna, M., Kopec, J., Wolfson, M.C. and Manuel, D.G., 2015. The Population Health Model (POHEM): an overview of rationale, methods and applications. Population health metrics, 13(1), pp.1-12.

Heger, Dörte and Kolodziej, Ingo, Changes in Morbidity by Proximity to Death over Time: Evidence from Europe (October 29, 2015). Netspar Discussion Paper No. 10/2015-077, Available at SSRN: https://ssrn.com/abstract=2744677 or http://dx.doi.org/10.2139/ssrn.2744677

Jaacks, L. M., Vandevijvere, S., Pan, A., McGowan, C. J., Wallace, C., Imamura, F., ... & Ezzati, M. (2019). The obesity transition: stages of the global epidemic. *The lancet Diabetes & endocrinology*, *7*(3), 231-240.

Janssen, F., Bardoutsos, A., & Vidra, N. (2020). Obesity prevalence in the long-term future in 18 European countries and in the USA. *Obesity facts*, *13*(5), 514-527.

Katz S. Assessing self-maintenance: activities of daily living, mobility, and instrumental activities of daily living. J Am Geriatr Soc. 1983 Dec;31(12):721-7. doi: 10.1111/j.1532-5415.1983.tb03391.x. PMID: 6418786.

King, A., Robinsin, M. & Baekgaard, H. DYNAMOD-2: An overview. (1999)

Marois, G., & Aktas, A. (2021). Projecting health-ageing trajectories in Europe using a dynamic microsimulation model. *Scientific reports*, *11*(1), 1785.

Michaud, P.C., Goldman, D., Lakdawalla, D., Gailey, A. and Zheng, Y., 2011. Differences in health between Americans and Western Europeans: effects on longevity and public finance. Social science & medicine, 73(2), pp.254-263.

OECD (2007), Trends in Severe Disability Among Elderly People: Assessing the evidence in 12 OECD countries and the future implications, OECD Health Working Papers No. 26

OECD (2009), The obesity epidemic: analysis of past and projected future trends in selected oecd countries, OECD HEALTH WORKING PAPERS NO. 45

OECD (2018), Spending on long-term care, Focus on.

OECD (2020), Assessing the comparability of Long-Term Care spending estimates under the Joint Health Accounts Questionnaire

OECD (2020a), Who Cares? Attracting and Retaining Care Workers for the Elderly OECD Health Policy Studies, OECD Publishing, Paris, https://doi.org/10.1787/92c0ef68-en.

OECD (2021) Colombo, F. *et al.* (2011), *Help Wanted? Providing and Paying for Long-Term Care*, OECD Health Policy Studies, OECD Publishing.

Pineda, E., Sanchez-Romero, L. M., Brown, M., Jaccard, A., Jewell, J., Galea, G., ... & Breda, J. (2018). Forecasting future trends in obesity across Europe: the value of improving surveillance. *Obesity facts*, *11*(5), 360-371.

Santos-Eggimann B, Cuénoud P, Spagnoli J, Junod J. Prevalence of frailty in middle-aged and older community-dwelling Europeans living in 10 countries. J Gerontol A Biol Sci Med Sci. 2009 Jun;64(6):675-81. doi: 10.1093/gerona/glp012. Epub 2009 Mar 10. PMID: 19276189; PMCID: PMC2800805.

Schneider, U., & Kleindienst, J. (2016). Monetising the provision of informal long-term care by elderly people: estimates for European out-of-home caregivers based on the well-being valuation method. Health and Social Care in the Community, 24(5), E81–E91. http://doi.org/10.1111/hsc.12250

Serrano-Alarcón, M., Kunst, A. E., Bosdriesz, J. R., & Perelman, J. (2019). Tobacco control policies and smoking among older adults: a longitudinal analysis of 10 European countries. Addiction, 114(6), 1076-1085.

Singh, P., Hussain, R., Khan, A., Irwin, L., & Foskey, R. (2014). Dementia care: Intersecting informal family care and formal care systems. Journal of Aging Research, 2014(1). http://doi.org/10.1155/2014/486521

Smith, K.E., 2012. Projection methods used in the dynamic simulation of income model (DYNASIM3). Washington DC: The Urban Institute.

Technopolis (2018), The Silver Economy, Final report, study prepared for the European Commission DG Communications Network, Dontenti & Technology by technopolis and Oxford Economics

Timmermans, E. J., Huisman, M., Kok, A. A., & Kunst, A. E. (2018). Smoking cessation and 16-year trajectories of functional limitations among Dutch older adults: results from the longitudinal aging study Amsterdam. The Journals of Gerontology: Series A, 73(12), 1722-1728.

UNECE / European Commission (2018) "Active Ageing Index (AAI) in non-EU countries and at subnational level: Guidelines"

United Nations (UN). (2015c). World population prospects: The 2015 revision, volume ii: Demographic profiles. Technical report. Department of Economic and Social Affairs, Population Division.

UNDESA, Population Division (2022). World Population Prospects 2022: Summary of Results. UN DESA/POP/2022/TR/NO. 3.

Vanella, Patrizio: Stochastic forecasting in demography and social insurance. Hannover : Gottfried Wilhelm Leibniz Universität, Diss., 2020, circa 230 S. DOI: https://doi.org/10.15488/9408michaud

Zucchelli, E., Jones, A. M. & Rice, N. The evaluation of health policies through dynamic microsimulation methods. Int. J. Microsimul. 5, 2–20 (2012).

WHO (2015), World report on ageing and health

WHO (2017), WHO Clinical Consortium on Healthy Ageing. Topic focus: frailty and intrinsic capacity. Report of consortium meeting 1–2 December 2016 in Geneva, Switzerland

World Obesity (2020), Obesity: missing the 2025 global target. Trends, costs and country reports, available at https://s3-eu-west-1.amazonaws.com/wof-files/970_-WOF_Missing_the_2025_Global_Targets_Report_ART.pdf

List of abbreviations and definitions

LTC	Long-term care
MS	Member States

Annexes

List of boxes

List of figures

List of tables

Annexes

Annex 1. Parameters of Obesity, Smoking and Chronic Disease Outcome

	Obesity Only		Smoking Only		Chronic Disease Only		Obesity and Smoking		Obesity and Chronic Disease		Smoking and Chronic Disease		Obesity, Smoking and Chronic Disease		None
Age group	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	
50-54	ref.		ref.		ref.		ref.		ref.		ref.		ref.		
55-59	0.116448	0.081152	-0.02813	0.043689	0.452841	0.050249	0.038938	0.080726	0.446168	0.070172	0.365913	0.048064	0.424328	0.069326	
60-64	0.129568	0.075274	-0.13246	0.040857	0.730728	0.046159	0.030583	0.075161	0.784724	0.06436	0.494871	0.044057	0.511746	0.062977	
65-69	0.068141	0.078693	-0.27631	0.042979	1.097801	0.046245	-0.18743	0.083199	1.05576	0.064431	0.654877	0.044933	0.614244	0.064053	
70-74	-0.01787	0.084376	-0.52505	0.048638	1.401413	0.048317	-0.46308	0.094076	1.223885	0.066666	0.736029	0.047865	0.526368	0.068137	
75-79	-0.00193	0.095557	-0.68554	0.056592	1.711665	0.051157	-0.58144	0.114966	1.392773	0.070786	0.841458	0.051119	0.393926	0.075394	
80+	-0.38767	0.104571	-0.95242	0.060134	1.842536	0.050032	-1.37298	0.142988	1.150642	0.071638	0.804349	0.051238	-0.06726	0.082946	
Sex															
Male	ref.		ref.		ref.		ref.		ref.		ref.		ref.		
Female	0.044105	0.04748	-0.0916	0.027056	0.136809	0.024685	-1.04581	0.051576	0.30982	0.034785	-1.25654	0.025123	-1.30884	0.035194	
Education															
Primary	ref.		ref.		ref.		ref.		ref.		ref.		ref.		
Secondary	0.311074	0.055907	-0.218306	0.034081	-0.2025	0.029757	-0.18068	0.056733	-0.45915	0.039312	-0.090196	0.031678	-0.1929	0.042242	Base outcome
Tertiary	-0.97745	0.073731	-0.01161	0.037712	-0.40591	0.033607	-0.85819	0.075452	-1.12618	0.050958	-0.18233	0.035178	-0.81266	0.052172	
Migrant status															
Non-mig.	Ref.		ref.		ref.		ref.		ref.		ref.		ref.		
Migrant	0.218555	0.088509	-0.09376	0.053401	0.05451	0.046534	-0.0522	0.104555	0.257066	0.063624	-0.01247	0.048272	-0.00732	0.077351	
Country															
Austria	ref.		ref.		ref.		ref.		ref.		ref.		ref.		
Germany	-0.06476	0.089873	-0.290147	0.050719	-0.189576	0.042129	-0.10943	0.097031	0.214226	0.056982	-0.378718	0.046036	-0.394977	0.063035	
Sweden	-0.24873	0.095438	-0.690036	0.051369	-0.17824	0.043607	-0.25123	0.100932	-0.70503	0.06486	-0.33574	0.047033	-0.09159	0.067975	
Netherlands	-0.32508	0.102478	-0.941146	0.057763	-0.17301	0.055793	-0.35070	0.103606	-0.67874	0.081865	-0.75864	0.053876	-0.29669	0.072067	
Spain	-0.252739	0.090868	-0.285671	0.061126	-0.02911	0.047077	-0.10967	0.117774	-0.08514	0.059963	-0.18765	0.054109	-0.17544	0.075927	
Italy	-0.27591	0.084361	-0.137964	0.052032	-0.10866	0.041751	-0.65504	0.097198	-0.54939	0.057742	-0.21785	0.046027	-0.33212	0.066906	
France	-0.08454	0.079442	-0.346163	0.047075	-0.016767	0.039259	-0.04831	0.089263	-0.27913	0.054688	-0.260251	0.043414	-0.019365	0.060171	
Denmark	-0.115879	0.087931	-0.944603	0.048046	-0.10372	0.043858	-0.41835	0.092409	-0.43285	0.065342	-0.83513	0.044788	-0.42049	0.063626	

