# Health inequality in Germany

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## Abstract

Pension reforms in Germany decreased benefit generosity and increased the retirement age since the 1980s. Decreasing benefit generosity may result in fewer out-of-pocket expenditures for healthcare, and later retirement ages imply a longer time in arduous jobs for many individuals. Both will most likely affect older individuals in the lower income brackets more than richer individuals. The question to be answered by this paper is therefore whether these reforms increased health inequality for retirees.
We use SHARE data from 2004 through 2022, five different health measures, and three different ways to characterize health inequality. We neither find a systematic pattern nor a statistically significant measure that would indicate that health inequality has increased from 2004 to 2022.

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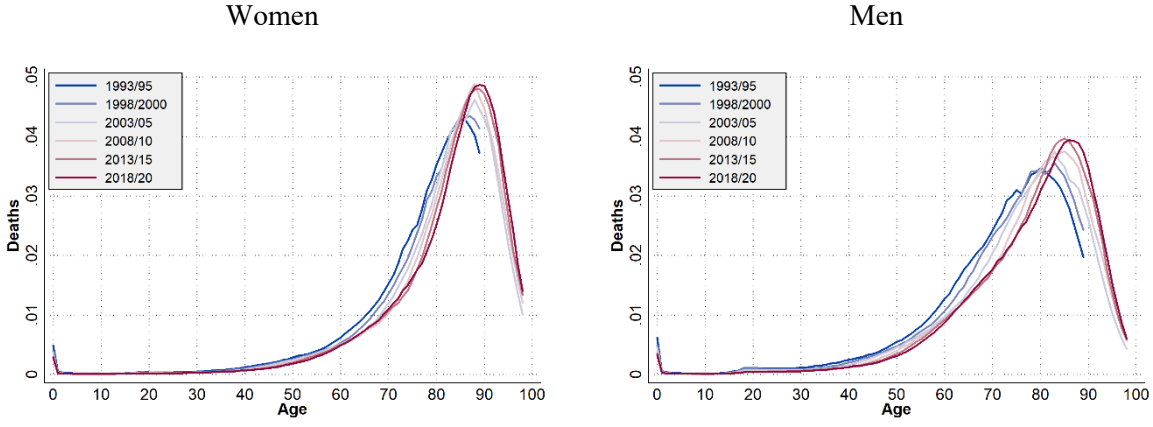
## 1. Introduction

Germany, like many other countries, experienced a flurry of pension reforms since the 1980s which generally decreased benefit generosity and increased the retirement age. Decreasing benefit generosity may imply cheaper food and fewer out-of-pocket expenditures for healthcare, and later retirement ages may cause a longer time in arduous jobs. This should affect older individuals in the lower income and wealth brackets more than richer individuals. Hence, the main question to be answered by this paper is whether these reforms increased health inequality for retirees. The paper is a follow up on our recent paper on the effects of reforms on income and wealth inequality (Börsch-Supan et al., 2024). In that paper, we did not find a statistically significant or economically relevant increase, mainly due to the fact that Germany introduced a variant of a minimum pension at the same time as it reduced the generosity of the general public pension scheme.

Health may be different since it is directly affected by an increase in the retirement age. A perennial argument in Europe against raising the retirement age in line with life expectancy is that "most workers are not healthy enough to keep working".[1] An increase in the retirement age should make this assumed condition even worse, and make the distribution of health more uneven. However, a first and arguably superficial view at the most severe health condition, mortality, shows the opposite. Figure 1 shows the distribution of the age at death according to period life tables and its change between 1992 and 2019, drawn from the German Federal Statistical Office (Statistisches Bundesamt (*Destatis*), 2025). The distribution shifts to the right as life expectancy increased by 4.4 years (women) and 6.2 years (men) during this time, but the spread actually became tighter rather than broader.

**Figure 1.** Mortality




**Source.** German Federal Statistical Office (2015).

**Note.** Distribution according to period life tables. The actual distribution of deaths by age can vary by historical shocks, like the First and Second World Wars.

[1] German Federal Minister of Labor and Social Affairs Bärbel Bas in August 2025, as quoted by RND (2025).

This paper uses the SHARE panel (Survey of Health, Ageing and Retirement in Europe, Börsch-Supan et al. 2013) to investigate whether this superficial impression holds if more detailed measures are considered and more refined statistical methods are used. We define "health inequalities" as the gradient of several common health measures with respect to retirement income, and study how this gradient has changed over time.

