Healthy Working Life Expectancy in an Aging and Unequal Brazil: A Socioeconomic Perspective

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Working Paper

Healthy Working Life Expectancy in an Aging and Unequal Brazil: A Socioeconomic Perspective

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ABSTRACT

Retirement ages are rising in many countries as a response to population aging and increasing longevity. However, recent gains in life expectancy have not been accompanied, proportionally, by improvements in health, and substantial inequalities in morbidity and mortality persist. Employment opportunities and family dynamics related to the division of domestic and care work also affect men and women differently across socioeconomic strata. Debates on extending working lives in Brazil therefore require an integrated approach that considers health, labor, education, and social protection, alongside careful attention to social and economic inequalities. This research examines differences in healthy working-life expectancy by gender and educational attainment among Brazilians aged 50 and over, using data from Wave 1 (2015–2016) from the Brazilian Longitudinal Study of Aging (ELSI), and provides the first estimates in Brazil that jointly incorporate economic activity, retirement status, and health. Results reveal clear inequalities by gender and education. Among men, health is the primary determinant of active life expectancy, exerting greater influence than education. Among women, higher levels of schooling are associated with longer expected time in activity; nevertheless, across all educational strata, they spend fewer years active and healthy and more years inactive and in poor health. Although women can retire earlier, those with low or intermediate education are expected to spend a smaller share of their lives in retirement than equally educated men. Overall, educational inequalities in the status analyzed were more pronounced among women. The evidence presented demonstrates that extending working lives in Brazil will require not only legal adjustments but, above all, structural transformations that ensure dignified conditions enabling men and women across all

socioeconomic strata to live longer, work in good health, and reach retirement with autonomy to choose how they wish to experience it.

Keywords: life expectancy; health; work; inequality; population ageing

1. Introduction

Population ageing has led many countries to raise statutory retirement ages, intensifying debates on the extension of working lives and its determinants (Coile et al., 2016; Fernandes & Queiroz, 2022). Whether longer lives translate into longer working lives depends on the joint interaction between health, labour-market trajectories, and retirement institutions over the life course. The capacity to remain active at older ages is shaped both by physiological and cognitive conditions (Skirbekk, 2008; Kotschy, Bloom & Scott, 2024) and by socioeconomic and institutional factors that structure opportunities for labour-market participation and attachment (Cutler et al., 2013; Fernandes & Queiroz, 2024). These dimensions are mutually reinforcing: health influences employment trajectories and contribution histories, while labour-market experiences feed back into health, particularly among workers in disadvantaged socioeconomic positions exposed to physically demanding jobs and poorer working conditions (Preston & Taubman, 1994; Wang et al., 2011; Maestas et al., 2016; McLaughlin & Neumark, 2018).

Education plays a central role in these processes. It shapes health-related behaviors, access to information and care, and the adoption of medical innovations (Link & Phelan, 1995; Mirowsky & Ross, 2003; Glied & Lleras-Muney, 2009; Pampel et al., 2010). At the same time, health shocks and early-life disadvantages can constrain educational attainment and occupational trajectories, generating persistent inequalities over the life course (Palloni & Pinto-Aguirre, 2011). In highly unequal contexts such as Brazil, these interactions are particularly pronounced: lower-educated individuals are disproportionately concentrated in informal, unstable, and physically demanding occupations, experience weaker contribution histories, and face earlier health deterioration (Wajnman, Oliveira & Oliveira, 2004; Queiroz, 2007; Sala & Oliveira, 2013; Camarano & Carvalho, 2015; Ribeiro, 2020).

Gender further structures these dynamics. Labour-market participation and retirement transitions reflect accumulated gendered divisions of paid and unpaid work within households, shaped by social norms and institutional arrangements (McDonald, 2006

England, 2010; Fisher et al., 2015; Goldscheider et al., 2015; Moen, 2016). These patterns are mirrored in health outcomes. Among men, greater exposure to risky behaviors and fatal chronic conditions results in higher premature mortality and selective survival; among women, longer life expectancy is accompanied by higher morbidity and non-fatal chronic conditions, partly driven by care responsibilities and health-reporting behaviors (Case & Paxson, 2005; Crimmins & Beltrán-Sánchez, 2011; Nepomuceno, Di Lego & Turra, 2021). As shown by Rios-Neto and Ribeiro (2025), health, labour-market activity, and retirement are not conditionally independent processes: even after controlling for age, sex, and education, strong interdependencies remain, reflecting a multidimensional system of cumulative advantage and disadvantage.

This integrated perspective motivates the present study, which examines the potential extension of healthy working lives in Brazil by analyzing gender and educational inequalities in life expectancy among individuals aged 50 and older. The study jointly considers states of economic activity, retirement, and health, moving beyond approaches that analyze these dimensions in isolation. To the best of the author's knowledge, this paper provides the first estimates of healthy working-life expectancy in Brazil that simultaneously incorporate health status and detailed labour-market states, distinguishing between activity and retirement, and stratifying results by gender and education.

Using data from the first wave of the Brazilian Longitudinal Study of Aging (ELSI, 2015–2016), the study estimates life expectancy across health and labour market states using the Sullivan method. The results reveal marked gender and educational inequalities in healthy working-life expectancy from age 50 onwards. Women generally live longer than men and, except among the lowest educated, spend more years in good health, but they also accumulate more years with health limitations. Among men, health is the primary determinant of remaining working-life expectancy, exerting a stronger influence than education. Among women, higher education is consistently associated with longer expected time in activity; nevertheless, across all educational groups, women spend fewer years active and healthy and more years inactive and unhealthy than men. Even though women are eligible for earlier retirement, those with low and intermediate education are expected to spend fewer years in

retirement relative to total life expectancy than men with comparable schooling. Educational inequalities are consistently more pronounced among women than among men.

By documenting how health, labour market participation, and retirement interact, this study highlights that healthy working-life expectancy in Brazil is not randomly distributed but strongly shaped by cumulative gendered and socioeconomic trajectories. These findings contribute to ongoing debates on active ageing and pension reform by showing that extending working lives in unequal contexts depends not only on legal changes but also on long-term investments that reduce inequalities, preserve health, and support sustained labour market attachment up to retirement ages.

2. Literature review

2.1 Theoretical framing: health, work, and cumulative inequality

Population ageing implies not only longer lives, but also a redistribution of remaining years across different states of health and labour market participation. Whether longevity gains translate into longer and healthier working lives depends on the joint evolution of mortality, morbidity, labour market opportunities, and institutional arrangements. These dimensions are deeply interdependent and socially stratified and cannot be adequately understood in isolation (Rios-Neto and Ribeiro, 2025).

A growing body of demographic research emphasizes that health and labour-market participation interact through cumulative life course processes. Individuals exposed to socioeconomic disadvantage tend to experience worse health trajectories, weaker attachment to stable employment, and greater difficulty in meeting retirement eligibility requirements at older ages (Ribeiro, 2020; Queiroz, 2007). These processes are strongly gendered. Socially constructed gender roles shape exposure to paid and unpaid work, caregiving responsibilities, occupational trajectories, and health risks, producing systematic differences between men and women in later-life outcomes (Scott, 1986; Grossi, 1998; Moen, 2003; Moen, 2016).

Brazilian micro-level evidence supports this gendered mechanism. Using data from the SABE study, Pérez, Wajnman, and Oliveira (2006) show that health status strongly conditions labour supply among older men, whereas among women health has no significant effect once family-related factors are considered. Instead, marital status and family responsibilities remain central predictors of women's labour-market participation at older ages, indicating that gendered social roles mediate the relationship between health and work.

From this perspective, extending working lives through policy reforms is not a neutral adjustment. Uniform increases in retirement ages or contribution requirements interact with unequal distributions of health, employment stability, and care burdens, potentially amplifying pre-existing inequalities (Cutler et al., 2013; Ribeiro, 2020). This insight motivates the empirical literature on healthy life expectancy, working-life expectancy and, more recently, their integration into joint measures of healthy working-life expectancy.

2.2 Empirical studies on socioeconomic and gender differentials in health and working-life expectancy

2.2.1 International evidence

Health Expectancies

International studies consistently document strong socioeconomic and gender gradients in health expectancies. Using Spanish data from EHIS (2019), Solé-Auró et al. (2022) estimate unhealthy life expectancy by education and gender applying the Sullivan method. Their results show that women live longer than men, but spend more years in poor health across all indicators, while lower-educated individuals live substantially more years with health problems. Importantly, educational inequalities are often steeper among women, suggesting that schooling plays a particularly protective role for female health.

A broader comparative perspective is provided by Di Lego, Nepomuceno, and Turra (2025), who analyze multiple countries using harmonized surveys from the HRS family. Their decomposition shows that gender differences in healthy life expectancy depend critically on the balance between mortality and morbidity. In many countries, women's survival advantage offsets their higher disability prevalence when disability indicators are used, whereas men may show higher disease-free life expectancy when chronic conditions are considered. These results highlight that similar gender gaps can emerge from very different mortality–morbidity configurations.

Occupational stratification further reinforces health inequalities. Using French data, Cambois et al. (2011) show that manual workers face a double disadvantage: shorter total life expectancy and more years lived with health limitations. Notably, inequalities in healthy life expectancy within the same sex exceed those observed for total life expectancy, underscoring the importance of analyzing morbidity directly.

Working-life Expectancy

Socioeconomic differences are also pronounced in working-life expectancy. Using longitudinal administrative data for Finland, Leinonen, Martikainen, and Myrskyla (2015) estimate remaining years in different labour-market states from age 50 onwards. Manual

workers are expected to spend fewer years in paid work and retirement and more years in non-employment than higher non-manual workers. Decomposition results show that most of this gap is driven by differences in employment rates rather than mortality.

Policy-oriented simulations reinforce these concerns. Cutler et al. (2013) show that raising retirement eligibility ages in the United States would disproportionately reduce the expected years in retirement among lower-educated groups, increasing exposure to disability and income loss. Similarly, Dudel and Myrskyla (2017) document large educational differentials in working-life expectancy at older ages in the United States using multistate life tables.

Joint Approaches to Health and Work

More recent studies integrate health and work within a single framework. Loichinger and Weber (2016) estimate both healthy life expectancy (using GALI) and working-life expectancy for 26 European countries. They find that women generally live longer and slightly healthier lives but spend fewer years economically active than men and that educational gradients in working-life expectancy are often larger among women.

Using Dutch longitudinal data, van der Noordt et al. (2018) estimate healthy and unhealthy working-life expectancy among workers aged 55–65. While they find no significant gender differences in total working-life expectancy, higher-educated workers spend more years in employment. The authors argue that similar levels of working with disability may mask deeper inequalities, as lower-educated workers are more likely to remain employed out of necessity and in more physically demanding jobs.

Focusing on retirement transitions, König, Lindwall, and Johansson (2018) show, using Swedish data, that lower-educated individuals are more likely to exit employment due to physically demanding work and to experience involuntary retirement transitions, which are associated with poorer health after retirement. This evidence suggests that continued employment at older ages may reflect constrained choices rather than better health among disadvantaged groups.

For England, Parker et al. (2020b) show that healthy working-life expectancy is strongly associated with education, occupation, and area-level deprivation, and that expected

healthy and active years at age 50 fall well below statutory retirement ages. A cross-national Sullivan-based analysis by Boissonneault and Rios (2021) further shows that men generally have higher healthy and unhealthy working-life expectancy than women across OECD countries.

2.2.2 Why Brazil is a distinctive case

Brazil constitutes a particularly informative and analytically demanding case for studying healthy working-life expectancy. The country experienced one of the fastest demographic transitions worldwide, with limited time to adapt labour markets and social protection systems to population ageing (Kinsella et al., 2005). At the same time, Brazil failed to fully convert demographic change into sustained social and economic advantages, with persistent inequalities in education, labour-market trajectories, and access to protection across all cohorts (Wong and Carvalho, 2006; Baerlocher, Stephen Parente, and Rios-Neto, 2019; Alves, 2020).

Socioeconomic inequality is central to this context. Brazil remains among the most unequal countries globally (Ritchie et al., 2023) and ageing unfolds over highly stratified life courses. Research consistently shows that individuals with lower education are concentrated in physically demanding occupations, informal employment, and unstable careers, which erode work capacity at older ages and hinder access to retirement benefits (Queiroz, 2007; Queiroz and Ramalho, 2009; Ribeiro, 2020).

Gender inequalities further compound these processes. Brazilian women—especially those with low and intermediate education—follow more interrupted and precarious labour trajectories, accumulate fewer contribution years, and carry a disproportionate burden of unpaid care work (Camarano, Kanso, and Fernandes, 2014; Camarano, 2017; Fernandes and Queiroz, 2022). These patterns shape both labour-market participation and health at older ages, producing cumulative disadvantage (Rios-Neto and Ribeiro, 2025).

This structural context is directly relevant for pension policy. The 2019 Social Security Reform (EC 103/2019) raised minimum retirement ages and tightened eligibility rules. While often framed as a necessary fiscal adjustment, its distributive consequences depend critically on whether individuals can realistically remain active and healthy until

older ages. Brazilian evidence shows that being out of the labour force does not necessarily coincide with retirement status, particularly among women and lower-educated groups (Correa, 2015; Nóbrega, 2019). Thus, extending legal working lives may translate into longer periods of inactivity without protection rather than a longer healthy employment.

2.2.3 Health expectancies in Brazil

Brazilian studies on health expectancies consistently document strong gender and educational gradients. Using PNAD data, Guedes et al. (2011) show that women live longer than men but spend more years with functional limitations, while lower education is associated with a higher proportion of life lived with disability. Similar patterns are confirmed using different health indicators and periods (Camargos and Gonzaga, 2015; Camargos et al., 2017).