Greece	0.129624	0.087699	0.483329	0.051468	0.064542	0.043942	0.050445	0.098461	-0.118289	0.059929	0.345174	0.047652	0.119135	0.067261
Belgium	-0.00409	0.081769	0.363633	0.048299	0.232673	0.039655	0.128676	0.090393	-0.037653	0.054553	0.645506	0.042855	0.408891	0.059215
Czech Rep.	0.532953	0.113483	0.25036	0.064681	0.404009	0.049421	0.406004	0.129248	0.541582	0.060212	0.505289	0.056844	0.73642	0.069298
Poland	0.54134	0.113559	0.997	0.068083	0.410679	0.062843	0.966455	0.111132	0.652165	0.075762	0.942946	0.064803	1.006478	0.080715
Ireland	0.814047	0.191084	0.532911	0.131688	0.213424	0.123922	0.822248	0.200664	0.293854	0.16321	0.824133	0.121518	0.913122	0.154026
Luxembourg	0.143214	0.161034	0.234746	0.097239	0.423709	0.081448	0.010847	0.164275	0.436187	0.098269	0.693795	0.083479	0.721062	0.100046
Hungary	0.161086	0.199944	0.436634	0.153045	0.846693	0.144141	0.538608	0.226689	1.060811	0.161147	1.083801	0.144 48	1.310151	0.182513
Portugal	0.037526	0.2092	0.068438	0.185581	0.428355	0.129298	-1.48559	0.36964	0.025568	0.152144	0.227847	0.149467	-0.8052	0.168148
Slovenia	0.32312	0.098165	0.150674	0.068296	0.421102	0.051691	0.05877	0.129144	0.443013	0.067728	0.278829	0.061617	0.432809	0.077615
Estonia	0.598747	0.082977	0.569311	0.051 55	0.574204	0.042132	0.593167	0.093171	0.960031	0.053354	0.851 41	0.046113	1.095046	0.060117
Croatia	0.215532	0.150 14	0.449156	0.091175	0.536051	0.079861	0.018459	0.173662	0.526493	0.099261	0.473487	0.086389	0.524275	0.1097
Constant	-1.65658	0.097127	0.097538	0.057 05	-0.84829	0.055704	-1.06086	0.104014	-1.582924	0.077574	-0.18187	0.056099	-0.7459	0.078096

Source: SHARE, multinomial logit model

Annex 2. Parameters of Chronic Disease Outcome

	Non-Smokers		Smokers	
	Haz. ratio	Std. err.	Haz. ratio	Std. err.
Obesity				
Not obese	ref.		ref.	
Obese	1.600321	0.048888	1.579012	0.053949
Sex				
Male	ref.		ref.	
Female	1.077076	0.027501	0.85144	0.025543
Country				
Austria	ref.		ref.	
Germany	1.236698	0.053255	1.168939	0.061841
Sweden	1.003295	0.046785	0.864081	0.046217
Netherlands	0.875461	0.046957	0.879305	0.046844
Spain	1.026653	0.048639	0.932069	0.058694
Italy	1.130581	0.050011	1.14467	0.064145
France	1.037634	0.046645	0.972963	0.052775
Denmark	0.940372	0.049371	0.948652	0.050048
Greece	1.251692	0.05505	1.021557	0.056954
Belgium	1.174059	0.050563	1.128535	0.058224
Czech Rep.	1.471846	0.065613	1.356204	0.081813
Poland	1.336329	0.078985	0.905864	0.065469
Ireland	1.167443	0.100262	1.074118	0.08761
Luxembourg	1.387762	0.088307	1.286848	0.093524
Hungary	1.412576	0.120677	1.363534	0.146175
Portugal	1.371645	0.151295	1.199679	0.180255
Slovenia	1.354135	0.063934	1.141391	0.075303
Estonia	1.355587	0.057689	1.136564	0.061807
Croatia	1.506195	0.085196	1.28706	0.08829

Source: SHARE, obs=66 084, Cox model

Annex 3. Parameters of Disability Outcome

	Non-Smokers						
	Moderate Disability		Severe Disability		No Disability	Moderate Disability	
	Coef.	Std. Err.	Coef.	Std. Err.		Coef.	Std. Err.
Event	0.6427803	0.0445748	0.4845867	0.059313		0.7190472	0.0560059
Age group							
50-54	ref.		ref.			ref.	
55-59	0.2614778	0.1137635	-0.0714958	0.1894372		0.1164476	0.0811519
60-64	0.3594592	0.10699	0.0495286	0.1685012		0.129568	0.0752737
65-69	0.4875045	0.1012527	0.4125464	0.1661244		0.0681414	0.078693
70-74	0.8485525	0.0990799	0.7487586	0.1612561		-0.0178737	0.0843755
75-79	1.210086	0.1000422	1.231066	0.1585888		-0.0019285	0.0955568
80+	2.03171	0.0958426	2.600356	0.1536337		-0.3876726	0.1045712
Sex							
Male	ref.		ref.			ref.	
Female	0.2812933	0.0425307	0.1467678	0.0580675		0.039566	0.0481572
Education							
Primary	ref.		ref.			ref.	
Secondary	-0.2956579	0.0525342	-0.3127201	0.0740237		-0.3155349	0.055347
Tertiary	-0.5623971	0.0733232	-0.7861772	0.1067929		-0.8723978	0.0745908
Country							
Austria	ref.		ref.		Base Outcome	ref.	
Germany	0.2000584	0.0738341	0.259035	0.0948599		0.1920856	0.0906328
Sweden	-0.2827243	0.0777371	-0.4046547	0.1040325		-0.1525706	0.090159
Netherlands	-0.2961971	0.1111887	-0.133044	0.1732766		-0.4259853	0.1198583
Spain	-0.0129503	0.0696409	0.2480503	0.0882128		-0.4340711	0.1074723
Italy	0.0425102	0.0700637	0.1381369	0.091035		-0.2772049	0.0881599
France	0.2012586	0.0644673	-0.226266	0.0913679		0.259298	0.0793121
Denmark	-0.2116284	0.0856977	-0.112925	0.1114175		0.0512042	0.0802704
Greece	-0.3258792	0.0777167	-0.5229371	0.1084593		-0.7396215	0.1021849
Belgium	0.4309922	0.0620986	-0.1569216	0.0894262		0.3875293	0.0758112
Czech Rep.	0.0375546	0.0728581	-0.1576255	0.1167613		-0.0884244	0.0924509
Poland	0.5426818	0.0842645	0.7457604	0.1089123		0.5869899	0.0920528
Ireland	0.1418178	0.199108	0.0775003	0.3109921		0.4590926	0.1798773
Luxembourg	-0.0083169	0.1184801	0.0668861	0.1623185		-0.1042553	0.1312108
Hungary	0.2824912	0.18323	0.3852424	0.2779852		0.1386481	0.2042938
Portugal	0.6540722	0.1674466	0.8342253	0.2005066		0.351051	0.2565831
Slovenia	-0.1256492	0.0842578	-0.4015123	0.1093546		-0.0058474	0.1028164
Estonia	0.4218537	0.0633343	0.3153778	0.0854763		0.4169996	0.0783301
Croatia	0.1546921	0.1228489	0.2295353	0.1730279		-0.1525906	0.1590043
Constant	-3.835714	0.1156809	-4.439555	0.1852115		-3.19148	0.1114795

Source: SHARE, multinomial logit regression model

Annex 4. Parameters of Death Outcome

	Male		Female	
	Haz. ratio	Std. err.	Haz. ratio	Std. err.
Disability				
No Disability	ref.		ref.	

Moderate Disability	0.995892	0.103018	1.134732	0.09491
Severe Disability	1.200173	0.136981	1.090271	0.100484
Smoking habit				
Non-smoker	ref.		ref.	
Smoker	1.624722	0.097437	1.555261	0.127617
Education (control)				
Primary	ref.		ref.	
Secondary	1.057185	0.086358	0.973361	0.099496
Tertiary	0.743511	0.06812	0.837198	0.100456
Migrant status				
Non migrant	ref.		ref.	
Migrant	0.703437	0.103282	0.756865	0.094108

Source: SHARE, obs=49 465, Cox model

Annex 5. Validation of the baseline

We conducted two validation exercises of the baseline projections. The first is a comparison of the total population by age and country with the projections by Eurostat which are the basis for he estimates in the Ageing Report (Figure 13). The second is a comparison with the estimates of disabled people by age groups in the aging report (Figure 14).

The comparison with Eurostat projections data indicates that our microsimulation is largely aligned with the trends for country and age in the official projections. A divergence is only present for the age groups above 94 and can be explained by the more optimistic assumption for the increase of life expectancy in our simulation.

The results of the projections for disability from our baseline scenario are aligned with the absolute values reported in the EU Ageing Report for the age groups from 50 to 69 and start to diverge for the age groups above 70. There are two possible explanations for this divergence.

The first is in the definition of disability and the source data used to estimate its prevalence: in the case of the Ageing Report is the EU-SILC and in our case the SHARE survey microdata.

The second and more complex to disentangle is that in our exercise we try to model complex pathways leading to disability through econometric estimates based on the SHARE microdata and the coefficient estimated from such models may introduce also small variations which rapidly translate in larger differences over the projections period in respect of the fixed prevalence rates adopted in the EU Ageing Report.