We consider five health measures:

(1) Functional health, based on the number of functional limitations,

(2) Diagnosed health, based on the number of conditions that a doctor has ever told a respondent,

(3) Comprehensive health, based on a health deficiency index with 44 items,

(4) Mental health, based on the Euro-D depression scale,

(5) Cognitive health, based on three cognition tests (immediate and delayed word recall, counting backwards in increments of seven).

These measures are defined in more detail below. Income is measured in deciles of the equivalized household income from all sources. We depict our findings as "health-income gradients", where the health measures are plotted against the income decile, and investigate whether the slope of this gradient becomes steeper during the period of pension reforms in Germany.

We begin this paper by providing a short summary of these reforms, with a focus on reforms that may have directly affected the retirees' health.

## 2. The German social insurance system

Social insurance in Germany is close to universal. It includes the public pension system, which has undergone major reforms on which this paper is focusing, public health insurance, which has experienced a slight and gradual decline in covered claims, plus long-term care insurance, unemployment insurance and workmen's compensation, which are less relevant for this paper.

### 2.1. Pension reforms potentially affecting health inequality

The German pension system is a mandatory insurance for all private sector workers and non-civil servant public sector workers. It is a strictly earnings-related system with means-tested benefits available for those with insufficient income in old-age. The system covers 85% of the German workforce and is mandatory for all private and public employees. Civil servants (approximately 5% of the workforce) have their own pension system, and most self-employed individuals (around 10%) also have their own system, with some exceptions. The system offers defined benefits and is financed pay-as-you-go by a

combination of payroll taxes and government subsidies. A detailed description of the current German system and its development over time is included in Börsch-Supan et al. (2024). A lengthy reform process since the 1980s has (a) reduced benefit generosity by adjusting the defined benefits principle to the increase of the dependency ratio, (b) increased the statutory retirement age in line with predicted life expectancy, (c) closed many pathways to early retirement, and (d) based the eligibility for disability pensions on strict medical criteria.

***(a) Reduction of benefit generosity***

Reducing the generosity of benefits took place in several steps. In 1992 the annual benefit adjustments switched from gross wage growth to net wage growth. With the introduction of individual saving accounts ("*Riester-Rente"*) in 2001, the maximum contribution rate for these pensions was netted from the wage base. In 2004, the defined benefit scheme was modified by introducing the so-called "sustainability factor". The growth of pension benefits became a weighted average of modified net wage growth and the inverse of the change of the dependency ratio, hence reducing the increase in pension benefits whenever the ratio of pensioners to contributors increased.[2] Averaged over the demographic transition process, the sustainability factor takes away about 0.5 percentage points of the wage increase.

Since the German pension system has very little redistributive properties and pension benefits are strictly proportional to life-time contributions, these changes to the annual pension adjustments have no effect on inequality. However, they change the balance between pensioners and workers, which is their main purpose. While there is little redistribution within the statutory pension insurance system, there are important redistributive mechanisms outside the system. Without going into details, they mimicked minimum pensions or base pensions, and were altered many times. Börsch-Supan et al. (2024) show, that they prevented a general increase of the income inequality among retirees.

***(b) Increase of statutory eligibility age***

Responding to the strong increase in life expectancy, Germany legislated a gradual increase of the statutory eligibility age in 2007. The increase will shift this age from 65 to 67 years until 2031. Early retirement schemes are adjusted in parallel. However, the legislation did not increase the benefit adjustments to a retirement before the statutory retirement age, which are 3.6% per year of earlier retirement and thus substantially less than actuarial (Gasche and Kluth, 2011, Werding, 2016). Moreover, in 2014, the government introduced a new early retirement pathway ("pensions for especially long-term insured") for workers that contributed for at least 45 years to the pension system that waived

[2] Modified net income refers to the complicated mixture of net and gross income used for determining wage growth. See Börsch-Supan and Reil-Held (2003) for a precise definition.

the anyway non-actuarial adjustments. Whether the gradual increase of the statutory retirement age will be continued after 2031, is currently under a controversial debate.

