European Population Conference
Bologna, Italy, 3-6 June 2026

Educational Inequalities in Healthy Life Expectancy in Catalonia: Evidence of a Decline in Healthy Years from a Population-Based Study

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Theme 801: Health, Morbidity & Wellbeing

Short Abstract (250 words)

As lifespans lengthen, a continuing challenge is to narrow the gap between longevity and healthy living. While increased life expectancy (LE) represents a major achievement, it does not indicate whether added years are healthy. The concept of healthy life expectancy (HLE) better reflects quality of life by distinguishing years lived healthily from those lived with illness (Robine et al., 2013). From a policy perspective, identifying factors that increase HLE is crucial. Education is a key determinant, and understanding educational inequalities in health can help reduce disparities and improve population wellbeing.

This study examines education inequalities in health in Catalonia (Spain) using register-based diagnosed data (Solé-Auró et al, 2025). We estimate HLE by education level (low, medium, high) for men and women in two periods (2011, 2021) using the Sullivan method (1971). We also decompose the contribution of mortality and multimorbidity to the HLE (Andreev et al. 2002).

Results show a persistent educational gap in LE over time, and a pronounced education gradient in LE and HLE. For both men and women, across education levels, and using both basic and complex multimorbidity, we find that HLE between 2011 and 2021 decreases while unhealthy life expectancy increases. Multimorbidity remains the main contributor to the educational differences in HLE when using basic multimorbidity, and we observe a shift from mortality to multimorbidity as the main contributor when using complex multimorbidity.

These findings offer a comprehensive view of educational inequalities in health in Catalonia, identifying factors shaping both longevity and years lived in good health.

Keywords: educational differences in health expectancy, education level, morbidity

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Extended abstract (2 to 4 pages)

Introduction

As lifespans lengthen, a continuing challenge is to narrow the gap between longevity and healthy living. Healthy life is considered one of the main challenge of societies worldwide. While increased life expectancy (LE) represents a major achievement, it does not indicate whether added years are lived in good health. Mortality is no longer the main culprit, but rather morbidity and, more specifically, the increasing co-morbidity (i.e., different diseases or health conditions affecting the same individuals) that naturally comes with age. This translates into growing health inequalities (Permanyer and Scholl 2019) among an older heterogeneous population, not only in mortality but, most importantly, in morbidity. Depending on the relative speed at which mortality and morbidity decline, the number of years individuals are expected to live in different health states can differ dramatically – an issue that has enormous implications for the sustainability of the health and pension systems (Christensen et al 2009; Murray et al 2015; Rechel et al 2013). The concept of healthy life expectancy (HLE) better reflects quality of life by distinguishing years lived healthily from those lived with illness (Robine et al., 2013). From a policy perspective, to explore such heterogeneity, it is necessary to assess whether the health inequalities that emerge over the life course are affected by factors like individual characteristics (e.g., age and sex), socio-economic position (e.g., educational attainment, type of job), geographical location (e.g., urban/rural) or other contextual variables. In particular, this work uses education as a key determinant, as understanding educational inequalities in health among men and women can help to reduce disparities and improve population wellbeing.

Formal education is acquired relatively early in the life course (education is completed for most individuals around age 30) and marks social status at the beginning of adulthood, functioning as the main bridge between the status of one generation and the next, and also as the main avenue of upward mobility. Social scientific findings are unequivocal in demonstrating that the health of midlife and older adults with lower levels of education differs from that of their more highly educated peers and that the latter are better able to maximize their longevity and to postpone or avoid disease, disability, and premature death (Montez & Brooks, 2021; Van Raalte et al., 2011). Individuals with higher levels of education better overcome socioeconomic disadvantages and therefore are more able to improve their quality of life; while low education is a strong marker of social disadvantage. Education has been identified as one of the strongest predictors of health and mortality, and a significant factor in shaping adult experiences, as it both mediates and moderates the health consequences of early-life disadvantages (Montez & Hayward, 2014).

In addition to education, gender disparities in health expectancy are notable, with females generally living longer but experiencing more years with disability (Oksuzyan et al., 2018; Wróblewska, 2022; Cambois et al., 2023), particularly among the less educated (Bramajo et al., 2024), reporting worse health than men (Crimmins et al. 2011) and spending a higher proportion of their life in poorer health (Luy and Minagawa 2014). Even though fewer studies put the focus on understanding gender differences in HLE, recent findings highlight the importance of this issue. In particular, the interaction between gender and socioeconomic status adds complexity to health outcomes. Uccheddu and colleagues (2019) focuses on gender and socioeconomic status as primary drivers of health (frailty) inequalities in older age across Europe. It revealed that education and wealth significantly impact health, particularly for women in Southern countries (Italy and Spain) and Western European countries (Austria, Belgium, France, Germany, and Switzerland), whereas Northern Europe (Denmark and Sweden) did not show any gender difference according to socioeconomic status. Some studies highlight the disparities by gender and country, with a systematic double disadvantage for those being women and at the bottom of

the social ladder (Cambois et al, 2020) and/or living in disadvantaged regions (Laborde et al, 2020). Other studies have focus on the fact that higher education or socio-economic status mitigates some of the disadvantages faced by women (Bramajo et al. 2024).