Multistate approaches reinforce the cumulative nature of health disadvantage. Nepomuceno and Turra (2015) show that initial health status strongly conditions remaining life expectancy among older Brazilian women, with limited recovery from disability. Studies using SABE data further demonstrate that higher education is associated with longer life and more years free of frailty or cognitive impairment, while women live longer but accumulate more years with limitations (Alves et al., 2019; Andrade et al., 2020).

Across datasets and indicators, education emerges as a key stratifying factor, often with stronger gradients among women, reflecting the interaction between schooling, labour trajectories, and health over the life course (Alves and Arruda, 2016; Guimarães and Andrade, 2020).

2.2.4 Working-life expectancy in Brazil

Evidence on working-life expectancy in Brazil is more limited. Using census data, Correa (2015) estimates economically-active life expectancy and shows that women, despite higher longevity, spend substantially fewer years economically active than men. Changes over time reflect both mortality decline and shifts in activity rates, with strong gender asymmetries.

In a pre-reform simulation incorporating new minimum ages, Nóbrega (2019) shows that expected time spent in formal employment is much lower for women, particularly among the less educated and other vulnerable groups. These findings highlight that retirement reforms interact with unequal labour-market realities, reinforcing the need to analyze work and health jointly.

2.3 Summary and research gap

International evidence demonstrates that gender and socioeconomic inequalities shape both health and working-life expectancy and that integrating these dimensions is essential to assess the feasibility and equity of extending working lives. In Brazil, however, empirical research has largely developed in parallel tracks: a rich literature on health expectancies and a smaller body of work on economically active life expectancy, with no studies integrating health, activity, and retirement simultaneously by gender and education.

Given Brazil's rapid ageing, high inequality, gendered labour trajectories, and recent pension reform, analyzing healthy working-life expectancy in an integrated framework is both empirically necessary and policy-relevant. This study addresses this gap by jointly estimating life expectancy by health and labour-market states, explicitly accounting for gender and educational stratification.

3. Methodology

To estimate life expectancies by health and work status, the Sullivan (1971) method was used, combining, on the one hand, the prevalence of the sample population in different states of economic activity, retirement, and health and their respective statuses (active, inactive, retired, non-retired, healthy, and unhealthy) and, on the other hand, the life table for Brazilian men and women, which reflects the current mortality experience of the Brazilian population in 2015.

The cross-sectional nature of the data (due to the unavailability of longitudinal data) justifies the choice of a method analogous to Sullivan's (1971) prevalence method, traditionally used to calculate healthy life expectancy, which reflects the current health status of a real population adjusted for mortality levels, regardless of age structure (Jagger et al., 2014). The difference here is that the labour aspect was included. Thus, the cross-sectional data from the life table and the proportions of people in each work and health status are used to construct hypothetical life courses for the observation period. The purpose of the method is to find the number of years remaining at a specific age that an individual can expect to live in a given status. Its interpretation as an expectation assumes that mortality rates and the proportions of people in each work and health status by age are stable over time. The results do not differ greatly from those obtained using transition probabilities (a multistate method that uses longitudinal data and therefore refers to the incidence of diseases and disabilities rather than prevalence) if changes in mortality, work, and health are smooth and regular over time. Other advantages of the Sullivan method are its simplicity, relative accuracy, and ease of interpretation (Mathers and Robine, 1997; Jagger et al., 2014).

3.1 Data Source

This study was conducted using data from the first wave (2015-2016) of the Brazilian Longitudinal Study of Health in the Elderly (Longitudinal Estudo da Saúde dos Idosos Brasileiros) (ELSI). This is a basic household survey, whose sample was designed to

represent the non-institutionalized Brazilian population[1] aged 50 years or older. The survey was conducted in 70 municipalities in the five macro-regions of the country, with 9,412 people participating in Wave 1.

The life table of the Brazilian population by sex and age in 2015 published by the Brazilian Institute of Geography and Statistics (IBGE) (IBGE, 2021) was used, which was abbreviated into five-year age groups. The year 2015 was chosen because it falls within the range of years when the first ELSI (2015-2016) was produced and because it is the year in which most of the first wave of interviews were conducted.

This study analyzes the differences in healthy and unhealthy working life expectancy by gender and educational level of Brazilians aged 50 and over, combining statuses of economic activity, retirement, and health.

3.2 Population subgroup controls – age, gender, and educational attainment

The population subgroups were divided by age, gender, and educational level. Five-year age groups were analyzed, starting at age 50, which is the youngest age of ELSI respondents, up to the 80-year-old group, which is the last age group available in the IBGE life tables for Brazilian men and women and, therefore, is also the last group used in the construction of EVLSNS.

Considering gender inequalities in mortality and morbidity (Case and Paxson, 2005; Vallin, 2007; Gordon et al., 2017; Crimmins et al., 2019; Lego et al., 2020) and in the labour market (Feijó, 2023; ILO, 2023), EVLSNS are constructed separately for men and women.

The choice of education to represent differences in life expectancy by socioeconomic status was made because it is an easier variable to measure and more stable. Unlike income and occupation, which vary more over the course of people's lives, education is acquired at a younger age and, from a certain point onwards, does not vary much with advancing age (Preston and Taubman, 1994).

[1] According to Camarano and Kanso (2010), the institutionalized elderly population in Brazil is relatively small.

The educational categories were classified into three groups:

- Low education – people who have never studied or have completed between the 1st and 4th grades of elementary school (EF);
- Intermediate education – people who have completed between the 5th grade of elementary school and high school (EM);
- High education – people who have studied up to incomplete or complete higher education (ES) or specialization/medical residency or master's or doctorate, including all undergraduate and graduate degrees and specializations.

The classifications “low education level,” “intermediate education level,” and “high education level” will be used throughout the text to refer to these groups. The criteria used to choose the latter were: the history of the division of basic education in Brazil, and the International Standard Classification of Education (ISCED) developed by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

3.3 States of work and health

The work indicators used in constructing the EVLSNS are economic activity and retirement statuses. The health indicator is instrumental activities of daily living (IADL)[2] . The construction of the indicators will be detailed in the following paragraphs.

3.3.1 Employment status - economic activity

The labour market participation rate represents the portion of the economically active population (EAP) in each age group, as defined by the International Labor Organization (ILO), and covers both employed and unemployed individuals. Those interviewed who reported having worked for pay in the last 30 days were considered active, along with those who did not work because they were temporarily away from their jobs, looking for work, or waiting to be called to jobs for which they had already been accepted, while inactive

[2] Measurements of functional disability in instrumental activities of daily living (IADL), as well as in basic activities of daily living (BADL), are important indicators of the health status of older adults (Jette, 1994; Agree, 1999). BADL refer to activities related to personal care, such as dressing, eating, and bathing. IADLs, on the other hand, relate to the person and the environment in which they live and are more complex tasks such as shopping, preparing meals, and tidying the house. The first standardization of IADLs was developed by Katz et al. (1963), and the IADL scale was proposed by Lawton & Brody (1969).

individuals were those who had not worked for pay in the last 30 days because they were retired, homemakers, pensioners, or for none of these reasons.

3.3.2 Employment status - retirement

Participation in the labor market does not allow conclusions to be drawn about the length of time spent in retirement, since an individual may be working and at the same time already receiving retirement benefits. Therefore, healthy and unhealthy working life expectancy calculated using only activity status probably underestimates the time spent in retirement, since, in Brazil, it is permitted to work for pay even while retired. Therefore, this justifies the need for a second work indicator that goes beyond issues related to labour market inclusion, one which also portrays aspects related to the transition to retirement for different socioeconomic groups.

This second work indicator was constructed based on retirement status. Those who answered “yes” to the question “Do you receive any retirement benefits or pension from the federal social security institute (INSS) or from the federal, state, or municipal government, or from a private retirement fund?” and “no” to the question “Do you receive a pension?”[3] were considered retired. Those who were not retired answered “no” to the first question.

3.3.3 Health status

For the health indicator, respondents who reported having difficulty performing at least one of the ADLs investigated or who were unable to perform it without the help of another person were considered unhealthy; those who reported having no difficulty were considered healthy.

The instrumental activities of daily living considered in this study include demonstrating difficulty performing: personal hygiene, using some form of transportation, using the telephone (landline or cell phone), and managing one's own medications. In addition to these, the ELSI questionnaire also includes demonstrating difficulty with:

[3] This is one of the limitations of this study, because by separating retirees from pensioners, those who are both retirees and pensioners at the same time (which is permitted in Brazil according to Constitutional Amendment No. 103 of November 2019) and those who are only pensioners are lost, although the sum of these groups represents a small portion of the population aged 50 and over, only 2%.

preparing a hot meal; managing one's own money; shopping; performing heavy household chores; and performing light household chores (making the bed, dusting, taking out the trash, etc.).

All of these latter activities can be influenced by biases associated with social expectations attributed to each gender. The first three were tested by Sheehan and Tucker-Drob (2017), who recommend, among other strategies to reduce this bias, their exclusion from the analysis. Similarly, household chores, whether light or heavy, are also subject to the same problem, especially in a context such as Brazil, where women devote almost twice as much time to household chores as men. This inequality is even more pronounced among less educated women, and persists even among those in the paid labour market, where they tend to reproduce traditional roles focused on household maintenance activities (IBGE, 2019; Jesus, 2018).

Among the health indicator options available in ELSI, ADLs were chosen for this study because they are an indicator traditionally used in the literature, and are more closely related to the cognitive and functional demands of the work environment, involving processes such as task management and decision-making to maintain functional independence, which are essential skills for both daily life and work performance. The decline in executive functions, including skills such as planning and organization, is directly associated with the deterioration of the ability to perform IADLs. These reflect the ability to live independently and actively engage in social and professional contexts, which is essential for analyzing lifelong participation in the labour market, offering a more relevant perspective aligned with the objectives of this research and highlighting the relationship between cognitive functionality, physical functionality, and the maintenance of work capacity (Lawton & Brody, 1969; Royall et al., 2004).

3.3.4 Groupings of statuses

Work and health states were organized into four analytical groupings, allowing results to be examined at increasing levels of complexity—from single dimensions to fully combined states. Three states are considered: economic activity, retirement, and health. Economic activity includes the statuses active (At) and inactive (In); retirement includes retired (Ap) and not retired (NAp); and health includes healthy (S) and unhealthy (NS). First,

each state is analyzed separately. Second, statuses of economic activity and retirement are combined. Third, work-related statuses are jointly analyzed with health status. Finally, all three states—economic activity, retirement, and health—are combined into mutually exclusive statuses, enabling a comprehensive assessment of healthy and unhealthy working-life trajectories.

Abbreviations for each status and their combinations are used consistently throughout the text, tables, and figures. Gender is denoted as "H" for men and "M" for women.

4. Life expectancy at age 50, focusing on differences by educational level among people of the same gender

This chapter presents the results of life expectancy in the four pre-established status groups, with emphasis on differences by educational level among people of the same gender. The first section addresses inequalities among men, and the second among women.

4.1 Inequalities by educational attainment among men

Graph1 (a) shows the differences by educational level in the life expectancy at age 50 of Brazilian men in each of the status analyzed. A clear pattern of inequality can be observed: the higher the educational level, the higher the healthy life expectancy and the lower the unhealthy life expectancy. Men with high educational levels can expect to live more than eight years longer in healthy statuses compared to those with low educational levels. In the other statuses, the disparities are less evident. In terms of activity, there is no consistent pattern according to education level. In terms of retirement, the differences between education levels are small (up to one year), but they still indicate that higher levels of education are associated with higher life expectancy in retirement and lower life expectancy outside of retirement.

Graph1 (b), considering only the possible combinations of work statuses, indicates that, without the health status shown in the previous graph, there are practically no differences by educational level in absolute terms. One point worth noting is that, regardless of educational level, as expected for life expectancy from age 50 onwards, the longest durations are concentrated in the inactive retired status, reaching 16.3 years among highly educated men.

When combining activity and health statuses in *Graph1 (c)*, it can be seen that the highest life expectancies for men with low levels of education are concentrated in the inactive status, regardless of whether the second status is healthy or not. In turn, among men with intermediate and high levels of education, the highest life expectancies occur in combinations that include the healthy status, regardless of whether the second status is active or inactive.

Combining retirement and health statuses in *Graph1 (c)*, a pattern similar to that observed in the interaction between activity and health can be observed men with low levels of education have higher values in the retired status, regardless of the associated status, whether healthy or not; while men with intermediate and high levels of education have higher life expectancies in the healthy status, whether associated with the retired or non-retired status.

In general, a pattern associated with health status and educational attainment can be identified: in combinations that include healthy statuses, the higher the educational attainment, the higher the life expectancy; the opposite occurs in unhealthy statuses. The differences between men with high and low educational attainment exceed 5 years in the following statuses: In-NS, In-S, Ap-NS, and Ap-S.

When analyzing activity, retirement, and health statuses simultaneously in *Graph1 (d)*, it can be seen that the highest life expectancies are concentrated in the combinations In-Ap-NS, In-Ap-S, and At-NAp-S. The difference between the groups lies in the order of these statuses according to educational attainment. Among men with low educational attainment, the descending sequence is In-Ap-NS, followed by In-Ap-S and, finally, At-NAp-S. Among those with intermediate and high educational attainment, the order is In-Ap-S, At-NAp-S, and In-Ap-NS. Educational disparities stand out: in the In-Ap-NS status, men with low educational attainment live, on average, more than twice as long as those with high educational attainment (7.8 years versus 3.5); in contrast, in the In-Ap-S status, the opposite occurs—those with high education live, on average, 5.6 years longer in this status than those with low education (12.9 years versus 7.3).