***(c) Closure of early retirement pathways***

In addition to regular retirement at the statutory retirement age, the German public pension scheme provides several pathways to early retirement. The eligibility criteria for each pathway vary, and individuals must fulfill specific requirements to access their pension entitlements. Pathways include pensions for long-term insured (at least 35 years of service, adjustments apply), pensions after an unemployment spell, pensions after part-time employment prior to retirement, pensions for women, and disability pensions (see below). In 1997, old-age pensions because of unemployment and old-age pension for women were abolished for cohorts born after 1952. Since both pathways were popular, this had a large effect on pension eligibility. In turn, as already mentioned, pensions for especially long-term insured (45 years of service) were introduced in 2014.

***(d) Disability pensions***

The German disability pension faced many changes over the last four decades. It started in 1984 when the requirements for disability pensions were tightened by making a minimum of three contribution years in the last five years a condition. Moreover, stricter medical examinations were introduced and the duration of benefits generally limited to three years, upon which another medical exam is required. In 2001, disability pensions for "vocationally disabled" (the inability to continue the current specific occupation) were abolished in favor of a two-step disability pension (partial/full earning incapacity) with strict focus on the maximal working capacity (less than six/three hours per day for a partial/full disability pension). As kind of compensation the vesting period for regular old-age pensions was reduced from 15 to 5 service years, and disability benefits were increased in several steps by gradually raising the hypothetical working time lost for which additional pension entitlements are credited.

Reforms of the German pension system have a clear pattern: After making the system less generous and shifting the retirement age up between the 1980s and about 2014, there has been a backlash returning to more generosity. The effects of these reforms on health inequality are complex. More stringent restrictions on disability pensions should more likely affect lower income-groups due to the correlation between health and income, and thus increase health inequality. However, the connection between the receipt of a disability pension and health was tenuous before the "vocational disability" was abolished in 2001. One may also argue that stricter medical exams and a focus on preventing work incapacity in the aftermath of the 2001 reform have improved health for the less healthy, thereby reducing health inequality.

### 2.2. Reforms of the public health insurance system

Health insurance in Germany is essentially universal and independent of the employment status and the current employer. However, the system is split along income lines. The German public health insurance permits opting out if annual earnings are above 1.3 times the average earnings. 88% of German residents are insured in the public system, while 12% use the option to privately insure. Only very few individuals are self-insured. The public health insurance system consists of some 90 separate insurers, traditionally organized by region and occupation but now competing with each other. Healthcare provision (stationary and ambulant) is separate from health insurance and largely private and charitable.

While healthcare costs have increased less than, e.g., in the US, such that the current (2024) share of health expenditures in GDP is 12.3% as opposed to the US with 17.2% (OECD Health Data 2024), Germany has the second highest health expenditures as share of GDP among the OECD countries. Hence, reforms of the German public health insurance have been targeted at reducing costs by structural reform of the complex system of the many public insurances and private health care providers, and by reducing claims. We will focus on the latter.[3]

In 1997, a co-payment of 15% was introduced and subsidies for glasses were abolished.

A major reform was legislated in 2004. Retirees compulsorily insured in the "Retirees' Health Insurance" (KVdR) will pay the full contribution rate for health and long-term care insurance on company pensions. Lump-sum payments from company pension plans became subject to the full contribution rate. To prevent contribution payments from being capped by the contribution assessment ceiling, the payment was notionally spread over 10 years. Travel expenses for outpatient treatment will generally no longer be reimbursed and a practice fee of €10 was introduced for each doctor's first visit per quarter. The only exceptions are referrals and preventive and follow-up examinations. The benefit for eyeglass lenses has also been eliminated, meaning that there is no longer any benefit for visual aids (except for those with severe visual impairment). The death benefit has been eliminated without replacement. Co-payments for drugs were increased to 10%, with a minimum of €5 and a maximum of €10; non-prescription drugs are generally no longer reimbursed. Similar co-payments apply for aids, including wheelchairs, and therapeutic products. A co-payment of €10 per calendar day for a maximum of 28 days per year was introduced for hospital stays.

In 2005, the previous percentage share of statutory health insurance funds in the cost of dentures was replaced by so-called "finding-related fixed subsidies." Instead of the current 50% (up to 65% with a bonus booklet) of the costs for simple and appropriate treatment, flat-rate payments will be made in the future, covering approximately 50% of the benefit based on the 2004 level.

[3] The following is largely based on https://www.gesetzlichekrankenkassen.de/reformen/reformen.html.

In 2006, co-payments for patients were eliminated if the price of the medication was at least 30% below the fixed amount, which was again reduced in 2006.