This work aims to examine education inequalities in health in Catalonia (Spain) using register-health data (Solé-Auró et al, 2025). We estimate HLE by education level (low, medium, high) for men and women in two time periods (2011, 2021) using the Sullivan method (1971). We also decompose the contribution of mortality and basic and complex multimorbidity to the HLE (Andreev et al. 2002).

Data

In the field of epidemiology, there is a long tradition of analysing databases that collect the health history of larger or smaller samples of patients. However, it is only recently that such databases have become representative of the population as a whole, and thus have been used in the analysis of population health. In this sense, Northern European countries were pioneers in the treatment and use of the registry data available in the different public institutions for academic purposes. Access to this type of information seems to be the cause or consequence of a greater interest on the part of demography in understanding the heterogeneity of the health of populations beyond mortality. It is in this context that the Public Data Analysis for Health Research and Innovation Program (PADRIS) database was born. This database comprehensively collects the diagnosis history of a large number of diseases as well as mortality for a representative sample of the entire population of Catalonia from 2005 onwards. The information on diagnoses is collected by the primary health care professionals of the Catalan Health Service (CatSalut) using the e-CAP programme. In Catalonia, primary care services are fully covered by public funding. CatSalut assigns all citizens to a primary care team based on where they live.

Here, we use data from the HEALIN cohort (a detailed information of the HEALIN cohort can be found here: Solé-Auró et al, 2025), a longitudinal population-based dataset encompassing over 1.5 million individuals (accounting for 22% of the total Catalan population) from 2005 up to 2021. This sample is representative in terms of age, sex, and region. All data within the HEALIN cohort are anonymized and comply with Spanish regulations regarding observational studies. Information on the diagnosis history of a large number of chronic diseases, mortality and some demographic characteristics are available. We use the death counts and population exposures from the HEALIN cohort.

Definition of multimorbidity

We used two alternative definitions of multimorbidity, which allows a more nuanced description of populations' health. 'Basic multimorbidity' is defined as the co-occurrence of two or more chronic diseases. 'Complex multimorbidity' is defined as the occurrence of three or more chronic diseases from the same list affecting at least three different body systems simultaneously. In both cases, individuals are considered to have the disease whenever they receive a diagnosis. Furthermore, we assess the sensitivity of our estimates by using the diseases simultaneously found in the HEALIN cohort.

Statistical analysis

We implement the Sullivan method at age 30+, in two time periods (2011, 2021) by education level (low, medium and high) for men and women. In addition, we apply a decomposition method (Andreev et al. 2002) to identify the exact contributions of: a) differences in age-specific **mortality rate;** b) differences in age-specific **multimorbidity rates**. This analytical strategy aspires to impart vital insights into enigmatic gender inequalities undermining population health.

Results

Descriptives

Although the complete HEALIN cohort contains more than 1.5 million observations, for the analyses carried out here the total amount of observations is slightly below 1 million, due to data cleaning (mostly due to unavailability of education information) and method choice, as LE calculations for ages 30+ exclude younger birth cohorts.

The sample is balanced by gender, women comprising around 52% of the subsamples used. Education level - recoded in three groups, low education equivalent to ISCED 0-2, medium education equivalent to ISCED 3-4, and high education equivalent to ISCED 5-6 – in the overall sample is distributed along the lines of 50% low education, 30% medium and 20% high education. However, as it can be seen in Figure 1, older cohorts are dominated by lower education achievement while younger ones are already posterior to Catalonia's education expansion, as the proportion of highly educated among those 30-34 in 2011 is 25% among men and 39% among women. In the oldest age group (95-99) those percentages, even assuming overrepresentation of highly educated among the nonagenarian, are, respectively, only 7% and 3%.

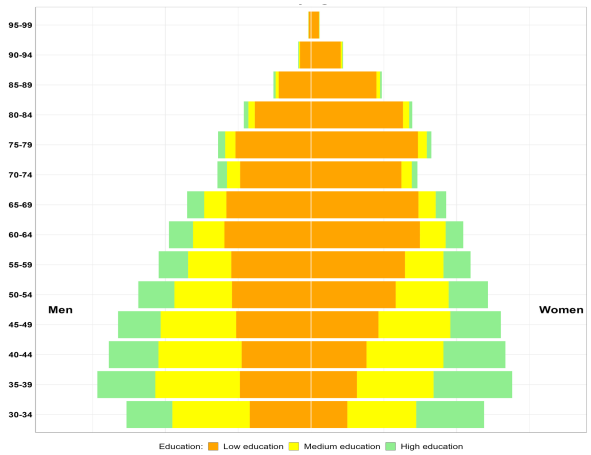

Figure 1: Population pyramid of HEALIN cohort aged 30+ in 2011 by education level

We also observe educational gradient and changes over time in the prevalence of basic multimorbidity and complex multimorbidity (See Figure 2). For every combination of gender, year and type of multimorbidity, we observe the highest prevalence of multimorbidity among those with low education and the lowest prevalence among those with high education. Between 2011 and 2021 we observe a consistent increase in prevalence for both types of multimorbidity across gender and education levels. As expected, the overall levels observed of complex multimorbidity are lower than those of basic multimorbidity, due to added definitional requirements, i.e., more chronic diseases observed.