In general, the logic that the higher the level of education, the higher the life expectancy in combinations that include the healthy status, and lower in those that include unhealthy status, is confirmed. There are, however, two exceptions: in the At-Ap-S status, men with intermediate education have the highest expectations; and in the In-NAp-S status, there is an inverse relationship, in which the lower the education level, the higher the life expectancy. Both combinations of statuses show relatively low life expectancy values for all educational levels, as well as low differences between them.

Finally, it is worth noting that although the In-NAp-NS and At-NAp-NS combinations show relatively low life expectancies for men of all educational levels, there are still important differences between educational groups. In the first combination, men with less education live, on average, one year longer than those with more education; in the second, this difference reaches two years. These results suggest that remaining in simultaneous statuses of inactivity or activity without retirement and with compromised health may reflect socially undesirable situations and possibly be marked by restricted choices. This is especially evident among the most educated (the group with the greatest decision-making power in the labour market), whose life expectancy in these statuses is practically zero.

Graph1 - Life expectancy at age 50 for Brazilian men, according to education level and statuses of economic activity, retirement, and health, 2015-2016

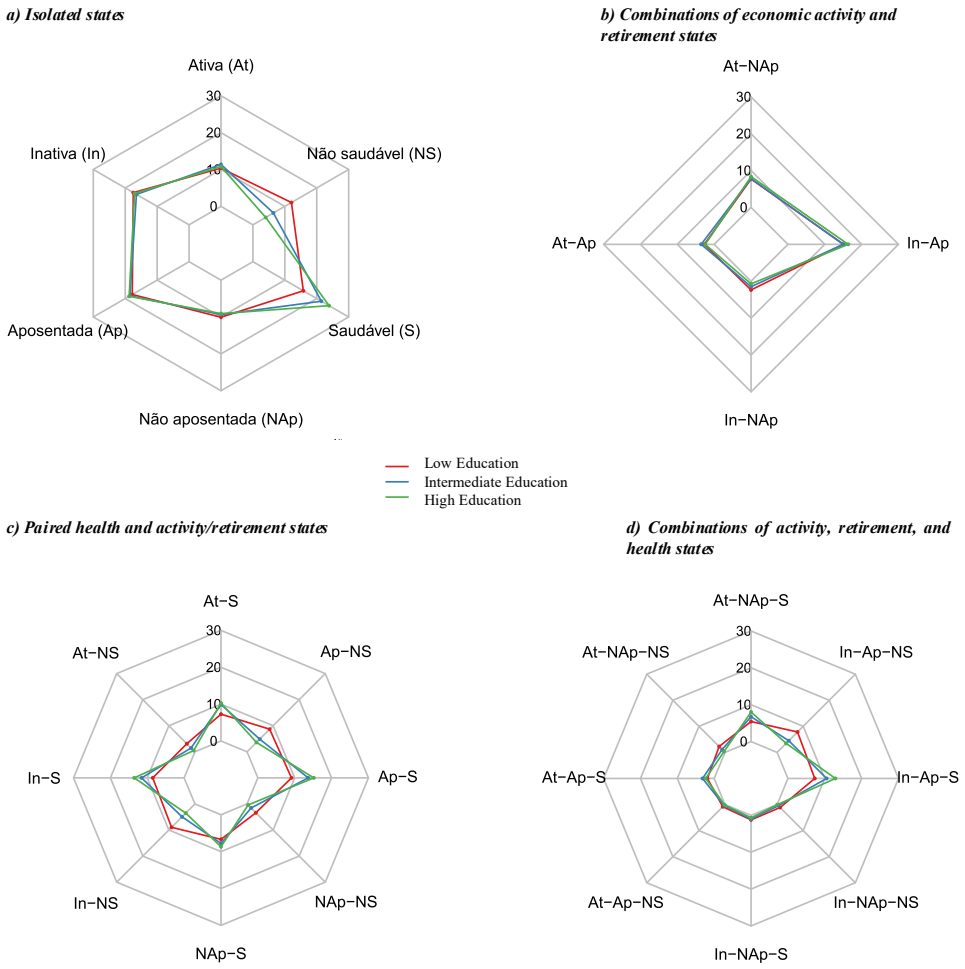


Gráfico A	Inactive (In)	Active (At)	Unhealthy (NS)	Healthy (S)	Non-retired (NAp)	Retired (Ap)		
Baixa Escol.	17,5	10,4	12,1	15,8	10	17,8		
Escol. Interm.	16,5	11,4	6,4	21,4	9,3	18,5		
Alta Escol.	17,1	10,8	4	23,9	9,1	18,8		
Gráfico B	In-Ap	In-NAp	At-Ap	At-NAp				
Baixa Escol.	15,1	2,4	2,7	7,7				
Escol. Interm.	15	1,5	3,5	7,8				
Alta Escol.	16,3	0,7	2,4	8,3				
Gráfico C	In-NS	In-S	At-NS	At-S	Ap-NS	Ap-S	NAp-NS	NAp-S
Baixa Escol.	9	8,5	3,1	7,3	8,7	9,1	3,4	6,7
Escol. Interm.	4,9	11,5	1,5	9,9	4,9	13,7	1,6	7,8
Alta Escol.	3,5	13,5	0,5	10,3	3,6	15,2	0,4	8,7
Gráfico D	In-Ap-NS	In-Ap-S	In-NAp-NS	In-NAp-S	At-Ap-NS	At-Ap-S	At-NAp-NS	At-NAp-S
Baixa Escol.	7,8	7,3	1,1	1,2	0,8	1,8	2,3	5,4
Escol. Interm.	4,5	10,5	0,5	1	0,4	3,2	1,1	6,7
Alta Escol.	3,5	12,9	0,1	0,7	0,1	2,3	0,3	8

Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).
Note: In – Inactive; At – Active; Ap – Retired; NAp – Non-retired; NS – Unhealthy; S – Healthy.
Baixa Escol. – Low Education; Escol. Interm. – Intermediate Education; Alta Escol. - High Education.

4.2 Inequalities by level of education among women

Graph2 (a), when considering statuses for women alone, shows striking differences by level of education, which are even more pronounced than among men. In terms of health statuses, the difference in life expectancy between women with higher and lower levels of education reaches 10 years. There are also strong educational inequalities in other statuses: women with high levels of education can expect to live almost four years longer in active statuses compared to those with low levels of education, while in retirement, the difference between high and intermediate levels exceeds four and a half years.

Contrary to what is observed among men, where differences by educational level in combinations of working statuses are smaller, the picture for women reveals a much more heterogeneous configuration in *Graph2 (b)*. There are striking inequalities, especially in the In-NAp and At-Ap statuses. In the former, there is an inverse pattern: the higher the level of education, the lower the expectations, so that women with low and intermediate levels of education spend more than twice as much time in this status compared to those with high levels of education. In the active retired status, however, the effect is reversed: the higher the level of education, the higher the life expectancy. It is worth noting the significant gender inequality in the In-NAp status among groups with lower levels of education. Among people with low levels of education, women expect to live 5.3 years longer in this status compared to men with the same educational level; among those with intermediate levels of education, this difference reaches 6 years.

In *Graph2 (c)*, the interaction between health and activity states reveals, among women with intermediate and low levels of education, a trend similar to that observed among men with low levels of education: the highest life expectancies are found in combinations that include inactive statuses, regardless of whether the second status is healthy or not. Women with high educational attainment resemble men with intermediate and high educational attainment, with the highest life expectancies found in combinations involving the healthy status, whether the second status is active or inactive. At all educational levels, women have higher life expectancies in the In-NS status when compared to men with the same educational level, and the opposite is true in the At-S status, where men predominate.

Combining retirement and health status in *Graph2 (c)*, a pattern similar to that observed in the interaction between activity and health for women with low education levels can be seen, with the highest values observed in the retired status, regardless of the associated status, healthy or not. Women with intermediate education levels show a pattern similar to that of women with high education levels, exhibiting higher life expectancy in the healthy status, whether associated with the retired or non-retired status.

As with men, a pattern associated with health status and educational attainment is observed: in combinations that include the healthy status, the higher the educational attainment, the higher the life expectancy; the opposite occurs in unhealthy statuses. The only exception occurs in the healthy non-retired status, where women with intermediate educational attainment record the highest values.

The Ap-S status deserves special mention due to its strong educational gradient: women with high levels of education live, on average, 9.2 years longer in this status than those with low levels of education and about 5.3 years longer than those with intermediate levels of education. At the same time, the opposite occurs in the NAp-NS status: women with less education have life expectancies more than four times higher than those with more education. Also noteworthy is the At-S life expectancy of women with high levels of education, which is more than double that of women with low levels of education, an absolute difference of 4.3 years.

When analyzing the states of work and health for women in the NAP-NS status (*Graph2 (d)*) together, three by three, it can be seen that the highest life expectancies for all levels of education are concentrated in combinations that simultaneously include the statuses of inactivity and retirement, regardless of whether the third status is healthy or not. In these situations, educational differences stand out: in the In-Ap-NS status, women with low levels of education live, on average, 12.1 years longer than those with high levels of education (5.9 years); while in the In-Ap-S status, the opposite occurs, with highly educated women reaching 14.5 years, compared to only 7.3 among those with low educational attainment. In general, women show a greater educational gradient in combinations that include the inactive status, while men show a greater gradient in those that include the active status.

Overall, the pattern is confirmed that higher levels of education are associated with higher life expectancy in combinations involving the healthy status, and lower life expectancy in those involving the unhealthy status. The exceptions appear in the In-NAp-S status, in which women with intermediate education lead in life expectancy, followed by those with low education, and in the At-Ap-NS status, in which life expectancy values are relatively low at all educational levels (around 6 months) with also low differences between them.

Finally, it is worth noting that even though the In-NAp-NS combination represents reduced life expectancy among women, there is a significant contrast between educational levels. In this status, women with lower levels of education live, on average, more than three years longer than those with higher levels of education—a difference that is even more pronounced than in the case of men. This result indicates that remaining outside the labour market, without access to retirement and in poor health, tends to reflect situations of vulnerability and limited choices. It is no coincidence that among women with higher levels of education, a group with greater autonomy to remain in economic activity or not, life expectancy in these statuses is practically zero.

Graph2 - Life expectancy at age 50 for Brazilian women, according to education level and statuses of economic activity, retirement, and health, 2015-2016

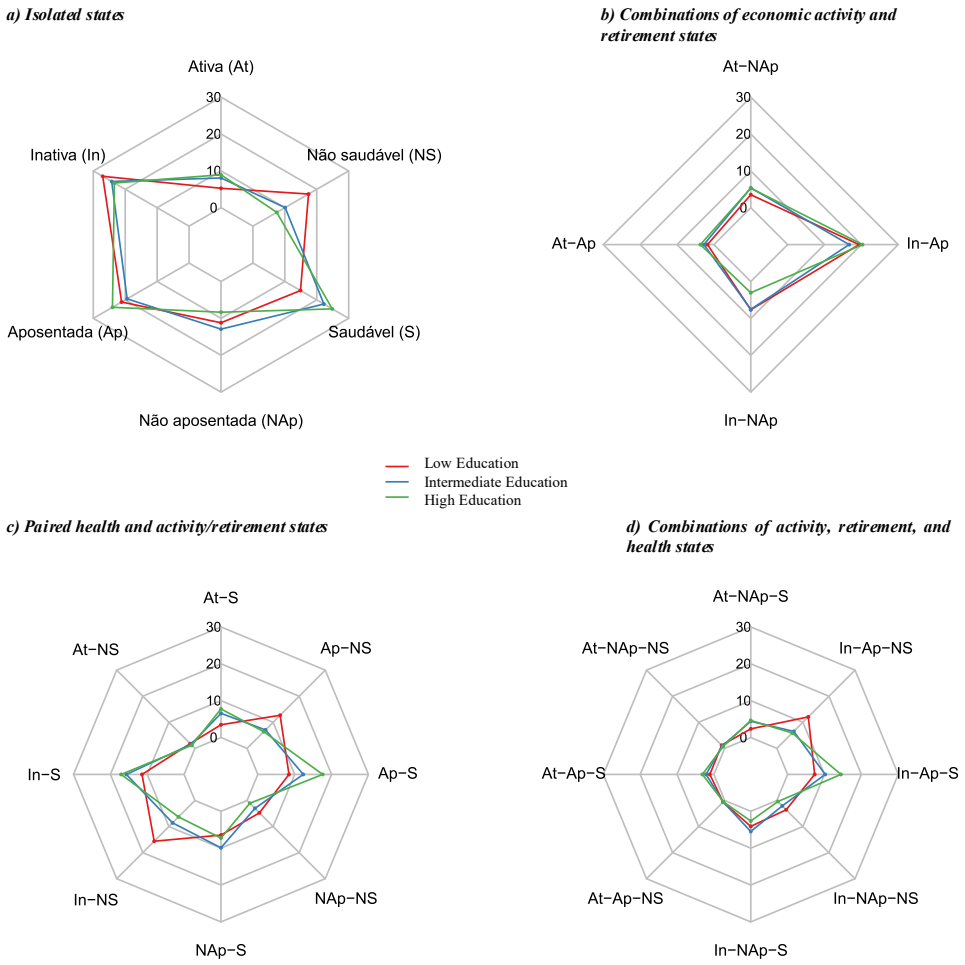


Gráfico A	Inactive (In)	Active (At)	Unhealthy (NS)	Healthy (S)	Non-retired (NAp)	Retired (Ap)		
Baixa Escol.	27	5,3	17,4	14,9	11,2	21,1		
Escol. Interm.	24,2	8,1	10,1	22,2	12,9	19,4		
Alta Escol.	23,3	9	7,5	24,9	8,3	24		
Gráfico B	In-Ap	In-NAp	At-Ap	At-NAp				
Baixa Escol.	19,4	7,7	1,7	3,5				
Escol. Interm.	16,7	7,5	2,7	5,4				
Alta Escol.	20,3	3	3,7	5,3				
Gráfico C	In-NS	In-S	At-NS	At-S	Ap-NS	Ap-S	NAp-NS	NAp-S
Baixa Escol.	15,6	11,4	1,8	3,5	12,7	8,4	4,7	6,5
Escol. Interm.	8,6	15,7	1,5	6,6	7,1	12,3	3	9,9
Alta Escol.	6,3	17,1	1,2	7,8	6,4	17,6	1,1	7,3
Gráfico D	In-Ap-NS	In-Ap-S	In-NAp-NS	In-NAp-S	At-Ap-NS	At-Ap-S	At-NAp-NS	At-NAp-S
Baixa Escol.	12,1	7,3	3,6	4,1	0,6	1,1	1,2	2,4
Escol. Interm.	6,5	10,2	2,1	5,5	0,6	2,1	0,9	4,4
Alta Escol.	5,9	14,5	0,4	2,6	0,5	3,1	0,7	4,6

Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).
Note: In – Inactive; At – Active; Ap – Retired; NAp – Non-retired; NS – Unhealthy; S – Healthy.
Baixa Escol. – Low Education; Escol. Interm. – Intermediate Education; Alta Escol. - High Education.