In 2007, prescription of special new medications was reimbursed only after a second medical opinion. If a discount agreement has been concluded between the health insurance company and the manufacturer for certain medications, the co-payments for the insured person can be reduced or waived entirely. In both outpatient and inpatient settings, secondary illnesses resulting from "self-inflicted" illnesses (e.g., removal of piercings or tattoos) must be paid for by the insured person. Doctors are required to report such treatments to the respective health insurance company. If chronically ill patients do not attend their preventive medical examinations regularly, their benefits may be withdrawn.

Since January 1, 2009, a uniform contribution rate has applied to all statutory health insurance funds, which is set by the federal government in November of the previous year. In addition, health insurance funds can levy additional contributions (with a cap of 1% of income) if necessary. This has strengthened the competition between health insurances and reduced costs.

The "Health Care Structure Act" of 2012 allowed health insurance funds to offer improved services in certain areas within the framework of so-called "extended statutory benefits." The law also introduces outpatient specialized medical care for serious or rare illnesses, and equates outpatient and inpatient rehabilitation facilities. Sanctions are now possible for health insurance funds that refuse to accept members of a closed health insurance fund.

In 2013, the "practice fee" of €10 per quarter, introduced in 2004, was abolished again. The hoped-for reduction in the number of doctor visits was not achieved, but low-income earners were deterred from necessary doctor visits. Doctors' offices also complained about the burdensome bureaucracy.

In 2015, co-payments were capped at two percent of annual gross household income, and one percent for chronically ill patients.

Since 2016, insured persons are legally entitled to obtain an independent second medical opinion in certain cases. Upon discharge, hospitals are now permitted to prescribe medications, home nursing care, and remedies for up to seven days, and to issue certificates of incapacity for work. A structural fund supports the conversion of surplus hospitals into acute inpatient care facilities.

In summary, we see a pattern similar to the reforms of the German pension system: healthcare reforms that significantly cut benefits, especially in 2004, and a backlash after 2013.

## 3. Data and Sample

This study utilizes data from the Survey of Health, Ageing and Retirement in Europe (SHARE, Börsch-Supan et al. 2013), a biennial survey that targets individuals aged 50 and above. SHARE provides extensive microdata on socioeconomic status, social and family networks, and health across multiple

European countries. Health data in SHARE are rich and include both subjective and objective measures of health, and we can link the individual's health status with their household composition and income. For our analysis, we combine data from Wave 1 (2004) through Wave 9 (2021/22), the most recent available wave. Wave 3 is an exception with the collection of life histories ("SHARELIFE"), which has different health measures, hence the year 2008 is missing in the graphs of this paper. Moreover, our measure of cognitive health is only available since Wave 4 (2011).

### 3.1. Variable Description

**Income.** In this study, we examine health inequalities across different income groups. Income is measured at the household level and adjusted using the OECD equivalence scale, which assigns a weight of 1 to the first adult in a household and 0.5 to each additional member. We use the imputed total household income provided by SHARE, which aggregates various income sources. As a result, all individuals within a household are assigned the same income group. This approach reflects our view that an individual's health is more closely linked to total disposable household income than to personal income alone.

To avoid potential bias from changes in income that may result from deteriorating health or entry into retirement, we fix individuals' income groups based on the first wave in which they are observed in our sample. This ensures that the income classification is not influenced by later health events. Individuals are assigned to an income group relative to all respondents participating in that same wave, regardless of when those other individuals entered the panel.

We make two exceptions to this rule: First, since income in Wave 1 was reported as "before taxes", while later waves report "after-tax" income, we prefer not to rely solely on Wave 1 data, as in Germany, individuals are usually better informed about after-tax income. If Wave 1 is an individual's first observed wave and they also participated in Wave 2, we calculate their average income across both waves and assign their income group relative to all participants in those two waves. If only Wave 1 data is available, we assign income groups based solely on Wave 1 respondents. Second, SHARE includes a retrospective module (SHARELIFE) administered only once per respondent. It was first implemented in Wave 3 (which is hence excluded from our analysis) and again Wave 7 for respondents who were not part of the survey already in Wave 3. Because our sample size is smaller and because participating in the retrospective module in Wave 7 is non-random, skewed towards younger, later-entering respondents, we avoid using Wave 7 to assign income groups. If Wave 7 is the first available wave for an individual, we instead use income data from Wave 8 or, if that is unavailable, from Wave 9.