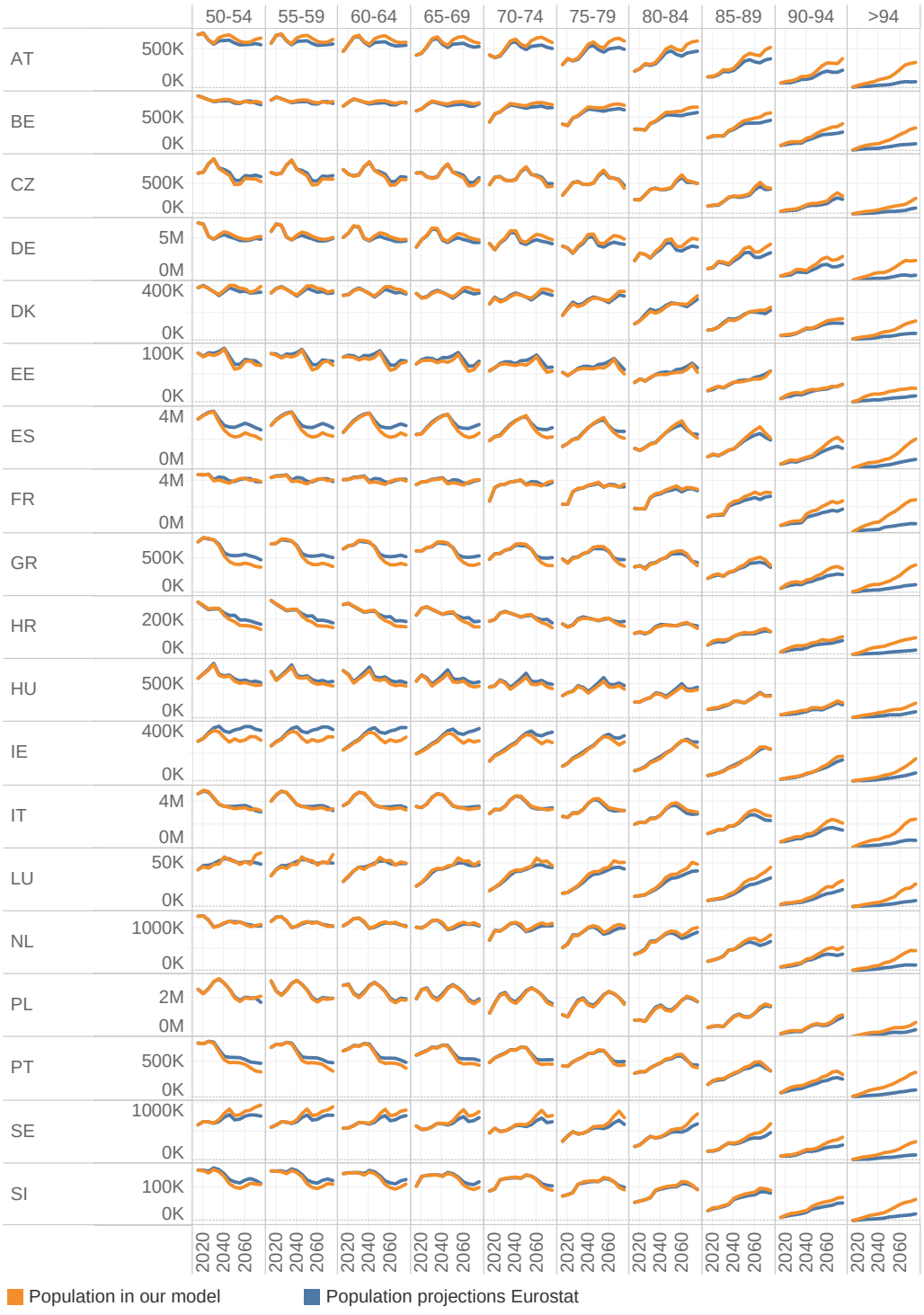


Figure 13 – Comparison of our projections for total population by age and country with the Eurostat projections used in the EU Ageing Report

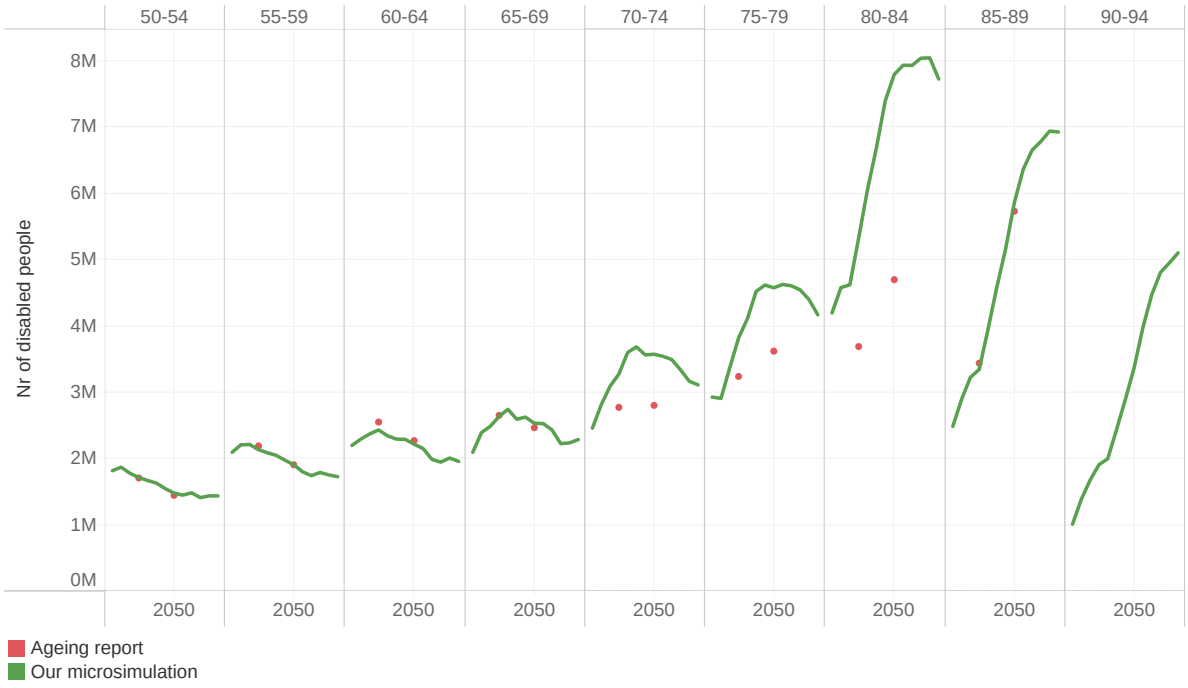


Figure 14 - Comparison of our projections for the absolute number of disabled people by age with the projections in the EU Ageing Report.

Annex 6. Validation of obesity reduction

In the healthy ageing scenario, obesity rates decrease by 5 percentage points in all age groups by 2040, compared to the baseline scenario. Table 3 presents the projected population by obesity status for this scenario and the baseline scenario for 2020, 2040, and 2070. It can be seen that the difference in obesity rates between the two scenarios reaches about 5 percentage points for all age groups in 2040, thus highlighting the model's internal consistency in predicting the impact of reducing obesity rates. By 2070, however, the difference between the two scenarios in percentage points between the obesity rates becomes somehow smaller as other variables, such as education level, start to affect the distribution of the population by obesity status.

Table 3 - Comparison of the projected obesity rates under two scenarios, 2020, 2040 and 2070.

		Baseline				Obesity reduced by 5 percentage points			
Calendar Year	Age	Non-obese	Obese	All	% Obese	Non-obese	Obese	All	% Obese
2020	50 - 54	24 472 416	5 101 731	29 574 147	17,3%	24 472 416	5 101 731	29 574 147	17,3%
	55 - 59	23 451 882	5 134 884	28 586 766	18,0%	23 451 882	5 134 884	28 586 766	18,0%
	60 - 64	21 158 184	4 875 143	26 033 327	18,7%	21 158 184	4 875 143	26 033 327	18,7%
	65 - 69	18 389 056	4 896 936	23 285 991	21,0%	18 389 056	4 896 936	23 285 991	21,0%
	70 - 74	15 535 553	4 398 282	19 933 835	22,1%	15 535 553	4 398 282	19 933 835	22,1%
	75 - 79	12 147 860	3 458 659	15 606 519	22,2%	12 147 860	3 458 659	15 606 519	22,2%
	80 - 84	9 781 331	2 676 056	12 457 387	21,5%	9 781 331	2 676 056	12 457 387	21,5%
	85 - 89	6 433 814	1 591 856	8 025 670	19,8%	6 433 814	1 591 856	8 025 670	19,8%
	90 - 94	3 385 828	633 246	4 019 074	15,8%	3 385 828	633 246	4 019 074	15,8%
	95+	1 301 679	248 654	1 550 333	16,0%	1 301 679	248 654	1 550 333	16,0%
	All	136 057 604	33 015 445	169 073 049	19,5%	136 057 604	33 015 445	169 073 049	19,5%
2040	50 - 54	21 498 890	4 293 175	25 792 065	16,6%	22 578 279	3 180 179	25 758 458	12,3%
	55 - 59	21 901 211	4 449 532	26 350 743	16,9%	23 031 583	3 287 035	26 318 618	12,5%
	60 - 64	21 925 148	4 555 451	26 480 599	17,2%	23 077 096	3 350 605	26 427 701	12,7%
	65 - 69	21 889 577	4 576 954	26 466 531	17,3%	23 113 711	3 345 715	26 459 427	12,6%
	70 - 74	21 530 222	4 447 838	25 978 060	17,1%	22 659 565	3 262 666	25 922 231	12,6%
	75 - 79	19 172 304	4 135 607	23 307 911	17,7%	20 216 249	3 055 139	23 271 387	13,1%
	80 - 84	14 955 480	3 372 223	18 327 703	18,4%	15 888 038	2 469 128	18 357 166	13,5%
	85 - 89	10 026 753	2 582 722	12 609 475	20,5%	10 642 485	1 899 959	12 542 445	15,1%
	90 - 94	5 561 966	1 516 694	7 078 660	21,4%	5 880 794	1 120 419	7 001 214	16,0%
	95+	3 517 552	954 140	4 471 691	21,3%	3 738 507	717 757	4 456 265	16,1%
	All	161 979 104	34 884 336	196 863 440	17,7%	170 826 308	25 688 604	196 514 912	13,1%
2070	50 - 54	19 295 237	3 703 594	22 998 831	16,1%	20 247 006	2 766 941	23 013 946	12,0%
	55 - 59	18 917 346	3 686 868	22 604 213	16,3%	19 988 996	2 737 808	22 726 804	12,0%
	60 - 64	19 250 099	3 801 992	23 052 091	16,5%	20 364 982	2 831 928	23 196 910	12,2%
	65 - 69	18 658 474	3 638 913	22 297 387	16,3%	19 575 530	2 673 889	22 249 419	12,0%
	70 - 74	18 363 364	3 697 245	22 060 609	16,8%	19 364 727	2 751 406	22 116 134	12,4%
	75 - 79	18 750 776	3 754 607	22 505 383	16,7%	19 659 748	2 779 483	22 439 231	12,4%
	80 - 84	18 174 394	3 585 568	21 759 962	16,5%	19 118 277	2 666 410	21 784 687	12,2%
	85 - 89	15 917 469	3 128 190	19 045 659	16,4%	16 711 328	2 320 678	19 032 006	12,2%
	90 - 94	11 610 057	2 305 298	13 915 355	16,6%	12 029 772	1 682 684	13 712 456	12,3%
	95+	10 647 893	2 102 688	12 750 581	16,5%	11 281 168	1 605 671	12 886 840	12,5%
	All	169 585 110	33 404 961	202 990 072	16,5%	178 341 533	24 816 899	203 158 432	12,2%