4.3 Comparison of educational gradients between genders

Measuring the gender educational gradient allows us to identify how inequalities in education are expressed differently between men and women, and which gender experiences greater intensity of these inequalities. This indicator highlights the most vulnerable groups and avoids interpretations biased by differences in longevity between genders.

This section analyzes the differences in the educational gradient between men and women. To do so, we first calculate, for each gender, the differences in life expectancy at age 50 between groups with high and low levels of education. We chose to compare these two extremes because, in general, it is between them that the greatest inequalities are concentrated. Positive values indicate that people with higher levels of education have higher life expectancies, while negative values indicate that the group with lower levels of education has a higher life expectancy.

Next, the difference between the genders in the magnitude of these educational differences is calculated, considering the absolute value (in modulus) of the gradients for each gender. The objective is to identify whether men or women have the most intense educational inequality, regardless of the direction of this inequality within each gender. In other words, the interest is not the distance between the raw gradients, but rather the difference between their magnitudes. Positive values indicate that men have a more intense educational gradient, while negative values indicate greater intensity among women.

As can be seen in *Table1*, women accumulate the highest educational gradients in the vast majority of the statuses analyzed, reaching values as high as 3.8 in the In-S status. In other words, while the difference between men with high and low levels of education is 5.5 years, among women, this same difference reaches 9.3 years, which is 3.8 years greater. In the In-Ap, At-Ap-NS, and At-NAp-S statuses, men have the highest educational gradients, but the differences between female gradients are low and do not exceed 0.6 years. For the At-NS and At-NAp-NS statuses, there are greater differences in the gradients in favor of men, whose educational gradient is 2 and 1.5 years higher than that of women, respectively.

In general, in combinations that include all three states, differences by educational level are more pronounced among women in combinations that include the inactive status

and greater among men when they include the active status. The only exception is the At-Ap-S status, where differences among women are also greater.

Table1 – Comparison of absolute educational gradients in life expectancy between men and women according to economic activity, retirement, and health statuses, 2015–2016

A) Isolated statuses	**In**	**At**	**NS**	**S**	**Ap**	**NAp**		
$\mathbf{G^{Abs}_{educ,H}}$	-0.4	0.4	-8.1	8.1	-0.9	1		
$\mathbf{G^{Abs}_{educ,M}}$	-3.7	3.7	-9.9	10	-2.9	2.9		
$\mathbf{G^{Abs}_{gen}}$	*-3.3*	*-3.3*	*-1.8*	*-1.9*	*-2*	*-1.9*		
B) Combinations of activity and retirement statuses	**In-Ap**	**In-NAp**	**At-Ap**	**At-NAp**				
$\mathbf{G^{Abs}_{educ,H}}$	1.2	-1.7	-0.3	0.6				
$\mathbf{G^{Abs}_{educ,M}}$	0.9	-4.7	2	1.8				
$\mathbf{G^{Abs}_{gen}}$	*0.3*	*-3*	*-1.7*	*-1.2*				
C) Combinations of health statuses with retirement and activity, in pairs	**In-NS**	**In-S**	**At-NS**	**At-S**	**Ap-NS**	**Ap-S**	**NAp-NS**	**NAp-S**
$\mathbf{G^{Abs}_{educ,H}}$	-5.5	5	-2.6	3	-5.1	6.1	-3	2
$\mathbf{G^{Abs}_{educ,M}}$	-9.3	5.7	-0.6	4.3	-6.3	9.2	-3.6	0.8
$\mathbf{G^{Abs}_{gen}}$	*-3.8*	*-0.7*	*2*	*-1.3*	*-1.2*	*-3.1*	*-0.6*	*1.2*
D) Combinations of activity, retirement, and health statuses	**In-Ap-NS**	**In-Ap-S**	**In-NAp-NS**	**In-NAp-S**	**At-Ap-NS**	**At-Ap-S**	**At-NAp-NS**	**At-NAp-S**
$\mathbf{G^{Abs}_{educ,H}}$	-4.3	5.6	-1	-0.5	-0.7	0.5	-2	2.6
$\mathbf{G^{Abs}_{educ,M}}$	-6.2	7.2	-3.2	-1.5	-0.1	2	-0.5	2.2
$\mathbf{G^{Abs}_{gen}}$	*-1.9*	*-1.6*	*-2.2*	*-1*	*0.6*	*-1.5*	*1.5*	*0.4*

Notes: $G^{Abs}_{educ,H}$ *– Absolute educational gradient among men;* $G^{Abs}_{educ,M}$ *– Educational gradient among women;* G^{Abs}_{gen} *– Absolute gender educational gradient.*
Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).

It is important to note that the method used in this study does not estimate specific life tables by education level, but applies Sullivan's method to the prevalence of economic activity, retirement, and health, using the same life table for each gender at a single point in

time. Thus, the observed gender education gradient stems exclusively from differences in outcomes—that is, in life expectancy in each state—between educational levels, and not from variations in mortality intensity between them. Since all subgroups start from the same radix (initial number of survivors), by methodological definition, and use the same life table by sex, educational composition does not interfere with the calculation of expectations, eliminating the risk that the gradients found reflect purely compositional effects. The largest educational gradients observed, in general, among women are therefore consistent with structural gender factors related to health, the labour market, and living conditions accumulated over life course.

Despite their simplicity and ease of interpretation, by directly expressing, in years, the impact of educational inequalities on the time lived in each state, absolute gradients are influenced by differences in longevity between groups, especially by the higher life expectancy of women, which can widen some differentials simply because there are more years “available” to be distributed. For this reason, the analysis was supplemented with a proportional measure presented in Appendix 1, which expresses educational inequality in relation to total remaining years of life.

5. Life expectancy at age 50 with a focus on gender differences among people with the same level of education

This chapter presents the results of life expectancy in the four pre-established status groups, with an emphasis on gender differences among people with the same level of education. The first section examines gender inequalities considering the three statuses of activity, retirement, and health in isolation. The second section analyzes these statuses simultaneously, combined in trios.

5.1 Gender inequalities in economic activity, retirement, and health statuses analyzed separately

Graph3 *(a, b, and c)* below show gender differences in life expectancy according to educational levels, depicting the statuses of each state of work and health separately.

Comparing the complementary categories of each status among people of the same gender and educational level, it can be seen that in the activity status, men and women spend more time inactive than active, and in the retirement status, more time retired than not retired, at all educational levels. In terms of health status, while men, regardless of educational level, spend more time in good health, there is an exception among women: women with low educational levels expect to live longer in poor health than in good health, while the opposite is true for those with other educational levels.

Graph3 (d) shows the differences in years between genders in life expectancy in each status analyzed. A negative difference means that women expect to spend more time in that status, and a positive difference shows more time for men. The inactive, active, and unhealthy statuses show differences in life expectancy by gender that behave relatively consistently in relation to education: in all of them, the lower the level of education, the greater the inequality between genders tends to be. Women with low levels of education, for example, expect to live an average of 9.5 years longer than men with the same level of education in the inactive status and 5.3 years longer in the unhealthy status. On the other hand, men with low levels of education project spending more than 5 years longer than women with the same level of

education in the active status. These differences remain high even among the most educated: at the highest level of education, women still spend, on average, 6.2 years more than men in the inactive status and 3.5 years more in the unhealthy status, while men continue to surpass women in the active status, with 1.8 more years of life expectancy.

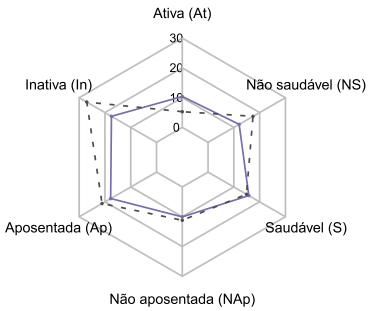
For healthy status, no significant gender inequalities are observed at any educational level. Men with low educational attainment expect to spend more time in good health than women with the same educational level, and women with intermediate and high educational attainment expect to spend more time in good health than men with the same educational level, although they also spend more years in poor health at all educational levels. Another relevant fact is that when analyzing life expectancy in a healthy state by educational level within each gender (and not between genders), it is clear that women, like men, expect to live more years in a healthy state than in an unhealthy state, with the sole exception, once again, of those with low levels of education. It is important to emphasize these differences, because the fact that women live longer in absolute terms in worse health than men does not necessarily mean that most of this expected remaining life will be in worse health.

In the non-retired status, considering that at the time, the minimum age for retirement by age in the RGPS was five years lower for women (60 years for women and 65 for men), it is noteworthy that, even though they could retire earlier, women with low and intermediate levels of education still projected to live 1.2 years and 3.6 years longer in this status, respectively, compared to men with the same level of education.

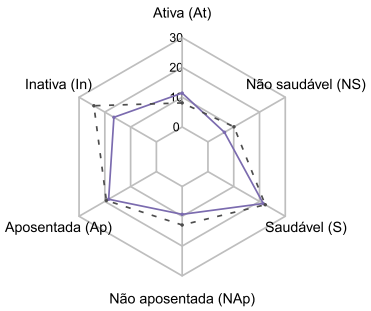
Finally, in retirement, women, regardless of their level of education, have higher expectations than men. The contrast is especially marked among the most educated, who expect to live, on average, 5.2 years longer than men in this status.

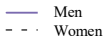
Graph3 - Life expectancy at age 50 for Brazilians, by gender, education level, and economic activity, retirement, and health statuses analyzed separately, 2015-2016

a) Low Education

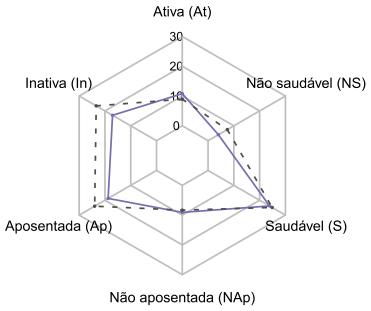


b) Intermediate Education



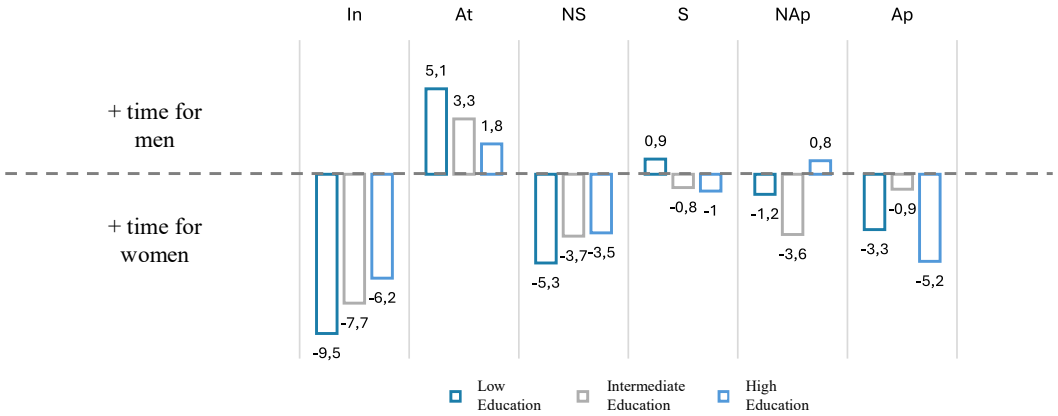


c) High Education



	In		At		NS		S		NAp		Ap	
	H	M	H	M	H	M	H	M	H	M	H	M
Baixa Escol.	17,5	27	10,4	5,3	12,1	17,4	15,8	14,9	10	11,2	17,8	21,1
Escol. Interm.	16,5	24,2	11,4	8,1	6,4	10,1	21,4	22,2	9,3	12,9	18,5	19,4
Alta Escol.	17,1	23,3	10,8	9	4	7,5	23,9	24,9	9,1	8,3	18,8	24

d) Gender differences in life expectancies



Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).
Note: In – Inactive; At – Active; Ap – Retired; NAp – Non-retired; NS – Unhealthy; S – Healthy.
Baixa Escol. – Low Education; Escol. Interm. – Intermediate Education; Alta Escol. - High Education.

5.2 Gender inequalities in activity, retirement, and health statuses combined in trios

Graph4 (a, b, and c) below show gender differences in life expectancy according to education levels, depicting each work and health status in combinations that consider three conditions at a time.