**Health.** We measure five different health outcomes and define them as health capacities, such that a higher score reflects better health. These health capacities are based on the following health measures in SHARE:

**(1) Functional health:** Our functional health measure is based on 20 limitations in functional health self-reported by the respondents in SHARE. They include mobility limitations, limitations in activities of daily living (ADLs), and limitations in instrumental activities of daily living (IADLs) (Lawton and Brody, 1969). Mobility items cover activities like walking, sitting, climbing stairs, and other (fine) motor tasks. The ADLs refer to basic self-care tasks such as bathing, dressing, and eating, while the IADLs capture more complex activities necessary for independent living, including preparing a hot meal and shopping (for a full list of all limitations used, see Appendix Table A1). Our health capacity measure is constructed by taking 20, the number of limitations consistently available in the SHARE data, and subtracting from it the actual limitations which the respondent reports.

**(2) Diagnosed health:** This measure counts the number of health conditions that a respondent has experienced over his lifetime. In the baseline wave of each respondent, for a list of eleven conditions (Appendix Table A2) it is asked whether a doctor diagnosed this condition. In follow-up waves, it is asked whether a doctor has diagnosed a condition or a condition is still in effect. We then construct an indicator for each condition that equals one if the respondent has ever self-reported this condition, regardless of whether it is still present at the time of the interview or was an episode that has passed. To construct a number that increases with better health, we subtract the actual number of conditions from eleven.

**(3) Comprehensive health:** This most comprehensive measure of health is based on the health-deficiency index as specified in Börsch-Supan et al. (2021), similar to Abeliansky and Strulik (2019). It summarizes the individual health status by aggregating a set of self-reported health deficits, including chronic conditions, functional limitations, and difficulties with daily activities. Each deficit is coded as present or absent, and the index is calculated as the proportion of observed deficits relative to the total number of non-missing health indicators. To construct a number that increases with better health, we subtract the actual number of deficiencies from the maximum number of possible health deficiencies.

**(4) Mental health:** To indicate mental health, we use the Euro-D scale, which is a standardized measure of depressive symptoms developed by Prince et al. (1999). It is targeted at clinical depression and is based on 12 binary (yes/no) items related to mood and behavior, such as sadness, pessimism, sleep disturbance, and lack of interest. Each affirmative response scores one point, resulting in a total score ranging from 0 to 12, with higher scores indicating more depressive symptoms. To construct a number that increases with better health, we subtract this index from 12.

**(5) Cognitive health:** We compute a cognition score based on three cognitive function tests included in the SHARE survey: immediate word recall (from a list of ten words, it is counted how many words a respondent can recall), delayed word recall (after about five minutes, the respondent is asked again to recall these words), and the serial 7s subtraction task (subtract seven from 100, and then four times keep subtracting seven from the result). It is akin to the Langa-Weir cognition score (Langa et al. 2009, Crimmins et al. 2011) but does not contain the backwards counting test (counting backwards from 20) since this item is available only in SHARE Waves 8 and 9. To address the disproportionately high weight of memory tasks, we assign double weight to the serial 7s component. This adjustment aims to provide a more balanced measure of cognitive performance. The total score ranges from 0 to 30, with higher scores indicating better cognitive functioning.

### 3.2. Sample

Our sample consists of individuals aged between 65 and 79 years and includes (former) private-sector employees, public-sector employees, and the self-employed. Respondents are included in the sample if we have information on the aforementioned health indicators as well as on income. In total, the sample comprises 5,416 individuals, yielding 11,168 person-wave observations. Table 1 presents summary statistics across three income groups.

While the overall sample is balanced in terms of gender composition, we find a higher proportion of women in the lowest income group and a higher share of men in the top income tercile. There are also notable differences in marital status, with having a spouse being significantly more common among higher-income respondents, although this is barely reflected in average household size. We observe stronger differences in other characteristics: home ownership is more prevalent in the top income tercile; the number of children is lower; and the share of individuals with higher educational attainment is substantially greater.

Regarding economic variables, the difference in equivalized household income between the bottom and the middle tercile is approximately €8,500, while the gap between the middle and top terciles is around €18,000. In terms of wealth, the difference between the lowest and middle groups is about €50,000, increasing to €130,000 between the middle and top income terciles. Retirement age, by contrast, does not vary substantially across the three groups.