Annex 7. Validation of smoking reduction

Table 4 highlights the significant impact of reducing the proportion of ever-smokers in the population entering the projection at age 50. By linearly decreasing the proportion of ever-smokers starting at age 50, the scenario ultimately results in a decrease of 80% in 2070. As modulation does not affect the population aged 50 or over in 2020, the effect of smoking reduction takes several years to reach its full extent. By 2070, at the end of the projection exercise, the proportion of smokers has decreased by 80% for all age groups 80-84 or younger. Additionally, reducing smoking tends to increase the population at a faster rate due to the lower death rates of non-smokers. This results in over a total of 4.5 million more survivors in 2070 compared to the baseline scenario. The results from Table 4 provide strong evidence for the benefits of reducing smoking in the population. With a linearly decreasing proportion of ever-smokers, the impact of smoking reduction can be seen to reach its full extent over time, leading to a significant increase in the number of survivors in 2070.

Table 4 – Comparison of the projected proportion of ever smokers under two scenarios, 2020, 2040 and 2070.

		Baseline				Proportion of smokers reduced by 80% in 2040					
Calendar year	Age	Non-smoker	Smoker	All	% Smokers	Non-smoker	Smoker	All	% Smokers	% Smokers Base/reduction	Diff. in total pop
2020	50 - 54	13 392 123	16 182 025	29 574 147	55%	13 392 123	16 182 025	29 574 147	55%	0%	0
	55 - 59	13 064 575	15 522 191	28 586 766	54%	13 064 575	15 522 191	28 586 766	54%	0%	0
	60 - 64	11 981 584	14 051 743	26 033 327	54%	11 981 584	14 051 743	26 033 327	54%	0%	0
	65 - 69	11 061 297	12 224 694	23 285 991	52%	11 061 297	12 224 694	23 285 991	52%	0%	0
	70 - 74	10 243 589	9 690 247	19 933 835	49%	10 243 589	9 690 247	19 933 835	49%	0%	0
	75 - 79	8 980 099	6 626 420	15 606 519	42%	8 980 099	6 626 420	15 606 519	42%	0%	0
	80 - 84	8 070 575	4 386 811	12 457 387	35%	8 070 575	4 386 811	12 457 387	35%	0%	0
	85 - 89	5 813 790	2 211 879	8 025 670	28%	5 813 790	2 211 879	8 025 670	28%	0%	0
	90 - 94	3 223 767	795 307	4 019 074	20%	3 223 767	795 307	4 019 074	20%	0%	0
	95+	1 334 902	215 431	1 550 333	14%	1 334 902	215 431	1 550 333	14%	0%	0
	All	87 166 300	81 906 748	169 073 049	48%	87 166 300	81 906 748	169 073 049	48%	0%	0
2040	50 - 54	11 773 230	14 018 835	25 792 065	54%	23 023 598	2 769 004	25 792 602	11%	20%	537
	55 - 59	12 078 393	14 272 351	26 350 743	54%	20 656 013	5 745 449	26 401 462	22%	40%	50 719
	60 - 64	12 226 370	14 254 229	26 480 599	54%	18 048 612	8 558 426	26 607 039	32%	60%	126 439
	65 - 69	12 379 607	14 086 924	26 466 531	53%	15 340 421	11 187 034	26 527 455	42%	79%	60 924
	70 - 74	12 327 780	13 650 281	25 978 060	53%	12 384 419	13 589 445	25 973 864	52%	100%	-4 196
	75 - 79	11 417 721	11 890 190	23 307 911	51%	11 430 880	11 803 180	23 234 060	51%	99%	-73 851
	80 - 84	9 440 997	8 886 706	18 327 703	48%	9 436 789	8 919 377	18 356 167	49%	100%	28 464
	85 - 89	7 068 558	5 540 917	12 609 475	44%	7 109 295	5 483 208	12 592 503	44%	99%	-16 973
	90 - 94	4 628 065	2 450 595	7 078 660	35%	4 620 833	2 455 206	7 076 039	35%	100%	-2 621
	95+	3 711 582	760 109	4 471 691	17%	3 696 237	753 061	4 449 298	17%	99%	-22 394
	All	97 052 303	99 811 137	196 863 440	51%	125 747 097	71 263 391	197 010 488	36%	71%	147 048
2070	50 - 54	10 438 921	12 559 909	22 998 831	55%	20 477 713	2 500 125	22 977 837	11%	20%	-20 993
	55 - 59	10 363 299	12 240 915	22 604 213	54%	20 255 383	2 457 691	22 713 074	11%	20%	108 861
	60 - 64	10 680 767	12 371 324	23 052 091	54%	20 708 055	2 516 327	23 224 382	11%	20%	172 291
	65 - 69	10 314 423	11 982 964	22 297 387	54%	20 011 857	2 413 756	22 425 613	11%	20%	128 226
	70 - 74	10 211 379	11 849 230	22 060 609	54%	19 974 047	2 316 223	22 290 269	10%	20%	229 660
	75 - 79	10 647 858	11 857 526	22 505 383	53%	20 611 649	2 379 244	22 990 892	10%	20%	485 509
	80 - 84	10 583 660	11 176 301	21 759 962	51%	20 437 676	2 221 718	22 659 395	10%	20%	899 433
	85 - 89	9 719 457	9 326 202	19 045 659	49%	16 283 491	3 713 554	19 997 045	19%	40%	951 386
	90 - 94	7 801 998	6 113 357	13 915 355	44%	11 206 457	3 635 994	14 842 452	24%	59%	927 096
	95+	8 926 388	3 824 193	12 750 581	30%	10 158 642	3 244 565	13 403 207	24%	85%	652 626
	All	99 688 150	103 301 922	202 990 072	51%	180 124 970	27 399 197	207 524 167	13%	27%	4 534 095

Annex 8. Validation of longer-life expectancy

In this scenario where mortality rates are reduced, life expectancy is extended by two years, leading to a more rapidly ageing population. This is evident from the data in Table 5, which compares the age structure of the projected population under the two different scenarios that are the baseline and reduced-mortality scenarios, and shows the number of potential additional survivors. The reduced-mortality scenario results in a significant increase in the number of people aged 50 and over, with almost 7.3 million more survivals in 2040 compared to the baseline.

We also note that the effect of the alternative scenario is cumulative with age, meaning that the older the population gets, the more pronounced the impact of the reduced mortality becomes. For example, in 2040 the alternative scenario generates only about 38,000 more people aged 50-54, but about 4.2 million more people aged 80 and over. This highlights that more than half (57.6%) of the population increase projected in 2040 by this scenario compared to the baseline scenario occurs among the oldest people. In 2070, the scenario proposing an accelerated reduction in mortality produces 10.6 million more survivors, with 75% of them being aged 80 and over. The number of survivors in the highest age group (95+) increases by over 2 million in 2070 compared to the baseline scenario.

Table 5 – Comparison of the population age structures according to two scenarios.

Year	Age	Baseline	Mortality reduction	Number of additional survivors
2040	50 - 54	25 792 065	25 829 983	37 918
	55 - 59	26 350 743	26 507 526	156 782
	60 - 64	26 480 599	26 817 584	336 984
	65 - 69	26 466 531	26 990 866	524 335
	70 - 74	25 978 060	26 818 970	840 910
	75 - 79	23 307 911	24 490 111	1 182 200
	80 - 84	18 327 703	19 825 962	1 498 259
	85 - 89	12 609 475	13 964 503	1 355 027
	90 - 94	7 078 660	7 872 949	794 289
	95+	4 471 691	5 013 986	542 295
	All	196 863 440	204 132 439	7 268 999
2070	50 - 54	22 998 831	23 132 287	133 456
	55 - 59	22 604 213	22 902 977	298 764
	60 - 64	23 052 091	23 324 195	272 104
	65 - 69	22 297 387	22 641 298	343 911
	70 - 74	22 060 609	22 730 559	669 950
	75 - 79	22 505 383	23 447 865	942 481
	80 - 84	21 759 962	23 164 781	1 404 819
	85 - 89	19 045 659	20 916 072	1 870 413
	90 - 94	13 915 355	15 906 189	1 990 834
	95+	12 750 581	15 474 465	2 723 884
	All	202 990 072	213 640 687	10 650 615

Annex 9. Overview of chronic disease

Table 6 presents the projected chronic disease status for the baseline and 4 alternative scenarios up to 2070. As expected, the baseline scenario projects an increase in overall chronic disease prevalence from 61% in 2020, to 65% in 2040, and 68% in 2070, due to the ageing population. Age is indeed the main driver of chronic disease, and this is reflected in the observed (2020) and the simulated (2040 and 2070) age-specific prevalence of chronic disease.

The alternative scenarios show only slight variations in the prevalence rates, with the evolution of age-specific or overall prevalence of chronic diseases remaining quite similar. For example, in 2040, the overall chronic disease rate is projected to be 64.9% in the baseline scenario, 64.7% in the reduced obesity scenario and 64.9% in the reduced smoking scenario. It is interesting to note that in 2070 the results show a slightly higher variation across scenarios.