In general, the combinations of stuses associated with the highest life expectancies for both genders are In-Ap-NS, In-Ap-S, and At-NAp-S. Among men, these three combinations have the highest values at all levels of education, and among women, this is repeated in the high education group. For women with low and intermediate levels of education, In-Ap-NS and In-Ap-S continue to rank among the two highest life expectancies, while the third position in both cases goes to the In-NAp-S status, which reaches almost 4.1 years among women with low levels of education and 5.5 years among women with intermediate levels of education.

At the opposite extreme, the At-Ap-NS combination has the lowest values: it is the lowest among women and men with low and intermediate levels of education and the second highest among people with high levels of education of both genders. In addition, the In-NAp-NS status appears to have the lowest life expectancy among men and women with high levels of education (reaching residual values, such as 0.1 years among men with high levels of education) and the second lowest among men with other levels of education.

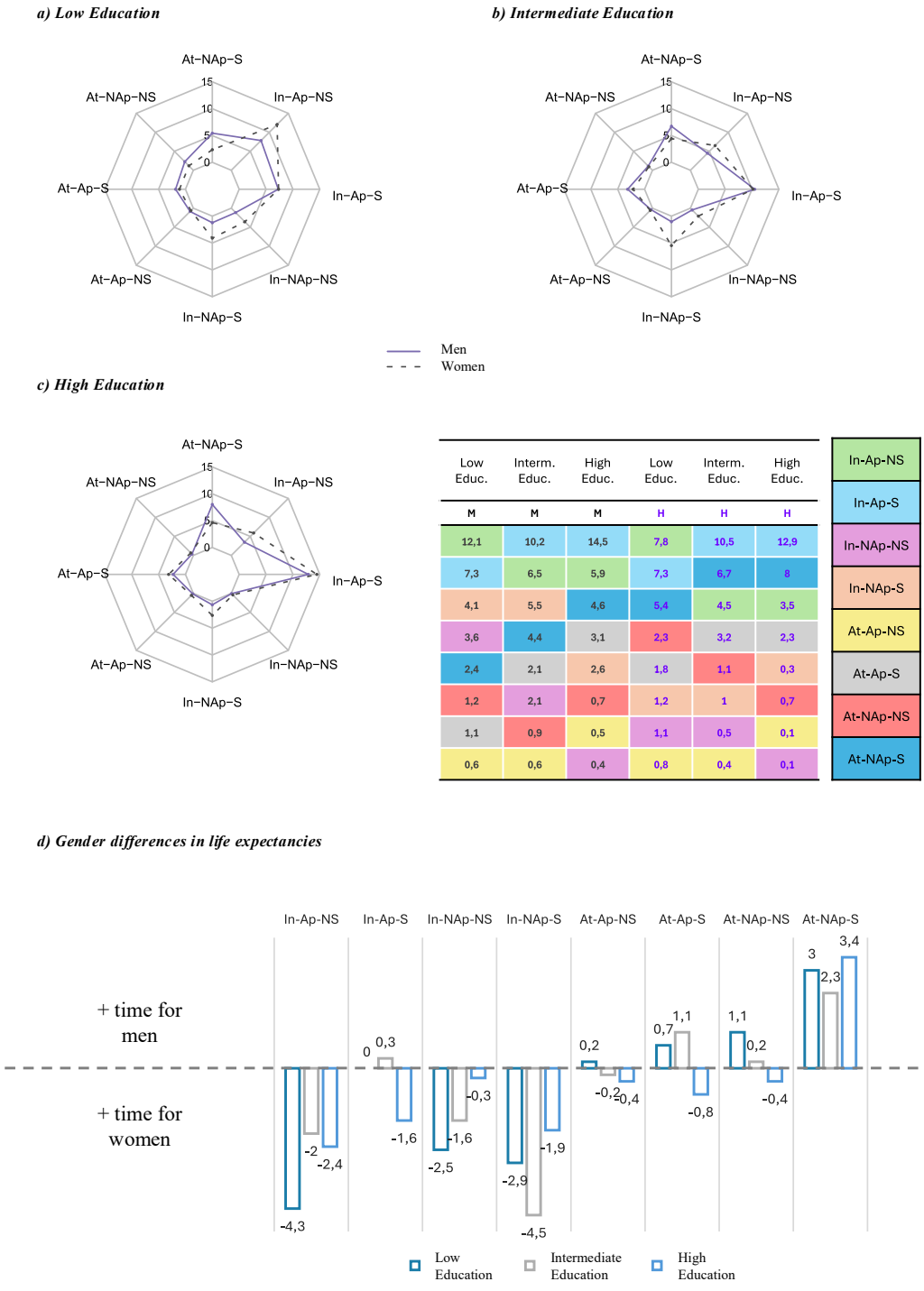
When comparing individuals with the same educational level but of different genders, it can be seen in *Graph4 (d)* that women have higher life expectancies at all levels of education in the In-Ap-NS statuses (a difference of more than 4 years among those with low levels of education), In-NAp-NS (difference reaches 2.5 years also among those with low education) and In-NAp-S (difference of 4.5 years among those with intermediate education). Men, on the other hand, have higher life expectancy in the At-NAp-S status, with differences of more than 2 years in relation to women in all educational strata.

It is also worth noting the relative inequalities in combinations that include inactive and non-retired statuses, whether in association with healthy or unhealthy statuses. While men have life expectancies in these situations that do not exceed 1.2 years, women reach

values of up to 5.5 years. Overall, the relative differences between people of opposite genders and the same educational level vary between 227% (among people with low educational attainment for the In-NAp-NS status) and 767% (among people with high educational attainment for the In-NAp-S status).

On the other hand, the In-Ap-S, At-Ap-NS, At-Ap-S, and At-NAp-NS statuses generally show insignificant differences between people of opposite genders with the same educational level, not exceeding 1.6 years and may even be non-existent (zero) or as residual as 0.2 years.

Graph4 - Life expectancy at age 50 for Brazilians, by gender, education level, and all possible statuses of economic activity, retirement, and health, combined in trios, 2015-2016



Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).
Note: In – Inactive; At – Active; Ap – Retired; NAp – Non-retired; NS – Unhealthy; S – Healthy.
Baixa Escol. – Low Education; Escol. Interm. – Intermediate Education; Alta Escol. - High Education.

6. Discussion

Brazilian literature analyzes gender and education inequalities in life expectancy mainly based on isolated states of health or economic activity.

Starting with health status, patterns found in Brazilian and international literature are confirmed (Guedes et al., 2011; Alves and Arruda, 2016; Alves et al., 2019; Andrade et al., 2019; Solé-Auró et al., 2022): individuals with lower levels of education expect to live longer in poor health.

Regarding gender differences among people with the same level of education and age, a result consolidated in the literature is also confirmed, even in studies that used other health indicators (Guedes et al., 2011; Camargos and Gonzaga, 2015; Alves and Arruda, 2016; Camargos et al., 2017; Alves et al., 2019; Andrade et al., 2019; Guimarães and Andrade, 2020; Solé-Auró et al., 2022): although women have greater longevity than men and a longer average survival in good health, they can also expect to live longer in poor health statuses. The only reversal of the expected pattern occurred among individuals with low levels of education, among whom men had slightly higher healthy life expectancy values than women.

This exception may be associated with two complementary mechanisms. The first refers to mortality selectivity: in contexts of greater social vulnerability, men are more exposed to risky behaviors, lethal chronic diseases, and external causes, which results in early mortality and makes survivors a more robust group from a health perspective (Salomon et al., 2012; Alvarez, Aburto, and Canudas-Romo, 2018; Calazans and Queiroz, 2020; Queiroz et al., 2020; Nepomuceno, Di Lego, & Turra, 2021). The second mechanism is related to the higher burden of chronic morbidity among women, especially in the accumulation of non-fatal but disabling conditions such as arthritis, depression, and functional limitations, whose prevalence is higher among those with less education (Case and Paxson, 2005; Crimmins and Beltrán-Sánchez, 2011; Guedes et al., 2011; Alves and Arruda, 2016; WHO, 2015). Thus, although women have greater life expectancy, the combination of greater survival and accumulation of chronic morbidities can reduce or neutralize their advantage in years lived in good health among the less educated strata.

In line with previous studies (Alves and Arruda, 2016; Solé-Auró et al., 2022), the results of this research show that the educational gradient in healthy and unhealthy life expectancy is more pronounced among women than among men. This phenomenon can be interpreted based on two sets of factors. In the Brazilian context, Alves and Arruda (2016) argued that higher education maximizes the female tendency to have a greater perception of illness, seek self-care, and seek more medical assistance than men. In addition, as pointed out by Solé-Auró et al. (2022) for Spain, which also applies to the Brazilian case: women with lower levels of education follow trajectories marked by less insertion in the formal labour market, greater occupational precariousness, and financial instability (Camarano, Kanso, and Fernandes, 2014; Camarano, 2017; Nóbrega, 2019; Fernandes and Queiroz, 2022), factors that limit access to health protection resources. Added to these conditions is the burden of unpaid care work for children, the elderly, and other dependents (Jesus, 2018), which implies physical and emotional exhaustion and reduces the time available for self-care and use of health services. It is also worth noting, as verified by Jesus (2018), that unlike Brazilian women from higher socioeconomic strata who can resort to outsourcing domestic work, less educated women are caught between the limits of domestic work and work done outside the home. Thus, education acts as a more powerful protective factor for women than for men, as it mitigates structural inequalities that combine economic vulnerability, care overload, and poorer health conditions throughout the life course.

When the results are analyzed in proportion to total life expectancy in Appendix 2, comparing men and women of the same educational level, the scenario partially changes: women still have higher percentages of unhealthy years in all educational groups and at almost all ages, but, on the other hand, they have lower percentages of healthy years. This pattern is consistent with previous findings for Brazil, even in studies that used other health indicators (Guedes et al., 2011; Camargos and Gonzaga, 2015; Camargos et al., 2017).

For economic activity status, no Brazilian studies were found that estimate active life expectancy by educational attainment. The closest study was that of Nóbrega (2019), who calculated life expectancy in formal and informal work between the ages of 25 and 62 for women and between the ages of 25 and 65 for men, classifying education as complete high school or higher and incomplete high school. Although the sum of the years lived in formal

and informal work approximates active life expectancy, this indicator does not include unemployed individuals who are looking for work, who are also considered economically active.

Nóbrega (2019) found a difference of 2.7 years in life expectancy in the labour market (formal and informal) between men with higher and lower levels of education. The results of this study show a different picture: among men, there is no consistent pattern in active life expectancy according to education, and the differences observed are small, not exceeding one year. Among women, the opposite occurs: there is a clear educational gradient, with differences of up to almost 4 years between levels of education. This result is consistent with the international literature (Dudel and Myrskylä, 2017; Loichinger and Weber, 2016; van der Noordt et al., 2018).

One hypothesis for this contrast is that, among men, regardless of education, those in sufficient health tend to remain in the labour market or seek employment, reproducing the social role of provider, while women assume the social role of providers of care for the home and family. This differentiation in gender social roles is widely defended in the literature (Scott, 1986; Grossi, 1998; Moen, 2003; Moen, 2016) and, according to Camarano et al. (2014) and Camarano (2017), this effect is particularly evident among older cohorts of Brazilian women, who were socialized in a context of more rigid gender roles, marked by low participation in the formal labour market, almost exclusive dedication to domestic and care work, and strong financial dependence on their spouses. Furthermore, as Correa (2015) shows, increases in female active life expectancy result precisely from generational changes in the social role of women, with greater participation in the labour market in recent decades, even after the age of 50.

Other results of this study reinforce the magnitude of these inequalities and highlight the decisive nature of health status in determining active life expectancy among men: women, especially those with less education, have much higher inactive life expectancies than men with the same educational level, with differences of up to 10 years. Among men, however, educational differences are minimal not only in terms of life expectancy in economic activity but also, unlike women, in other combinations involving only labour statuses (activity and retirement), without considering health. However, when combining activity/retirement with

health in pairs, a clear educational gradient emerges: the higher the level of education, the longer the time lived in healthy statuses, regardless of whether the individual is active, inactive, retired, or not retired. The opposite occurs for unhealthy statuses. These findings are consistent with the study by Pérez, Wajnman, and Oliveira (2006) for older adults in the city of São Paulo, which showed that health is a determining factor in the labour supply among men, while among women it seems to have no effect. The authors also highlight that family variables are especially relevant for women, which reinforces the importance of social gender roles for them. Correa (2015) corroborates this argument by demonstrating that, between 2000 and 2010, about 85% of the increase in the active life expectancy of Brazilian women was due to greater female participation in the labour market, while only 15% was explained by the reduction in mortality. Future research at the national level using longitudinal data and occupational trajectories over the life course will be able to assess more accurately the extent to which gender roles and health explain the observed inequalities between men and women in active life expectancy.

It should be noted that, among both men and women—although more pronounced for women—the lower the level of education, the higher the expectation of unhealthy inactive life, and the higher the level of education, the higher the expectation of healthy active life. This result converges with the findings of Rios-Neto and Ribeiro (2025), according to which the relationship between health and work activity is strong and stratified: individuals in poorer health were more likely to be out of the labour force, especially those with lower levels of education, whose occupations tend to be more physically demanding or less adaptable to functional limitations.

Regarding the relationship between activity status and gender, the same pattern found in Brazil by Correa (2015) and Loichinger and Weber (2016) was found in the vast majority of the 26 European countries analyzed by them: women were unable to achieve the active life expectancy of men at age 50. Among Brazilians with low levels of education, the gender gap in estimated active life expectancy in this study was almost 5 years, a situation even worse than the largest gender gaps found by Loichinger and Weber (2016) in Ireland, Italy, and Spain, which were around 4 years.