Finally, we compare average values of the health measures of interest across income groups. All five indicators are coded such that higher values represent better health. Across all outcomes, individuals in the highest income tercile consistently show better health.

**Table 1**. Summary Statistics

| | Total | Income Tercile 1 | Income Tercile 2 | Income Tercile 3 |
|---|---|---|---|---|
| **Demographics** | | | | |
| % Women | 50.4 | 56.4 | 50.7 | 46.0 |
| % Married | 76.3 | 65.9 | 77.2 | 83.5 |
| Household Size | 1.90 | 1.89 | 1.89 | 1.93 |
| Owns their home | 61.8 | 48.2 | 60.2 | 74.0 |
| Number of children | 1.99 | 2.1 | 1.97 | 1.93 |
| % with higher educational attainment | 31.4 | 17.6 | 27.3 | 45.2 |
| % with lower educational attainment | 12.5 | 22.4 | 11.2 | 6.4 |
| **Income & Wealth** | | | | |
| Equivalized Household Income (in €) | 27,480 | 14,585 | 23,267 | 41,759 |
| Equivalized Household Wealth (in €) | 198,500 | 114,823 | 162,082 | 296,523 |
| Retirement Age | 62.4 | 62.4 | 62.2 | 62.5 |
| **Health** | | | | |
| Functional health | 18.2 | 17.6 | 18.2 | 18.7 |
| Diagnosed health | 9.3 | 9.1 | 9.2 | 9.4 |
| Comprehensive health | 0.86 | 0.83 | 0.85 | 0.88 |
| Mental health | 9.9 | 9.6 | 9.9 | 10.3 |
| Cognitive health | 19.0 | 18.0 | 18.9 | 19.8 |
| # Individuals | 5,416 | | | |
| # Observations | 11,168 | | | |

**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** We use household equivalized income, dividing total household income by 1 for the first person in the household, plus 0.5 for every additional household member. We adjust for purchasing power parity. Respondents stay in the same income group over time, based on their position in the wave they entered SHARE.

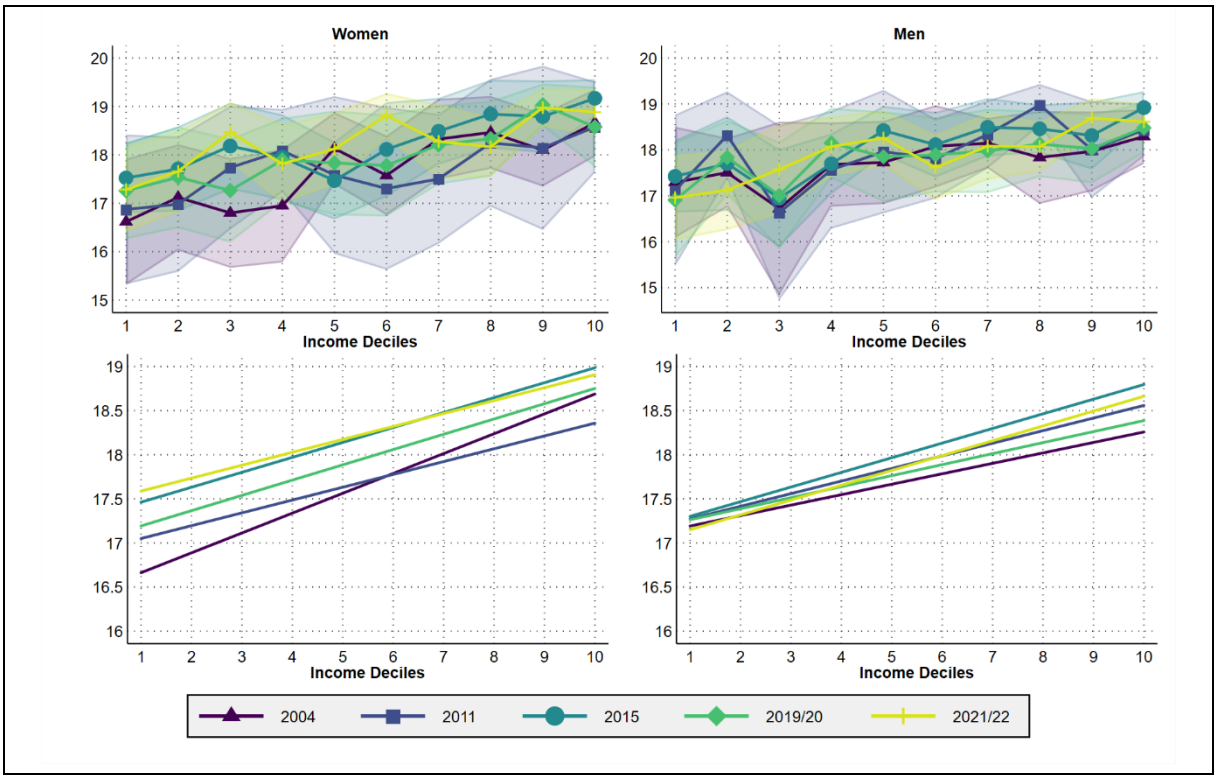
## 4. The income-health gradient by income decile