In 2070, the baseline scenario projects a chronic disease rate of 67.5%, which is a relatively high percentage among the population. However, this rate is slightly lower in the reduced obesity scenario (67.2%) and higher in the reduced smoking scenario (68.3%). Thus potentially, the reduction of obesity can decrease the risk of chronic diseases. On the other hand, reducing smoking, while increasing life expectancy, has the consequence of leading to a slight increase in the overall prevalence of chronic diseases. This is because as people age, their risk of developing chronic diseases increases. The scenario that increases life expectancy results in a slight increase in the prevalence of chronic diseases, reaching 65.3% in 2040 and 68.1% in 2070, and the scenario removing education show a percentage of chronic disease equal to 64.8% and 67. 4% in 2040 and 2070 respectively.

Table 6 – Projected population by chronic disease status for the baseline and five alternative scenarios (2020, 2040 and 2070).

		Baseline				Faster decline in mortality			
Calendar Year	Age	No Chronic	Chronic	All	% Chronic	No Chronic	Chronic	All	% Chronic
2020	50 - 54	17 229 823	12 344 324	29 574 147	41,7%	17 261 540	12 315 090	29 576 630	41,6%
	55 - 59	14 346 040	14 240 726	28 586 766	49,8%	14 383 216	14 272 107	28 655 323	49,8%
	60 - 64	11 329 782	14 703 544	26 033 327	56,5%	11 335 922	14 758 445	26 094 367	56,6%
	65 - 69	8 121 852	15 164 140	23 285 991	65,1%	8 160 496	15 220 562	23 381 058	65,1%
	70 - 74	6 038 001	13 895 834	19 933 835	69,7%	6 064 347	14 019 746	20 084 094	69,8%
	75 - 79	3 903 533	11 702 986	15 606 519	75,0%	3 942 633	11 791 779	15 734 412	74,9%
	80 - 84	2 626 794	9 830 593	12 457 387	78,9%	2 656 123	9 955 879	12 612 001	78,9%
	85 - 89	1 537 126	6 488 543	8 025 670	80,8%	1 533 193	6 602 172	8 135 365	81,2%
	90 - 94	757 979	3 261 095	4 019 074	81,1%	778 955	3 323 394	4 102 349	81,0%
	95+	313 239	1 237 094	1 550 333	79,8%	323 472	1 259 225	1 582 697	79,6%
	All	66 204 170	102 868 879	169 073 049	60,8%	66 439 897	103 518 399	169 958 295	60,9%
2040	50 - 54	15 044 702	10 747 363	25 792 065	41,7%	15 122 944	10 707 039	25 829 983	41,5%
	55 - 59	13 283 925	13 066 818	26 350 743	49,6%	13 315 591	13 191 934	26 507 526	49,8%
	60 - 64	11 083 531	15 397 069	26 480 599	58,1%	11 188 665	15 628 919	26 817 584	58,3%
	65 - 69	9 024 165	17 442 366	26 466 531	65,9%	9 337 712	17 653 154	26 990 866	65,4%
	70 - 74	7 342 880	18 635 180	25 978 060	71,7%	7 515 019	19 303 951	26 818 970	72,0%
	75 - 79	5 426 597	17 881 314	23 307 911	76,7%	5 719 145	18 770 966	24 490 111	76,6%
	80 - 84	3 790 684	14 537 019	18 327 703	79,3%	4 045 061	15 780 901	19 825 962	79,6%
	85 - 89	2 191 350	10 418 126	12 609 475	82,6%	2 446 151	11 518 351	13 964 503	82,5%
	90 - 94	1 218 440	5 860 221	7 078 660	82,8%	1 340 941	6 532 008	7 872 949	83,0%
	95+	746 611	3 725 080	4 471 691	83,3%	829 486	4 184 500	5 013 986	83,5%
	All	69 152 884	127 710 556	196 863 440	64,9%	70 860 715	133 271 724	204 132 439	65,3%
2070	50 - 54	13 512 247	9 486 583	22 998 831	41,2%	13 707 818	9 424 468	23 132 287	40,7%
	55 - 59	11 520 942	11 083 271	22 604 213	49,0%	11 631 499	11 271 478	22 902 977	49,2%
	60 - 64	9 837 846	13 214 244	23 052 091	57,3%	9 881 100	13 443 095	23 324 195	57,6%
	65 - 69	7 765 517	14 531 870	22 297 387	65,2%	7 854 193	14 787 105	22 641 298	65,3%
	70 - 74	6 377 706	15 682 903	22 060 609	71,1%	6 467 992	16 262 567	22 730 559	71,5%
	75 - 79	5 206 387	17 298 997	22 505 383	76,9%	5 459 567	17 988 297	23 447 865	76,7%
	80 - 84	4 292 407	17 467 555	21 759 962	80,3%	4 641 413	18 523 369	23 164 781	80,0%
	85 - 89	3 289 574	15 756 085	19 045 659	82,7%	3 589 441	17 326 630	20 916 072	82,8%
	90 - 94	2 232 842	11 682 514	13 915 355	84,0%	2 479 426	13 426 763	15 906 189	84,4%
	95+	1 942 074	10 808 507	12 750 581	84,8%	2 334 512	13 139 952	15 474 465	84,9%
	All	65 977 541	137 012 531	202 990 072	67,5%	68 046 963	145 593 724	213 640 687	68,1%

		Smoking declines				Obesity declines			
Calendar Year	Age	No Chronic	Chronic	All	% Chronic	No Chronic	Chronic	All	% Chronic
2020	50 - 54	17 229 823	12 344 324	29 574 147	41,7%	17 229 823	12 344 324	29 574 147	41,7%
	55 - 59	14 346 040	14 240 726	28 586 766	49,8%	14 346 040	14 240 726	28 586 766	49,8%
	60 - 64	11 329 782	14 703 544	26 033 327	56,5%	11 329 782	14 703 544	26 033 327	56,5%
	65 - 69	8 121 852	15 164 140	23 285 991	65,1%	8 121 852	15 164 140	23 285 991	65,1%
	70 - 74	6 038 001	13 895 834	19 933 835	69,7%	6 038 001	13 895 834	19 933 835	69,7%
	75 - 79	3 903 533	11 702 986	15 606 519	75,0%	3 903 533	11 702 986	15 606 519	75,0%
	80 - 84	2 626 794	9 830 593	12 457 387	78,9%	2 626 794	9 830 593	12 457 387	78,9%
	85 - 89	1 537 126	6 488 543	8 025 670	80,8%	1 537 126	6 488 543	8 025 670	80,8%
	90 - 94	757 979	3 261 095	4 019 074	81,1%	757 979	3 261 095	4 019 074	81,1%
	95+	313 239	1 237 094	1 550 333	79,8%	313 239	1 237 094	1 550 333	79,8%
	All	66 204 170	102 868 879	169 073 049	60,8%	66 204 170	102 868 879	169 073 049	60,8%
2040	50 - 54	15 131 555	10 661 047	25 792 602	41,3%	15 090 136	10 668 322	25 758 458	41,4%
	55 - 59	13 230 018	13 171 444	26 401 462	49,9%	13 339 207	12 979 411	26 318 618	49,3%
	60 - 64	11 073 352	15 533 687	26 607 039	58,4%	11 081 606	15 346 095	26 427 701	58,1%
	65 - 69	9 083 317	17 444 138	26 527 455	65,8%	9 098 308	17 361 119	26 459 427	65,6%
	70 - 74	7 318 458	18 655 406	25 973 864	71,8%	7 330 082	18 592 149	25 922 231	71,7%
	75 - 79	5 441 534	17 792 526	23 234 060	76,6%	5 428 703	17 842 685	23 271 387	76,7%
	80 - 84	3 794 038	14 562 129	18 356 167	79,3%	3 781 020	14 576 146	18 357 166	79,4%
	85 - 89	2 217 241	10 375 262	12 592 503	82,4%	2 194 850	10 347 595	12 542 445	82,5%
	90 - 94	1 200 504	5 875 535	7 076 039	83,0%	1 208 016	5 793 197	7 001 214	82,7%
	95+	745 558	3 703 739	4 449 298	83,2%	740 664	3 715 601	4 456 265	83,4%
	All	69 235 576	127 774 912	197 010 488	64,9%	69 292 592	127 222 320	196 514 912	64,7%
2070	50 - 54	13 559 734	9 418 103	22 977 837	41,0%	13 570 053	9 443 894	23 013 946	41,0%
	55 - 59	11 409 282	11 303 792	22 713 074	49,8%	11 588 241	11 138 563	22 726 804	49,0%
	60 - 64	9 747 196	13 477 186	23 224 382	58,0%	9 874 519	13 322 391	23 196 910	57,4%
	65 - 69	7 585 769	14 839 844	22 425 613	66,2%	7 857 216	14 392 203	22 249 419	64,7%
	70 - 74	6 140 506	16 149 764	22 290 269	72,5%	6 447 088	15 669 046	22 116 134	70,8%
	75 - 79	5 203 792	17 787 101	22 990 892	77,4%	5 365 620	17 073 611	22 439 231	76,1%
	80 - 84	4 373 423	18 285 971	22 659 395	80,7%	4 366 502	17 418 184	21 784 687	80,0%
	85 - 89	3 409 245	16 587 800	19 997 045	83,0%	3 370 094	15 661 912	19 032 006	82,3%
	90 - 94	2 311 914	12 530 538	14 842 452	84,4%	2 192 837	11 519 619	13 712 456	84,0%
	95+	2 024 173	11 379 033	13 403 207	84,9%	1 963 487	10 923 353	12 886 840	84,8%
	All	65 765 035	141 759 132	207 524 167	68,3%	66 595 656	136 562 775	203 158 432	67,2%