For Correa (2015), this gender inequality stems in part from different retirement rules for the sexes, which tend to favor women's earlier exit from the labour market. However, the results of this study suggest that this explanation is insufficient. The combined analysis of work and retirement states reveals significant gender inequality. Among individuals with low and intermediate levels of education, women expect to live more than five years longer than men of the same educational levels in the inactive non-retired status, despite being able to retire by age in the RGPS five years earlier (60 years for women and 65 for men, according to the rules in force at the time), In other words, being out of the labour force does not necessarily mean being retired.

When health status is incorporated into the analysis, the scenario becomes even more unfavorable for women. In the absence of studies with this combined approach for Brazil, the results of this article are in line with Boissonneault and Rios (2021), who showed that, in 14 OECD countries, men have higher healthy working life expectancy values than women. In Brazil, this pattern is reproduced: women of all educational levels not only expect to live less time active and healthy, but also project spending more years in statuses of inactivity and compromised health. The results also corroborate the evidence synthesized in the four studies found in the systematic review by Parker et al. (2020a) that population-level estimates of time spent healthy and working do not exceed 10 years. In this research, this pattern is confirmed: healthy active life expectancy reaches values as low as 3.5 years among Brazilian women with low levels of education. The only exception observed was among men with high levels of education, whose life expectancy reached 10.3 years.

The combinations of the three states that include statuses of inactivity and non-retirement, regardless of health status (i.e., In-NAp-S and In-NAp-NS), are in line with a more unfavorable scenario for women, revealing that the relative differences between women and men with the same educational level vary between 2.5 and 4.5 years more for women in these statuses. This indicates that they disproportionately accumulate years of life outside the labour market and without social security protection, regardless of health status.

The percentages of total life expectancy lived in states of inactivity and retirement in this article (Appendix 2) reinforce the argument that gender inequality in active life expectancy cannot be attributed to the lower minimum retirement age among women. Among

women who had already reached the minimum age for retirement under the RGPS, between 19.5% (high education) and 25% (low education) of their remaining lifetime would be spent in an inactive state. Among men who had already reached retirement age, these figures ranged from only 7% to 10.9%. In relation to the non-retired status, 60-year-old women would live, respectively, between 9.9% and 22.7% of their total life expectancy in this situation, while among 65-year-old men, this percentage remained around 5%, regardless of educational level. Even at more advanced ages, such as 80, women with low and medium levels of education could still expect to live more than 7% of their remaining life without being retired.

Thus, although women with low and intermediate levels of education have, in absolute terms, a longer life expectancy in retirement and non-retirement statuses than men with the same level of education, the proportional analysis reveals a different picture. When considering the time lived in these statuses in relation to total remaining life expectancy, it can be seen that they expect to spend a smaller proportion of their lives retired, even though they generally have the possibility of retiring five years earlier than men. This result suggests that the length of retirement among these women is determined less by more favorable social security rules and more by lower female mortality, which prolongs survival after the end of working life. In addition, women's more interrupted and precarious occupational trajectories, especially among those with less education (Camarano, Kanso, and Fernandes, 2014; Camarano, 2017; Costanzi et al., 2018; Nóbrega, 2019; Fernandes and Queiroz, 2022) make it difficult to accumulate contribution time, which contributes to a larger portion of post-retirement time being lived in statuses of inactivity not protected by benefits. To confirm whether the longer retirement life expectancy among women is mainly due to lower mortality and not just social security rules, future studies could apply demographic decompositions or multistate life table models. These approaches would make it possible to separate how much of the differences between the genders is explained by post-retirement survival and how much is due to transitions between activity, inactivity, and retirement. Longitudinal studies that track work trajectories and mortality over time would also be particularly useful for this purpose. Microeconomic analyses focused on specific groups of women, such as housewives, pensioners, widows, and single mothers, could also reveal relevant particularities in labour, social security, and health trajectories, deepening the understanding of the gender inequalities observed.

No studies were identified that specifically estimate retirement life expectancy by level of education in Brazil. Nevertheless, the results of this study corroborate the international literature: those with less education expect to spend less time in retirement (Cutler et al., 2013). These findings are also in line with Brazilian studies (Caetano, 2016; Nery, 2016; Costanzi and Ansiliero, 2017; Costanzi et al., 2018) showing that the now-defunct contribution-based retirement system favored early exit from the labour market among the most privileged socioeconomic groups, whose more continuous work trajectories allowed them to reach the minimum contribution time required more quickly. In contrast, Brazilians from less privileged groups face greater barriers to eligibility for social security benefits (Queiroz, 2007). Although they start working earlier, they tend to retire later, have a lower capacity for work at ages close to retirement, and are concentrated in more physically demanding occupations (Ribeiro, 2020), in informal work, in precarious working conditions and with lower incomes or in situations of unemployment (Queiroz and Ramalho, 2009; Camarano and Carvalho, 2015). In addition, retired elderly people in these groups often need to supplement their income from retirement benefits (Orellana, Ramalho, and Balbinotto, 2018).

Although there are no Brazilian studies that combine health, retirement, and education in life expectancy estimates, the findings of this research are consistent with international evidence. Konig et al. (2018) show that Swedish retirees with lower education tend to have poorer health statuses than those with higher education. The results of this study point in the same direction: in Brazil, the lower the level of education, the longer the time lived in the unhealthy retired (Ap-NS) status and the shorter in the healthy retired (Ap-S) status, both among men and women. The differences between women with low and high levels of education are significant, exceeding 6 years in the Ap-NS status and reaching more than 9 years in the Ap-S status, differences that remain relatively high even at older ages. These results are also consistent with the findings of Rios-Neto and Ribeiro (2025), who demonstrated that the association between health and retirement varies greatly according to gender, age, and education: women, older individuals, and less educated people have different patterns of retirement when conditioned by health.

Parker et al. (2020b) found that in England, life expectancy without prolonged limiting illness at age 50 was considerably lower than the retirement age. The empirical evidence found in this research for Brazil points in the same direction. As can be deduced from the data mentioned earlier in this discussion, healthy life expectancy would be a maximum of 60.3 years among the most educated men and a minimum of 53.5 years among the least educated women. These values are considerably lower, especially in the case of women, than the current minimum retirement ages under the RGPS, established after the Social Security Reform: 62 years for women and 65 years for men.

7. Final considerations

This study highlights the scarcity not only of research that estimates life expectancy while simultaneously considering work and health status, but also of studies in Brazil that address life expectancy according to work status analyzed in isolation (economic activity and retirement), especially when disaggregated by gender and level of education. Thus, this study contributes to the literature by examining conditions that coexist throughout the life course, whose effects are strongly interlinked and mutually reinforcing, constituting determinants, in different magnitudes, of the decisions, opportunities, and possibilities associated with the extension of working life.

Even without using specific life tables by educational attainment, the study identified striking inequalities in life expectancy by educational attainment and gender among Brazilians. These inequalities could be even more pronounced if life tables disaggregated by education level were used, which will be possible with the availability of longitudinal data and specific mortality rates for individuals followed over time in the second wave (2019–2021) of ELSI and in future editions of the survey (the third wave was scheduled to begin in 2023, according to information on the official website). Added to this is the fact that the exclusive use of period data assumes that the differences observed derive only from chronological age, when a substantial part of these variations may reflect cohort effects, understood as patterns associated with the conditions and experiences lived by each birth cohort throughout the life cycle. Since period information does not allow for distinguishing between age and cohort effects, the absence of longitudinal data prevents the adequate identification of these components.

An integrated analysis of life expectancy by gender, education, and age in terms of economic activity, retirement, and health shows that the inequalities observed are not only due to biological or institutional differences, but also to a set of social, economic, and health mechanisms that reinforce each other throughout the life course. As Rios-Neto and Ribeiro (2025) point out, the relationship between these sociodemographic variables, work and health status cannot be understood in isolation or in a simplified manner, as it is an interdependent and stratified system, with direct implications for the formulation of policies that seek to

prolong working life and promote healthy active ageing in a country deeply marked by social inequalities such as Brazil.

Although men have higher mortality rates and women have greater longevity, the latter remain at a disadvantage when considering the quality and conditions of these additional years of life, especially among those with less education. The combination of caregiving overload, precarious employment, and the accumulation of non-lethal but disabling diseases contributes to widening the gap between female educational groups and reinforces the role of education as a more significant protective factor for women than for men.

Although women have greater longevity and more years lived in good health, they also spend more time in unfavorable conditions. The only reversal of this pattern occurred among the least educated in all ages analyzed. This exception may reflect both the selectivity of male mortality and the greater burden of chronic diseases and functional limitations among women, especially those with lower levels of education. Thus, the combination of greater survival and accumulation of morbidities tends to neutralize part of the female health advantage in these groups.

Among men, the results indicate that health is the main determinant of active life expectancy, exerting a more significant influence than education. Educational differences, although present, are subtle and do not constitute a consistent gradient. Among women, a clear pattern can be observed: the higher the level of education, the longer the expected active life span, and yet, at all educational levels, they live less time active and healthy, and spend more years inactive and with compromised health. This result reflects not only the protective effect of education, but also the social gender roles historically assigned to women, which combine greater responsibility for domestic and care work, less formal employment, and greater occupational precariousness. Less educated women, in particular, face more interrupted and overburdened work trajectories, which limits the accumulation of social security contributions, reduces access to benefits, and increases their vulnerability in old age.

A joint analysis of activity, retirement, and health status shows that gender differences in active life expectancy cannot be explained solely by social security rules that are more favorable to women, but reflect structural inequalities in occupational trajectories and

opportunities for contribution throughout life. Even though they can retire earlier, women of all educational levels spend more time in combinations involving inactivity and non-retirement, regardless of health status, which highlights a cumulative vulnerability resulting from the interaction between greater longevity, less social security protection, and poorer health conditions. Among those with low and intermediate levels of education, although the absolute length of life in both the non-retired and retired statuses is longer, the proportion lived as retirees is lower than among men. Even at more advanced ages, women in these educational groups continue to project a significant portion of their lives in a non-retired situation, reinforcing the persistent nature of these inequalities.

It is worth remembering that the data used in this study refer to 2015–2016; that is, the least favorable scenario for extending the working life of women with intermediate and low levels of education, in terms of work, and of men with low levels of education, in terms of health, was already taking shape even before the 2019 Social Security Reform (EC 103/2019). This context reinforces Ribeiro's (2020) argument that the reform is progressive in nature in combating inequalities, especially by eliminating retirement based on contribution time. However, this change only partially solves the problem of extending working life: by raising the minimum age, it forces the more educated, who already had better health and employability, to remain in the labour market longer, something that the less educated already did not by choice, but because they faced greater difficulties in meeting retirement requirements. For the most vulnerable groups, however, raising the minimum age for women and the contribution period for men may represent a new obstacle to remaining in work, widening inequalities that were already evident before the reform.

This reinforces, once again, that the issue of extending working life in Brazil goes beyond legislative solutions imposed by social security reforms, involving structural changes that enable men of all educational levels to survive longer in old age and women to participate more broadly and continuously in the labour market so that they can effectively reach retirement. To understand the effects of the reform more accurately, it will be necessary to monitor, through longitudinal studies, the trajectories of people close to retirement age, observing the impact before and after the changes. The next waves of ELSI will be particularly useful in this regard.

Encouraging the creation of more age-friendly jobs, with greater flexibility in working hours, the possibility of remote work, lower physical demands, more autonomy, and training opportunities, as suggested by Acemoglu et al. (2022), could benefit older people of all genders and socioeconomic strata. Although these authors indicate that younger workers tend to take greater advantage of this type of job, this imbalance could be mitigated by creating minimum quotas exclusively for older people. Measures of this nature could be complemented by instruments that allow for gradual transitions between work and retirement, as is the case in some European countries—for example, in the Netherlands, where occupational pension funds (supplementary pension plans linked to employment and distinct from public pensions) allow for a reduction in working hours accompanied by proportional pension payments, favoring a less abrupt exit from working life and greater preservation of health (OECD, 2018). Jobs with these characteristics would not only favor the extension of working life, but also enable it to occur with a higher quality of life, reducing social isolation, promoting a better balance between work and leisure time, and providing smoother transitions to the definitive end of professional life.

Thinking specifically about older people of both genders with lower levels of education, the first obvious measure is to expand access to education and professional and technical training for future generations who will still reach more advanced ages. For those who are already in these age groups, a relevant strategy is to encourage participation in Youth and Adult Education (EJA), a form of basic education aimed at those who did not complete elementary or high school at the appropriate age. As Baerlocher, Stephen Parente, and Rios-Neto (2019) point out, there is a second demographic dividend associated with education, which is substantially more relevant than the first in terms of economic growth. Complementarily, Correa, Carrasco-Gutiérrez, and Turra (2025) point out that a possible educational demographic bonus could mitigate the impacts of population ageing by increasing the productivity of the workforce, and Fernandes and Queiroz (2024) reinforce that a silver demographic dividend in Brazil would only be achieved in scenarios that contemplate raising the educational levels of the population.

Long-term advances in countries' industrial composition and technological development make the ability to cope with new work procedures highly relevant (Skirbekk,

Loichinger, and Weber, 2012). The introduction of new technologies has compensated for declines in sensory and muscular abilities and increased the productive potential of workers, allowing people to continue to function professionally at more advanced ages (Skirberkk, 2008). However, these advances are not distributed equally across social strata: people aged 50 and over who experienced poorer living conditions in childhood and adulthood, such as inadequate nutrition, shorter duration and lower quality of education, low levels of physical and social activity, and greater exposure to disease, tend to have poorer cognitive performance (Skirbekk, Loichinger, and Weber, 2012). This scenario reinforces the importance of investments in continuing education, especially in skills for dealing with new technologies, in a context increasingly marked by the spread of artificial intelligence.