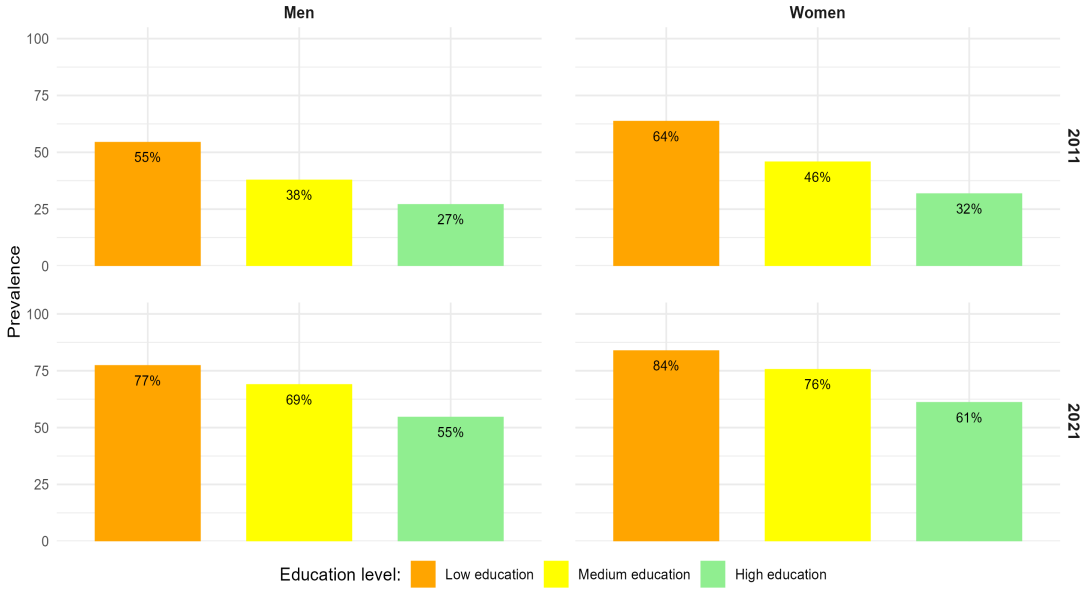

Figure 2: Basic multimorbidity prevalence by year, gender and education level.

Healthy life expectancy findings

Results show a persistent educational gap in LE over time, and a pronounced education gradient in LE and HLE. Those with least education consistently have the shortest LE and HLE, the opposite being true for those with most education, in both 2011 and 2021, and with both multimorbidity types used for estimation.

We observe LE at 30 increased between 2011 and 2021 for the lowest educated (2.1 years for men and 1.2 years for women), but more mixed results for medium- and highly educated. These results are in line with lower LE estimates for 2021 provided by Statistical Institute of Catalonia (IdesCat), accounting for the effects of the Covid-19 pandemic.

For both men and women, across education levels, and using both basic and complex multimorbidity, we find that HLE between 2011 and 2021 decreases while unhealthy LE increases. The drop in HLE estimated using basic multimorbidity is the most pronounced among the medium-educated women (-14.4 years), highly educated women (-13.8 years), and medium-educated men (-12.1 years). Using complex multimorbidity for HLE estimations, women lose more years of HLE between 2011 and 2021 than men in all education levels.

Multimorbidity remains the main contributor to the educational differences in HLE when using basic multimorbidity in both time periods. For complex multimorbidity, we observe a reduction of the mortality contribution over time, and multimorbidity effects became more relevant.

Table 1: HLE by education level in two time periods for men and women using basic MM

Basic MM			**2011**		**2021**	
			Men	**Women**	**Men**	**Women**
LE30		Low	49,6	55,9	51,7	57,1
		Medium	53,8	58,5	53,0	59,3
		High	54,9	60,0	55,9	59,0
HLE30		Low	24,3	22,8	14,7	12,3
		Medium	28,5	28,1	16,4	13,7
		High	35,2	35,3	24,8	21,5
Contribution of mortality & multimorbidity differences HLE30	Low education	Mortality effect	2,1		0,8	
		Multimorbidity effect	-3,6		-3,3	
	Medium education	Mortality effect	1,9		1,2	
		Multimorbidity effect	-2,4		-4,0	
	High education	Mortality effect	2,4		0,9	
		Multimorbidity effect	-2,4		-4,2	

Source: HEALIN cohort

Discussion

The expected results from this research will be useful for scholars worldwide investigating contemporary health dynamics. It will provide a comprehensive map of the gender differences in HLE by education in Catalonia (Spain), identifying factors contributing to shorter LE as well as life lived in good health. In sum, our contemporary ageing society is becoming increasingly complex and heterogeneous, and our societies present global social, economic, and health challenges.

Full references are not included due to lengths concerns