		Obesity and smoking decline				No protection of education against disability			
Calendar Year	Age	No Chronic	Chronic	All	% Chronic	No Chronic	Chronic	All	% Chronic
2020	50 - 54	17 229 823	12 344 324	29 574 147	41,7%	17 254 238	12 324 371	29 578 609	41,7%
	55 - 59	14 346 040	14 240 726	28 586 766	49,8%	14 348 119	14 240 442	28 588 562	49,8%
	60 - 64	11 329 782	14 703 544	26 033 327	56,5%	11 384 321	14 650 199	26 034 521	56,3%
	65 - 69	8 121 852	15 164 140	23 285 991	65,1%	8 132 577	15 157 308	23 289 884	65,1%
	70 - 74	6 038 001	13 895 834	19 933 835	69,7%	5 965 019	14 003 492	19 968 511	70,1%
	75 - 79	3 903 533	11 702 986	15 606 519	75,0%	3 899 044	11 719 625	15 618 669	75,0%
	80 - 84	2 626 794	9 830 593	12 457 387	78,9%	2 632 906	9 851 000	12 483 907	78,9%
	85 - 89	1 537 126	6 488 543	8 025 670	80,8%	1 507 455	6 478 463	7 985 918	81,1%
	90 - 94	757 979	3 261 095	4 019 074	81,1%	761 627	3 224 350	3 985 978	80,9%
	95+	313 239	1 237 094	1 550 333	79,8%	309 709	1 273 451	1 583 160	80,4%
	All	66 204 170	102 868 879	169 073 049	60,8%	66 195 015	102 922 702	169 117 717	60,9%
2040	50 - 54	15 000 668	10 815 502	25 816 170	41,9%	15 122 276	10 584 945	25 707 221	41,2%
	55 - 59	13 264 225	13 035 468	26 299 694	49,6%	13 137 949	13 103 948	26 241 897	49,9%
	60 - 64	10 997 935	15 569 522	26 567 457	58,6%	11 069 213	15 429 086	26 498 299	58,2%
	65 - 69	9 168 427	17 408 389	26 576 816	65,5%	9 104 559	17 349 497	26 454 056	65,6%
	70 - 74	7 394 030	18 566 514	25 960 545	71,5%	7 352 131	18 569 787	25 921 918	71,6%
	75 - 79	5 434 809	17 828 441	23 263 251	76,6%	5 383 565	17 860 269	23 243 834	76,8%
	80 - 84	3 749 387	14 526 560	18 275 947	79,5%	3 812 312	14 463 054	18 275 366	79,1%
	85 - 89	2 229 296	10 355 133	12 584 429	82,3%	2 165 135	10 364 327	12 529 463	82,7%
	90 - 94	1 196 317	5 845 671	7 041 988	83,0%	1 163 201	5 805 449	6 968 650	83,3%
	95+	741 430	3 722 073	4 463 503	83,4%	713 653	3 716 107	4 429 760	83,9%
	All	69 176 527	127 673 273	196 849 800	64,9%	69 023 995	127 246 469	196 270 464	64,8%
2070	50 - 54	13 617 508	9 455 875	23 073 383	41,0%	13 668 851	9 453 480	23 122 331	40,9%
	55 - 59	11 591 261	11 169 789	22 761 050	49,1%	11 565 009	11 116 173	22 681 182	49,0%
	60 - 64	9 736 393	13 466 565	23 202 958	58,0%	9 824 850	13 283 053	23 107 902	57,5%
	65 - 69	7 665 725	14 783 036	22 448 761	65,9%	7 815 159	14 540 095	22 355 254	65,0%
	70 - 74	6 252 324	16 141 452	22 393 775	72,1%	6 328 923	15 782 743	22 111 666	71,4%
	75 - 79	5 255 782	17 735 932	22 991 714	77,1%	5 256 554	17 234 316	22 490 869	76,6%
	80 - 84	4 430 852	18 223 432	22 654 284	80,4%	4 351 762	17 447 593	21 799 355	80,0%
	85 - 89	3 302 415	15 716 476	19 018 891	82,6%	3 268 997	15 635 775	18 904 772	82,7%
	90 - 94	2 359 170	12 469 546	14 828 715	84,1%	2 193 876	11 656 150	13 850 026	84,2%
	95+	2 046 387	11 395 688	13 442 075	84,8%	1 917 806	10 753 708	12 671 514	84,9%
	All	66 257 815	140 557 791	206 815 606	68,0%	66 191 786	136 903 086	203 094 871	67,4%

Annex 10. Disability detailed results

Table 7 shows the results in terms of disability status for the baseline and five alternative scenarios. In the baseline scenario, the proportion of people without disability decreases between 2020 and 2040, from 88.3% to 87.3%. This proportion continues to decrease until 2070 when it reaches 86%. The prevalence of disability also increases across age groups, which was expected: like for chronic diseases, age is the main driver of disability.

Like with chronic diseases, the different scenarios do not produce much differences. In 2040, the proportion of people without disability is 87.3% in the baseline scenario and 87.6% and 87.3% in the scenarios where the prevalence of smoking or obesity is reduced. The differences between scenarios are even smaller in 2070.

Table 7 - Projected population by disability status for the baseline and five alternative scenarios (2020, 2040 and 2070).

		Baseline				**Mortality declines faster**			
			Disability				Disability		
Calendar Year	Age	None	Moderate	Severe	Total	None	Moderate	Severe	Total
2020	50 - 54	28 230 534	1 012 615	330 999	29 574 147	28 241 055	1 015 552	320 023	29 576 630
	55 - 59	26 954 001	1 242 594	390 172	28 586 766	26 982 810	1 264 756	407 756	28 655 323
	60 - 64	24 310 454	1 281 974	440 899	26 033 327	24 338 933	1 290 406	465 028	26 094 367
	65 - 69	21 431 684	1 337 889	516 417	23 285 991	21 508 913	1 342 778	529 366	23 381 058
	70 - 74	17 692 182	1 576 056	665 598	19 933 835	17 796 847	1 588 933	698 313	20 084 094
	75 - 79	13 160 842	1 661 697	783 979	15 606 519	13 221 911	1 710 009	802 491	15 734 412
	80 - 84	8 415 934	2 360 656	1 680 797	12 457 387	8 523 508	2 391 797	1 696 697	12 612 001
	85 - 89	5 384 779	1 528 800	1 112 091	8 025 670	5 452 017	1 538 539	1 144 808	8 135 365
	90 - 94	2 710 900	756 634	551 540	4 019 074	2 766 673	773 387	562 289	4 102 349
	95+	1 065 208	276 744	208 381	1 550 333	1 088 545	289 129	205 023	1 582 697
	All	149 356 518	13 035 658	6 680 873	169 073 049	149 921 214	13 205 288	6 831 794	169 958 295
2040	50 - 54	24 664 649	846 107	281 309	25 792 065	24 702 727	861 258	265 999	25 829 983
	55 - 59	24 919 413	1 086 426	344 904	26 350 743	25 081 787	1 080 147	345 592	26 507 526
	60 - 64	24 843 650	1 191 695	445 255	26 480 599	25 153 996	1 227 144	436 443	26 817 584
	65 - 69	24 564 220	1 380 779	521 532	26 466 531	25 052 999	1 383 731	554 136	26 990 866
	70 - 74	23 259 320	1 892 930	825 810	25 978 060	24 047 181	1 940 286	831 502	26 818 970
	75 - 79	19 814 781	2 401 360	1 091 770	23 307 911	20 850 992	2 501 766	1 137 352	24 490 111
	80 - 84	12 845 561	3 304 826	2 177 316	18 327 703	13 902 568	3 570 125	2 353 269	19 825 962
	85 - 89	8 830 770	2 271 177	1 507 528	12 609 475	9 740 693	2 568 090	1 655 720	13 964 503
	90 - 94	4 983 807	1 242 096	852 757	7 078 660	5 522 001	1 400 951	949 997	7 872 949
	95+	3 210 805	736 063	524 823	4 471 691	3 552 902	854 092	606 992	5 013 986
	All	171 936 975	16 353 461	8 573 004	196 863 440	177 607 846	17 387 591	9 137 001	204 132 439
2070	50 - 54	21 812 062	752 772	234 543	22 799 376	22 122 876	772 683	236 727	23 132 287
	55 - 59	21 775 356	878 513	263 737	22 917 607	21 748 609	880 367	274 001	22 902 977
	60 - 64	21 100 863	988 594	323 553	22 413 009	21 962 331	1 029 986	331 879	23 324 195
	65 - 69	21 253 132	1 099 556	412 995	22 765 682	21 068 678	1 148 784	423 835	22 641 298
	70 - 74	19 764 087	1 489 244	635 583	21 888 914	20 350 468	1 720 645	659 446	22 730 559
	75 - 79	18 425 701	2 085 722	897 939	21 409 362	20 172 867	2 266 808	1 008 189	23 447 865
	80 - 84	15 230 391	3 552 136	2 285 186	21 067 713	16 738 705	3 872 927	2 553 149	23 164 781
	85 - 89	13 743 339	3 103 503	1 982 146	18 828 988	15 012 052	3 592 137	2 311 883	20 916 072
	90 - 94	10 347 005	2 312 565	1 494 249	14 153 819	11 567 344	2 616 103	1 722 742	15 906 189
	95+	10 132 938	2 165 357	1 409 533	13 707 828	11 409 159	2 461 960	1 603 345	15 474 465
	All	173 584 874	18 427 962	9 939 463	201 952 299	182 153 090	20 362 400	11 125 197	213 640 687