Other strategic points involve increasing the participation of older women with less education in the labour market and ensuring better health conditions and greater longevity for men in the same educational group.

Among women, it is essential to implement public policies that reduce the workload resulting from the female social role of responsibility for domestic work and care for dependents of any age, such as children, parents, or elderly or sick spouses. These responsibilities often lead women, especially those with low levels of education, to face exhausting double shifts as they juggle these activities with employment. Policies aimed at freeing up time, such as expanding full-time schools, increasing paternity leave, and expanding the number of public daycare centers and nursing homes, could contribute to this. In addition, policies that effectively guarantee gender pay equality among workers performing the same job, of equal value, for the same employer and in the same location, can increase the opportunity cost of remaining exclusively in domestic and care activities, making it more advantageous, from a family strategy perspective, for women to enter and remain in the labour market.

Recent examples of policy advances in this direction include Bill No. 3,935/2008, approved by the Chamber of Deputies on November 4, 2025, and currently pending in the Senate, which proposes extending paternity leave in Brazil from five to up to twenty days, with gradual implementation and coverage of formal and informal workers. Also noteworthy is Law No. 14,611/2023, which created mechanisms for transparency, oversight, and

sanctions aimed at making the guarantee of equal pay more effective—already provided for in Brazilian law since the CLT of 1943 (art. 461) and by the Federal Constitution of 1988. Finally, the Full-Time School Program (Law No. 14,640/2023), enacted on July 31, 2023, was relaunched by the federal government with the aim of expanding enrollment and financing the extension of the school day.

Among men, it is not enough for those who have already reached more advanced ages to be in good health. It is essential to ensure that more men, as well as women, reach these ages, especially those with lower levels of education. To this end, it is necessary to increase investments in the prevention and treatment of lethal diseases, in health awareness campaigns, and in the promotion of healthy lifestyles, in order to reduce inequalities in survival and improve conditions for prolonging working life.

In summary, understanding inequalities in the length of working life requires an integrated approach between health, work, education, and social protection. The evidence presented here shows that extending working life in Brazil will depend not only on legal adjustments, but above all on structural changes that guarantee decent conditions so that men and women from all socioeconomic strata can live and work in good health until more advanced ages.

Ultimately, extending working life in Brazil should not only mean working longer, but above all working better, with more health, equity, and dignity. The challenge is to make population ageing not an economic burden, but an opportunity to build a more just and inclusive society for all generations.

Author Contributions

Alexandre Oliveira Ribeiro: Conceptualization; Methodology; Formal analysis; Data curation; Investigation; Writing – original draft; Writing – review & editing.

Eduardo Luiz Gonçalves Rios-Neto: Supervision; Conceptualization.

Conflict of Interest

The authors declare that they have no conflicts of interest of a financial, commercial, or institutional nature that could have influenced this study.

Data Availability Statement

The data used in this study are from the Brazilian Longitudinal Study of Aging (ELSI-Brazil) and are publicly available upon registration from the data providers at: https://elsi.cpqrr.fiocruz.br/

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APPENDIX 1 – Proportional educational gradients

This second measurement strategy expresses educational gradients in life expectancy as proportions of remaining life years, thereby attenuating scale effects arising from gender differences in total life expectancy. By doing so, it enables a more balanced comparison between men and women and highlights the relative intensity of inequalities across groups.

The educational gradient based on the difference between high and low educational levels in the proportion of remaining life expresses the fraction of future years lived in each state for each educational level ($P_{state,esc}$). This measure normalizes inequalities by the size of remaining life, reducing the bias arising from greater female longevity and allowing for more balanced comparisons between men and women. For each gender and educational level, the proportion is given by:

$$P_{estado,esc} = \frac{EV_{estado,esc}}{EV_{total,gênero}}$$

Where $EV_{state,esc.}$ represents life expectancy, in a given state, gender, and age, among individuals of a given educational level, and $EV_{total,gender}$ is the total life expectancy for individuals of the same age, gender, and educational level.

Since all educational levels share the same total life expectancy within each gender in the context of this research, this standardization is particularly appropriate. The proportional educational gradient (G_{educ}^{Prop}) results from the difference between the proportions of high and low educational attainment:

$$G_{educ}^{Prop} = P_{estado,AE} - P_{estado,BE}$$

This value indicates for each gender and age, in percentage points, how much higher education increases (or decreases) the portion of life remaining lived in that state compared to low education.

The comparison between men and women is made using the gender education gradient (G_{gen}), calculated as the absolute difference (in modulus) between the magnitudes of the education gradients for men ($G_{educ,M}$) and women ($G_{educ,F}$):

$$G_{gen} = \left|G_{educ,H}\right| - \left|G_{educ,M}\right|$$

Positive values of G_{gen} indicate greater educational inequality among men, while negative values indicate greater inequality among women.

Proportional gradients compare, within each gender, how much higher education increases the fraction of remaining life lived in each state, relative to lower education. Since all educational levels start from the same total life expectancy within each gender in the context of this research, this approach allows for a more balanced comparison between men and women, reducing the bias resulting from greater female longevity. Next, the intensity of educational inequalities between genders is compared using the difference between the magnitudes of the gradients for each group: positive values indicate greater educational inequality between men, and negative values indicate greater inequality among women. This metric highlights the composition of remaining life and complements the analysis in absolute years by offering a more comparable proportional perspective between genders.

Even after normalizing for total life expectancy, that is, even reducing the effect of women having higher levels of longevity, gender educational gradients remain greater among women. As shown in *Table2*, with the exception of the only two states where the gender difference became zero (In-S and NAp-NS), all gender education gradients that were negative in the absolute analysis remained negative in the proportional analysis. This indicates that, although normalization partially mitigates the magnitude of inequalities, it does not alter the overall pattern: women continue to exhibit greater educational penalties relative to men.

Table2 – Comparison of proportional educational gradients in life expectancy between men and women according to economic activity, retirement, and health statuses, 2015–2016

A) Isolated statuses	**In**	**At**	**NS**	**S**	**Ap**	**NAp**		
$\mathbf{G^{Prop}_{educ,H}}$	1	1	29	29	3	4		
$\mathbf{G^{Prop}_{educ,M}}$	11	11	31	31	9	9		
$\mathbf{G^{Prop}_{gen}}$	-10 p.p.	-10 p.p.	-2 p.p.	-2 p.p.	-6 p.p.	-5 p.p.		
B) Combinations of activity and retirement statuses	**In-Ap**	**In-NAp**	**At-Ap**	**At-NAp**				
$\mathbf{G^{Prop}_{educ,H}}$	4.3	6.1	1	2.2				
$\mathbf{G^{Prop}_{educ,M}}$	2.8	14.6	6	5.6				
$\mathbf{G^{Prop}_{gen}}$	1.5 p.p.	-8.5 p.p.	-5 p.p.	-3.4 p.p.				
C) Combinations of health statuses with retirement and activity, in pairs	**In-NS**	**In-S**	**At-NS**	**At-S**	**Ap-NS**	**Ap-S**	**NAp-NS**	**NAp-S**
$\mathbf{G^{Prop}_{educ,H}}$	20	18	9	10.8	18.3	21.9	11	7
$\mathbf{G^{Prop}_{educ,M}}$	29	18	2	13.3	-19.5	28.5	11	2
$\mathbf{G^{Prop}_{gen}}$	-9 p.p.	0	7 p.p.	-2.6 p.p.	-1.2 p.p.	-6.6 p.p.	0	5 p.p.
D) Combinations of activity, retirement, and health statuses	**In-Ap-NS**	**In-Ap-S**	**In-NAp-NS**	**In-NAp-S**	**At-Ap-NS**	**At-Ap-S**	**At-NAp-NS**	**At-NAp-S**
$\mathbf{G^{Prop}_{educ,H}}$	15	20	4	1.8	3	2	7.2	9.3
$\mathbf{G^{Prop}_{educ,M}}$	19	22	10	4.6	0%	6	1.5	6.8
$\mathbf{G^{Prop}_{gen}}$	-4 p.p.	-2 p.p.	-6 p.p.	-2.9 p.p.	3 p.p.	-4 p.p.	5.6 p.p.	2.5 p.p.

Notes: $G^{Prop}_{educ,H}$ *– Proportional educational gradient among men;* $G^{Prop}_{educ,M}$ *– Proportional gradient among women;* G^{Prop}_{gen} *– Proportional gender educational gradient.*

p.p. – percentage points.

Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).

APPENDIX 2 - Percentage of life expectancy spent in unhealthy, inactive, and retired statuses, by age, gender, and educational level

In addition to estimates in absolute years, the analysis in percentage terms of expected lifetime in each condition offers an additional perspective that is essential for understanding the inequalities observed. While absolute measures capture the total number of years lived in each state, they can be influenced by the greater or lesser longevity of the groups analyzed, especially in the case of differences between men and women. Percentages, in turn, allow us to compare how life time is distributed among different statuses, regardless of total life span, revealing qualitative contrasts in the structure of longevity that might remain hidden when looking only at absolute values. This approach contributes to a clearer reading of inequalities in the experience of aging, highlighting the proportion of life lived in each state and not just its duration in years.

This chapter presents the percentages of life expectancy that Brazilians expect to spend in unhealthy, inactive, and retired statuses over five-year age intervals, from 50 to 80 years, according to gender and level of education.

1.1 Unhealthy status

Graph5 shows, by age, gender, and level of education, the proportion of life expectancy in unhealthy status over total life expectancy, encompassing both unhealthy and healthy status. As expected, the percentages of unhealthy life expectancy increase progressively with age in all groups analyzed, with the exception of highly educated women, among whom there is a slight reduction in the percentage between 75 and 80 years of age.

In general, the percentages of unhealthy life expectancy follow a pattern associated with gender and educational level: among people of the same gender, the lower the educational level, the higher the percentages observed; and among people of the same educational level, women always have higher values than men. The only exception occurs at age 80, when highly educated men begin to register higher percentages than women in the same group.

It is worth noting that, even in percentage terms, the pattern identified in *Graph3*, according to which women live more unhealthy years than men in absolute terms, also holds true in relative terms. In other words, women not only expect to spend more years in an unhealthy status but also expect to experience a greater proportion of their remaining life at each age in such status, when compared to men with the same educational level. On the other hand, given that unhealthy statuses are complementary to healthy statuses, the fact that women have higher percentages in unhealthy statuses implies that men expect to live longer in good health in proportional terms.

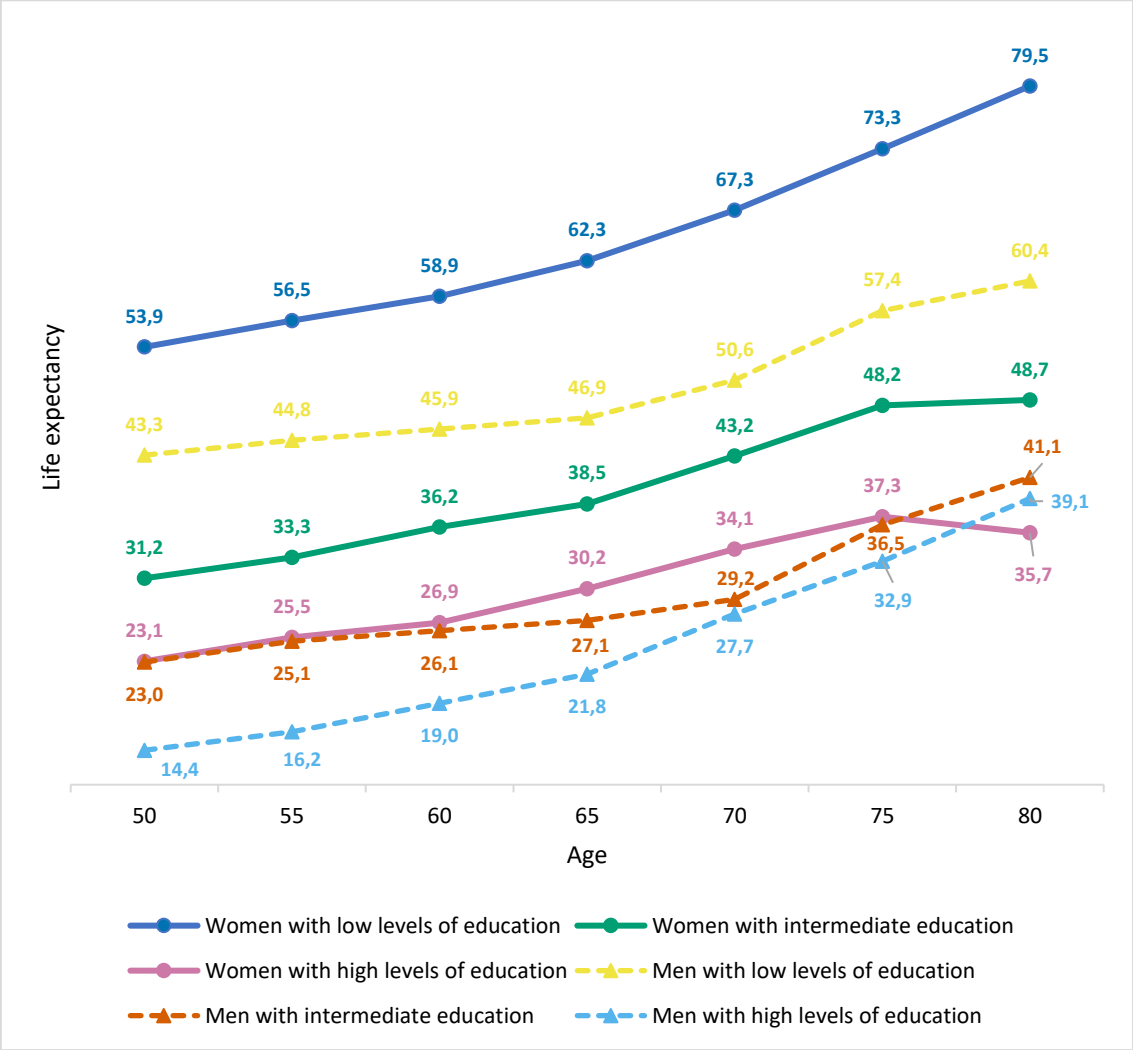
Another relevant finding is that only among groups with low levels of education, for both women and men, does unhealthy status account for most (more than half) of remaining life at each age. For women, this is true at all ages analyzed, while for men, it is true from age 70 onwards.

The disparities between women with low educational attainment and men with high educational attainment are always high, ranging from 39.5 to 40.5 percentage points. Even within the same educational level, gender inequalities are striking, especially among individuals with low educational attainment, and persist at older ages, reaching 19.1 percentage points at age 80.

The magnitude of inequalities between people of the same gender but with different educational levels is also noteworthy, especially when comparing groups with low levels of education to others. Among women of the same age with low and high levels of education, the average difference is 32.1 percentage points, reaching 43.8 at age 80; among women with low and intermediate levels of education, the average difference is 23.8 percentage points. Among men, these differences are smaller: 25.1 percentage points, on average, between low and high education levels, and 19.8 percentage points between low and intermediate levels.

Finally, it is observed that disparities by level of education among women tend to widen with age, while among men, they are stable between those with low and intermediate education and tend to decrease between those with low and high education and between those with intermediate and high education. In the latter case, the approximation between the values is noteworthy, with a difference of only 1.4 percentage points at age 70.

Graph5 – Proportion of life expectancy of Brazilians aged 50 to 80 years lived in unhealthy statuses, by gender and education level, 2015-2016



Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).

1.2 Inactive status

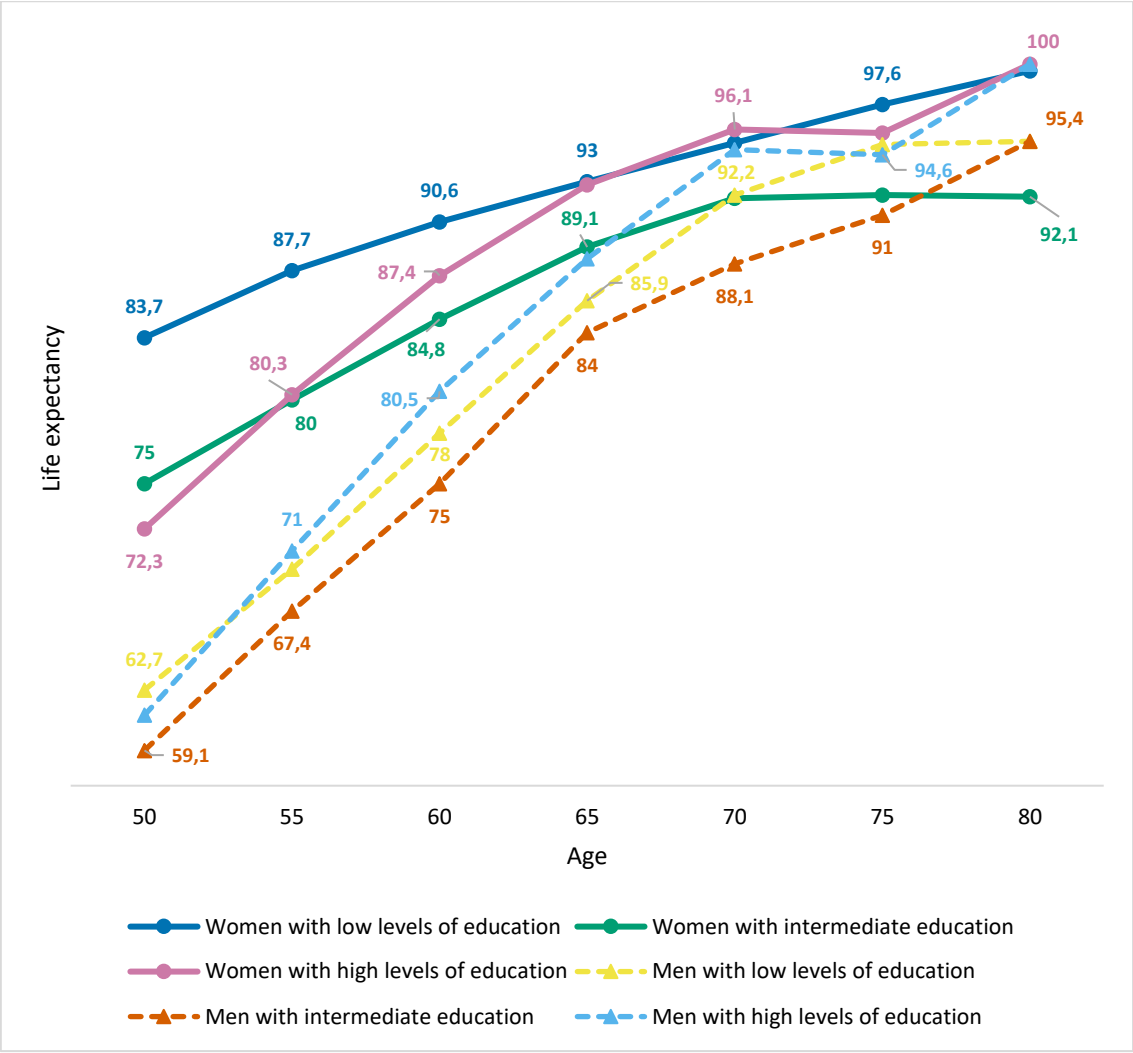
Graph6 shows, by age, gender, and educational level, the proportion of life expectancy in an inactive status over total life expectancy, encompassing inactive and active statuses. As expected, the percentages of inactive life expectancy increase progressively with age in all groups analyzed.

Up to age 65, the minimum retirement age for men in the RGPS, women of all educational levels exhibit higher percentages of inactive life expectancy than men. From age 70 onwards, higher percentages are observed among men than women with intermediate education, whose percentages remain around 92.1% in this age group. At age 80, only men and women with high levels of education reach 100% inactive life expectancy.

There are striking gender inequalities within the same educational level, particularly among younger people, reaching 21 percentage points among people with low educational attainment at age 50. These differences decrease with advancing age.

With regard to comparisons by educational level within the same gender, the disparities among men are not very significant. Among women, however, it can be observed that those with low levels of education have the highest percentages of inactive life expectancy from an early age. However, with advancing age, they are progressively caught up by those with high levels of education, whose percentages grow sharply and approach those of women with low levels of education by the age of 65—the age immediately after the minimum retirement age under the RGPS (60 years). Women with intermediate levels of education, in turn, have persistently lower percentages than the others.

Graph6 - Proportion of life expectancy of Brazilians aged 50 to 80 years lived in an inactive status, by gender and education level, 2015-2016



Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).

1.3 Retired status

Graph7 shows, by age, gender, and education level, the proportion of life expectancy in retirement status over total life expectancy, encompassing both retired and non-retired status. As expected, the percentages of life expectancy in retirement increase progressively with age in all groups, with more pronounced growth up to the minimum retirement ages in

force at the time (60 years for women and 65 years for men) and, from then on, with curves that become progressively flatter.

Women with high levels of education have, up to the age of 60, higher percentages of retirement life expectancy than men of all educational levels. At ages 65 and 70, however, they are surpassed by men and subsequently return to equal levels with highly educated men at more advanced ages (75 and 80), when both are the only groups to reach 100% retirement life expectancy. Women with low levels of education have higher percentages than men of the same level up to the age of 55, but from that age onwards, they align themselves with women with intermediate levels of education, comprising the groups with the lowest percentages among all those analyzed.

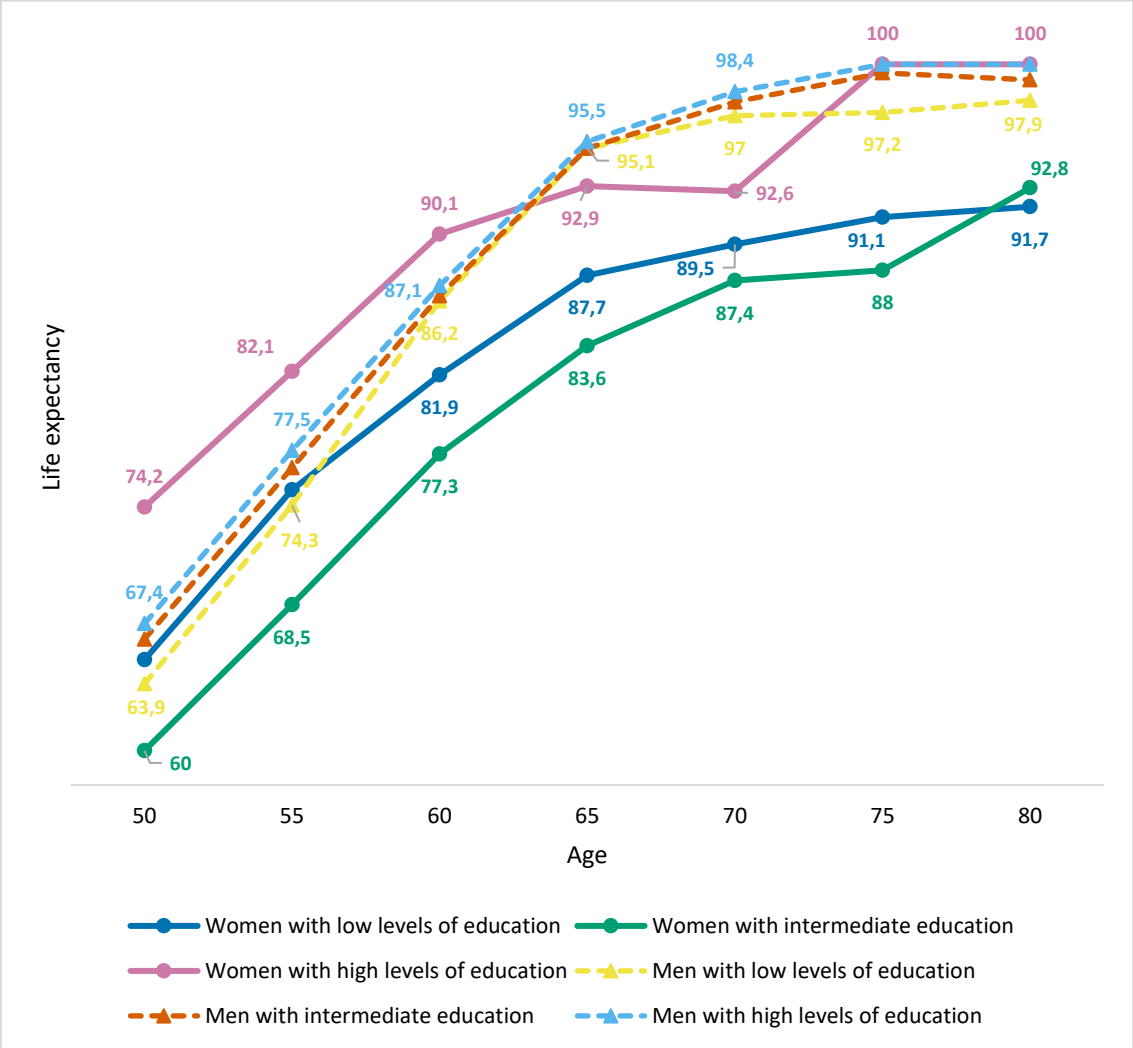
With regard to comparisons by educational level within the same gender, among men, the percentage differences are not very significant across age groups, although there is a clear trend: the higher the level of education, the higher the percentages of life expectancy in retirement. Among women, however, there is no such clear pattern. Those with high levels of education have the highest percentages, followed by those with low levels of education, who exceed those with intermediate levels at virtually all ages, except at age 80. Unlike men, there are large disparities in the percentages observed among women, reaching 14.2 percentage points between women with high and intermediate levels of education at age 50.

When comparing people of the opposite gender with the same educational level, it is worth noting that, even though they spend more time in absolute terms in retirement, as shown inGraph3 in the previous chapter, women with low and intermediate levels of education expected to spend a smaller proportion of their remaining lifetime in this status, as shown inGraph7 . The greatest inequalities occur among individuals with intermediate levels of education, to the detriment of women, whose life expectancy at retirement at ages 65 and 75 is 11.5 percentage points lower than that of men in the same group.

Focusing specifically on retirement ages, women with low, intermediate, and high levels of education expected to spend 81.9%, 77.3%, and 90.2% of their remaining life at age 60—the minimum retirement age for women in 2015-2016—as retirees, respectively. whereas in the corresponding male groups, the proportions exceeded 95% of their remaining life expectancy at age 65, which was the minimum retirement age for them. In absolute terms,

this inequality becomes even more evident: in these same groups, women expected to live 4.3, 5.4, and 2.3 years as non-retirees, while men expected to live less than one year (0.8 years) as non-retirees.

Graph7 - Proportion of life expectancy of Brazilians aged 50 to 80 years lived in retirement, by gender and education level, 2015-2016



Source: prepared by the author based on data from ELSI (2015-2016) and IBGE (2021).

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