Percent distribution

			Disability				Disability		
Calendar Year	Age	None	Moderate	Severe	Total	None	Moderate	Severe	Total
2020	50 - 54	95,5%	3,4%	1,1%	100,0%	95,5%	3,4%	1,1%	100,0%
	55 - 59	94,3%	4,3%	1,4%	100,0%	94,2%	4,4%	1,4%	100,0%
	60 - 64	93,4%	4,9%	1,7%	100,0%	93,3%	4,9%	1,8%	100,0%
	65 - 69	92,0%	5,7%	2,2%	100,0%	92,0%	5,7%	2,3%	100,0%
	70 - 74	88,8%	7,9%	3,3%	100,0%	88,6%	7,9%	3,5%	100,0%
	75 - 79	84,3%	10,6%	5,0%	100,0%	84,0%	10,9%	5,1%	100,0%
	80 - 84	67,6%	18,9%	13,5%	100,0%	67,6%	19,0%	13,5%	100,0%
	85 - 89	67,1%	19,0%	13,9%	100,0%	67,0%	18,9%	14,1%	100,0%
	90 - 94	67,5%	18,8%	13,7%	100,0%	67,4%	18,9%	13,7%	100,0%
	95+	68,7%	17,9%	13,4%	100,0%	68,8%	18,3%	13,0%	100,0%
	All	88,3%	7,7%	4,0%	100,0%	88,2%	7,8%	4,0%	100,0%
2040	50 - 54	95,6%	3,3%	1,1%	100,0%	95,6%	3,3%	1,0%	100,0%
	55 - 59	94,6%	4,1%	1,3%	100,0%	94,6%	4,1%	1,3%	100,0%
	60 - 64	93,8%	4,5%	1,7%	100,0%	93,8%	4,6%	1,6%	100,0%
	65 - 69	92,8%	5,2%	2,0%	100,0%	92,8%	5,1%	2,1%	100,0%
	70 - 74	89,5%	7,3%	3,2%	100,0%	89,7%	7,2%	3,1%	100,0%
	75 - 79	85,0%	10,3%	4,7%	100,0%	85,1%	10,2%	4,6%	100,0%
	80 - 84	70,1%	18,0%	11,9%	100,0%	70,1%	18,0%	11,9%	100,0%
	85 - 89	70,0%	18,0%	12,0%	100,0%	69,8%	18,4%	11,9%	100,0%
	90 - 94	70,4%	17,5%	12,0%	100,0%	70,1%	17,8%	12,1%	100,0%
	95+	71,8%	16,5%	11,7%	100,0%	70,9%	17,0%	12,1%	100,0%
	All	87,3%	8,3%	4,4%	100,0%	87,0%	8,5%	4,5%	100,0%
2070	50 - 54	95,7%	3,3%	1,0%	100,0%	95,6%	3,3%	1,0%	100,0%
	55 - 59	95,0%	3,8%	1,2%	100,0%	95,0%	3,8%	1,2%	100,0%
	60 - 64	94,1%	4,4%	1,4%	100,0%	94,2%	4,4%	1,4%	100,0%
	65 - 69	93,4%	4,8%	1,8%	100,0%	93,1%	5,1%	1,9%	100,0%
	70 - 74	90,3%	6,8%	2,9%	100,0%	89,5%	7,6%	2,9%	100,0%
	75 - 79	86,1%	9,7%	4,2%	100,0%	86,0%	9,7%	4,3%	100,0%
	80 - 84	72,3%	16,9%	10,8%	100,0%	72,3%	16,7%	11,0%	100,0%
	85 - 89	73,0%	16,5%	10,5%	100,0%	71,8%	17,2%	11,1%	100,0%
	90 - 94	73,1%	16,3%	10,6%	100,0%	72,7%	16,4%	10,8%	100,0%
	95+	73,9%	15,8%	10,3%	100,0%	73,7%	15,9%	10,4%	100,0%
	All	86,0%	9,1%	4,9%	100,0%	85,3%	9,5%	5,2%	100,0%

		Smoking declines				Obesity declines			
		Disability				Disability			
Calendar Year	Age	None	Moderate	Severe	Total	None	Moderate	Severe	Total
2020	50 - 54	28 230 534	1 012 615	330 999	29 574 147	28 230 534	1 012 615	330 999	29 574 147
	55 - 59	26 954 001	1 242 594	390 172	28 586 766	26 954 001	1 242 594	390 172	28 586 766
	60 - 64	24 310 454	1 281 974	440 899	26 033 327	24 310 454	1 281 974	440 899	26 033 327
	65 - 69	21 431 684	1 337 889	516 417	23 285 991	21 431 684	1 337 889	516 417	23 285 991
	70 - 74	17 692 182	1 576 056	665 598	19 933 835	17 692 182	1 576 056	665 598	19 933 835
	75 - 79	13 160 842	1 661 697	783 979	15 606 519	13 160 842	1 661 697	783 979	15 606 519
	80 - 84	8 415 934	2 360 656	1 680 797	12 457 387	8 415 934	2 360 656	1 680 797	12 457 387
	85 - 89	5 384 779	1 528 800	1 112 091	8 025 670	5 384 779	1 528 800	1 112 091	8 025 670
	90 - 94	2 710 900	756 634	551 540	4 019 074	2 710 900	756 634	551 540	4 019 074
	95+	1 065 208	276 744	208 381	1 550 333	1 065 208	276 744	208 381	1 550 333
	All	149 356 518	13 035 658	6 680 873	169 073 049	149 356 518	13 035 658	6 680 873	169 073 049
2040	50 - 54	24 788 598	704 021	299 983	25 792 602	24 608 916	875 662	273 879	25 758 458
	55 - 59	25 121 150	976 507	303 805	26 401 462	24 892 063	1 067 956	358 599	26 318 618
	60 - 64	25 051 632	1 136 490	418 917	26 607 039	24 810 472	1 186 632	430 598	26 427 701
	65 - 69	24 673 118	1 326 530	527 807	26 527 455	24 585 820	1 347 454	526 153	26 459 427
	70 - 74	23 282 411	1 900 987	790 466	25 973 864	23 197 239	1 913 517	811 476	25 922 231
	75 - 79	19 805 693	2 359 140	1 069 227	23 234 060	19 778 664	2 395 135	1 097 589	23 271 387
	80 - 84	12 902 211	3 280 398	2 173 558	18 356 167	12 902 005	3 269 624	2 185 538	18 357 166
	85 - 89	8 786 753	2 298 927	1 506 823	12 592 503	8 772 811	2 258 681	1 510 953	12 542 445
	90 - 94	4 995 969	1 255 467	824 603	7 076 039	4 914 849	1 254 615	831 750	7 001 214
	95+	3 168 961	757 490	522 846	4 449 298	3 189 741	752 876	513 648	4 456 265
	All	172 576 496	15 995 959	8 438 034	197 010 488	171 652 578	16 322 151	8 540 183	196 514 912
2070	50 - 54	22 136 761	588 280	252 796	22 977 837	22 030 107	741 456	242 383	23 013 946
	55 - 59	21 744 208	730 367	238 500	22 713 074	21 572 460	884 002	270 342	22 726 804
	60 - 64	22 051 995	886 002	286 386	23 224 382	21 844 766	1 009 879	342 264	23 196 910
	65 - 69	21 057 019	978 275	390 319	22 425 613	20 793 308	1 044 827	411 284	22 249 419
	70 - 74	20 282 958	1 428 578	578 733	22 290 269	19 910 359	1 550 861	654 913	22 116 134
	75 - 79	20 003 839	2 046 348	940 705	22 990 892	19 348 900	2 126 053	964 277	22 439 231
	80 - 84	16 324 839	3 629 308	2 705 248	22 659 395	15 810 859	3 629 462	2 344 366	21 784 687
	85 - 89	14 237 359	3 349 924	2 409 762	19 997 045	13 720 835	3 219 065	2 092 105	19 032 006
	90 - 94	10 704 247	2 421 584	1 716 621	14 842 452	9 945 070	2 300 241	1 467 144	13 712 456
	95+	9 863 117	2 132 488	1 407 601	13 403 207	9 530 637	2 044 268	1 311 935	12 886 840
	All	178 406 340	18 191 154	10 926 672	207 524 167	174 507 302	18 550 115	10 101 015	203 158 432

Percent distribution

			Disability				Disability		
Calendar Year	Age	None	Moderate	Severe	Total	None	Moderate	Severe	Total
2020	50 - 54	95,5%	3,4%	1,1%	100,0%	95,5%	3,4%	1,1%	100,0%
	55 - 59	94,3%	4,3%	1,4%	100,0%	94,3%	4,3%	1,4%	100,0%
	60 - 64	93,4%	4,9%	1,7%	100,0%	93,4%	4,9%	1,7%	100,0%
	65 - 69	92,0%	5,7%	2,2%	100,0%	92,0%	5,7%	2,2%	100,0%
	70 - 74	88,8%	7,9%	3,3%	100,0%	88,8%	7,9%	3,3%	100,0%
	75 - 79	84,3%	10,6%	5,0%	100,0%	84,3%	10,6%	5,0%	100,0%
	80 - 84	67,6%	18,9%	13,5%	100,0%	67,6%	18,9%	13,5%	100,0%
	85 - 89	67,1%	19,0%	13,9%	100,0%	67,1%	19,0%	13,9%	100,0%
	90 - 94	67,5%	18,8%	13,7%	100,0%	67,5%	18,8%	13,7%	100,0%
	95+	68,7%	17,9%	13,4%	100,0%	68,7%	17,9%	13,4%	100,0%
	All	88,3%	7,7%	4,0%	100,0%	88,3%	7,7%	4,0%	100,0%
2040	50 - 54	96,1%	2,7%	1,2%	100,0%	95,5%	3,4%	1,1%	100,0%
	55 - 59	95,2%	3,7%	1,2%	100,0%	94,6%	4,1%	1,4%	100,0%
	60 - 64	94,2%	4,3%	1,6%	100,0%	93,9%	4,5%	1,6%	100,0%
	65 - 69	93,0%	5,0%	2,0%	100,0%	92,9%	5,1%	2,0%	100,0%
	70 - 74	89,6%	7,3%	3,0%	100,0%	89,5%	7,4%	3,1%	100,0%
	75 - 79	85,2%	10,2%	4,6%	100,0%	85,0%	10,3%	4,7%	100,0%
	80 - 84	70,3%	17,9%	11,8%	100,0%	70,3%	17,8%	11,9%	100,0%
	85 - 89	69,8%	18,3%	12,0%	100,0%	69,9%	18,0%	12,0%	100,0%
	90 - 94	70,6%	17,7%	11,7%	100,0%	70,2%	17,9%	11,9%	100,0%
	95+	71,2%	17,0%	11,8%	100,0%	71,6%	16,9%	11,5%	100,0%
	All	87,6%	8,1%	4,3%	100,0%	87,3%	8,3%	4,3%	100,0%
2070	50 - 54	96,3%	2,6%	1,1%	100,0%	95,7%	3,2%	1,1%	100,0%
	55 - 59	95,7%	3,2%	1,1%	100,0%	94,9%	3,9%	1,2%	100,0%
	60 - 64	95,0%	3,8%	1,2%	100,0%	94,2%	4,4%	1,5%	100,0%
	65 - 69	93,9%	4,4%	1,7%	100,0%	93,5%	4,7%	1,8%	100,0%
	70 - 74	91,0%	6,4%	2,6%	100,0%	90,0%	7,0%	3,0%	100,0%
	75 - 79	87,0%	8,9%	4,1%	100,0%	86,2%	9,5%	4,3%	100,0%
	80 - 84	72,0%	16,0%	11,9%	100,0%	72,6%	16,7%	10,8%	100,0%
	85 - 89	71,2%	16,8%	12,1%	100,0%	72,1%	16,9%	11,0%	100,0%
	90 - 94	72,1%	16,3%	11,6%	100,0%	72,5%	16,8%	10,7%	100,0%
	95+	73,6%	15,9%	10,5%	100,0%	74,0%	15,9%	10,2%	100,0%
	All	86,0%	8,8%	5,3%	100,0%	85,9%	9,1%	5,0%	100,0%

		Obesity and smoking decline				No protection of education against disability			
		Disability				Disability			
Calendar Year	Age	None	Moderate	Severe	Total	None	Moderate	Severe	Total
2020	50 - 54	28 230 534	1 012 615	330 999	29 574 147	27 704 596	1 416 931	457 081	29 578 609
	55 - 59	26 954 001	1 242 594	390 172	28 586 766	26 376 928	1 680 594	531 040	28 588 562
	60 - 64	24 310 454	1 281 974	440 899	26 033 327	23 735 544	1 706 425	592 552	26 034 521
	65 - 69	21 431 684	1 337 889	516 417	23 285 991	20 894 016	1 712 496	683 372	23 289 884
	70 - 74	17 692 182	1 576 056	665 598	19 933 835	17 151 475	1 967 217	849 819	19 968 511
	75 - 79	13 160 842	1 661 697	783 979	15 606 519	12 706 599	1 977 252	934 818	15 618 669
	80 - 84	8 415 934	2 360 656	1 680 797	12 457 387	7 898 533	2 644 647	1 940 726	12 483 907
	85 - 89	5 384 779	1 528 800	1 112 091	8 025 670	5 087 016	1 677 543	1 221 358	7 985 918
	90 - 94	2 710 900	756 634	551 540	4 019 074	2 596 570	801 789	587 618	3 985 978
	95+	1 065 208	276 744	208 381	1 550 333	1 059 016	302 486	221 657	1 583 160
	All	149 356 518	13 035 658	6 680 873	169 073 049	145 210 295	15 887 380	8 020 042	169 117 717
2040	50 - 54	24 827 804	692 260	296 106	25 816 170	24 072 035	1 237 246	397 940	25 707 221
	55 - 59	24 902 936	1 065 884	330 874	26 299 694	24 187 965	1 558 975	494 957	26 241 897
	60 - 64	25 076 988	1 105 067	385 402	26 567 457	24 200 092	1 697 511	600 696	26 498 299
	65 - 69	24 731 561	1 334 568	510 687	26 576 816	23 855 980	1 857 409	740 666	26 454 056
	70 - 74	23 228 605	1 920 566	811 373	25 960 545	22 233 075	2 536 298	1 152 545	25 921 918
	75 - 79	19 805 686	2 375 336	1 082 229	23 263 251	18 714 283	3 100 764	1 428 787	23 243 834
	80 - 84	12 819 099	3 313 734	2 143 114	18 275 947	11 574 353	4 023 800	2 677 213	18 275 366
	85 - 89	8 812 700	2 269 107	1 502 622	12 584 429	7 938 203	2 755 327	1 835 932	12 529 463
	90 - 94	4 943 005	1 254 607	844 376	7 041 988	4 525 500	1 461 860	981 289	6 968 650
	95+	3 188 272	755 340	519 892	4 463 503	2 968 343	853 630	607 788	4 429 760
	All	172 336 656	16 086 468	8 426 675	196 849 800	164 269 829	21 082 821	10 917 814	196 270 464
2070	50 - 54	22 197 891	619 307	256 185	23 073 383	21 679 957	1 087 651	354 723	23 122 331
	55 - 59	21 748 728	758 929	253 393	22 761 050	20 922 942	1 333 962	424 279	22 681 182
	60 - 64	22 059 109	870 114	273 736	23 202 958	21 095 296	1 510 238	502 368	23 107 902
	65 - 69	21 060 026	984 606	404 129	22 448 761	20 113 770	1 605 976	635 507	22 355 254
	70 - 74	20 389 126	1 416 484	588 165	22 393 775	18 939 322	2 214 832	957 512	22 111 666
	75 - 79	19 990 896	2 070 720	930 097	22 991 714	18 086 620	2 996 086	1 408 163	22 490 869
	80 - 84	16 241 556	3 662 559	2 750 169	22 654 284	13 747 491	4 810 012	3 241 852	21 799 355
	85 - 89	13 777 220	3 181 097	2 060 574	19 018 891	11 957 385	4 194 792	2 752 596	18 904 772
	90 - 94	10 640 286	2 451 882	1 736 547	14 828 715	8 892 274	2 965 599	1 992 152	13 850 026
	95+	9 921 163	2 121 011	1 399 901	13 442 075	8 437 166	2 557 806	1 676 542	12 671 514
	All	178 026 001	18 136 710	10 652 895	206 815 606	163 872 223	25 276 954	13 945 694	203 094 871

Percent distribution

			Disability				Disability		
Calendar Year	Age	None	Moderate	Severe	Total	None	Moderate	Severe	Total
2020	50 - 54	95,5%	3,4%	1,1%	100,0%	93,7%	4,8%	1,5%	100,0%
	55 - 59	94,3%	4,3%	1,4%	100,0%	92,3%	5,9%	1,9%	100,0%
	60 - 64	93,4%	4,9%	1,7%	100,0%	91,2%	6,6%	2,3%	100,0%
	65 - 69	92,0%	5,7%	2,2%	100,0%	89,7%	7,4%	2,9%	100,0%
	70 - 74	88,8%	7,9%	3,3%	100,0%	85,9%	9,9%	4,3%	100,0%
	75 - 79	84,3%	10,6%	5,0%	100,0%	81,4%	12,7%	6,0%	100,0%
	80 - 84	67,6%	18,9%	13,5%	100,0%	63,3%	21,2%	15,5%	100,0%
	85 - 89	67,1%	19,0%	13,9%	100,0%	63,7%	21,0%	15,3%	100,0%
	90 - 94	67,5%	18,8%	13,7%	100,0%	65,1%	20,1%	14,7%	100,0%
	95+	68,7%	17,9%	13,4%	100,0%	66,9%	19,1%	14,0%	100,0%
	All	88,3%	7,7%	4,0%	100,0%	85,9%	9,4%	4,7%	100,0%
2040	50 - 54	96,2%	2,7%	1,1%	100,0%	93,6%	4,8%	1,5%	100,0%
	55 - 59	94,7%	4,1%	1,3%	100,0%	92,2%	5,9%	1,9%	100,0%
	60 - 64	94,4%	4,2%	1,5%	100,0%	91,3%	6,4%	2,3%	100,0%
	65 - 69	93,1%	5,0%	1,9%	100,0%	90,2%	7,0%	2,8%	100,0%
	70 - 74	89,5%	7,4%	3,1%	100,0%	85,8%	9,8%	4,4%	100,0%
	75 - 79	85,1%	10,2%	4,7%	100,0%	80,5%	13,3%	6,1%	100,0%
	80 - 84	70,1%	18,1%	11,7%	100,0%	63,3%	22,0%	14,6%	100,0%
	85 - 89	70,0%	18,0%	11,9%	100,0%	63,4%	22,0%	14,7%	100,0%
	90 - 94	70,2%	17,8%	12,0%	100,0%	64,9%	21,0%	14,1%	100,0%
	95+	71,4%	16,9%	11,6%	100,0%	67,0%	19,3%	13,7%	100,0%
	All	87,5%	8,2%	4,3%	100,0%	83,7%	10,7%	5,6%	100,0%
2070	50 - 54	96,2%	2,7%	1,1%	100,0%	93,8%	4,7%	1,5%	100,0%
	55 - 59	95,6%	3,3%	1,1%	100,0%	92,2%	5,9%	1,9%	100,0%
	60 - 64	95,1%	3,8%	1,2%	100,0%	91,3%	6,5%	2,2%	100,0%
	65 - 69	93,8%	4,4%	1,8%	100,0%	90,0%	7,2%	2,8%	100,0%
	70 - 74	91,0%	6,3%	2,6%	100,0%	85,7%	10,0%	4,3%	100,0%
	75 - 79	86,9%	9,0%	4,0%	100,0%	80,4%	13,3%	6,3%	100,0%
	80 - 84	71,7%	16,2%	12,1%	100,0%	63,1%	22,1%	14,9%	100,0%
	85 - 89	72,4%	16,7%	10,8%	100,0%	63,3%	22,2%	14,6%	100,0%
	90 - 94	71,8%	16,5%	11,7%	100,0%	64,2%	21,4%	14,4%	100,0%
	95+	73,8%	15,8%	10,4%	100,0%	66,6%	20,2%	13,2%	100,0%
	All	86,1%	8,8%	5,2%	100,0%	80,7%	12,4%	6,9%	100,0%

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct centres. You can find the address of the centre nearest you online (european-union.europa.eu/contact-eu/meet-us_en).

On the phone or in writing

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

— by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

— at the following standard number: +32 22999696,

— via the following form: european-union.europa.eu/contact-eu/write-us_en.

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website (european-union.europa.eu).

EU publications

You can view or order EU publications at op.europa.eu/en/publications. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (european-union.europa.eu/contact-eu/meet-us_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

Open data from the EU

The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

Science for policy

The Joint Research Centre (JRC) provides independent, evidence-based knowledge and science, supporting EU policies to positively impact society

EU Science Hub
joint-research-centre.ec.europa.eu

@EU_ScienceHub
EU Science Hub - Joint Research Centre
EU Science, Research and Innovation
EU Science Hub
@eu_science

Publications Office
of the European Union