We first construct health-income gradients by plotting the five health measures against the income deciles, and investigate whether the slopes of these gradients become steeper during the period of pension reforms in Germany.

Figures 2 and 3 display the change of functional health over time and by income decile. The left panel of Figure 2 refers to women, the right to men. The raw data and their 95 percent confidence intervals are plotted in the upper part of the figure, and a linear regression is displayed in the lower part. We select

five waves (Wave 1 in 2004, Wave 4 in 2011, Wave 6 in 2015, Wave 8 in 2019/20, and Wave 9 in 2021/22) to limit clutter. Figure 3 shows all waves.

**Figure 2. Functional health** based on the number of functional limitations



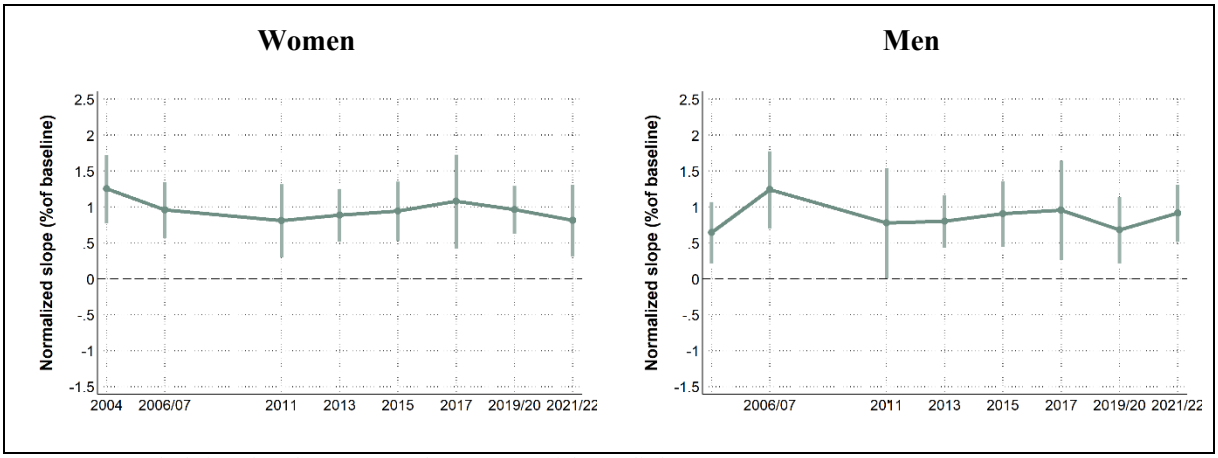

**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** In the upper panel, we plot the mean health status by income group over waves with the shaded areas depicting 95%-confidence bands around these means. In the lower panel, we plot a linear regression of the health status on income deciles and call this the *health gradient*.

Functional health has improved in the 18 years between Wave 1 and Wave 9. This is most clearly visible for women, with the regression line of Wave 9 in 2021/22 above the regression line for Wave 1 in 2004. There is no indication of an increase in the slope for women. Just the opposite: the slope of the regression line in 2004 is much steeper than for the other waves, which display an almost parallel shift to better health for all income deciles.

For men, the regression lines for each wave are more similar than for women, and differences are hardly visible. We therefore draw the slopes by wave in Figure 3 with their confidence intervals. Slopes are normalized by dividing by the mean in Wave 9. There is no significant increase of the slope over time that would indicate an increase in health inequality.

**Figure 3:** Steepness of health-income gradient by wave, functional health

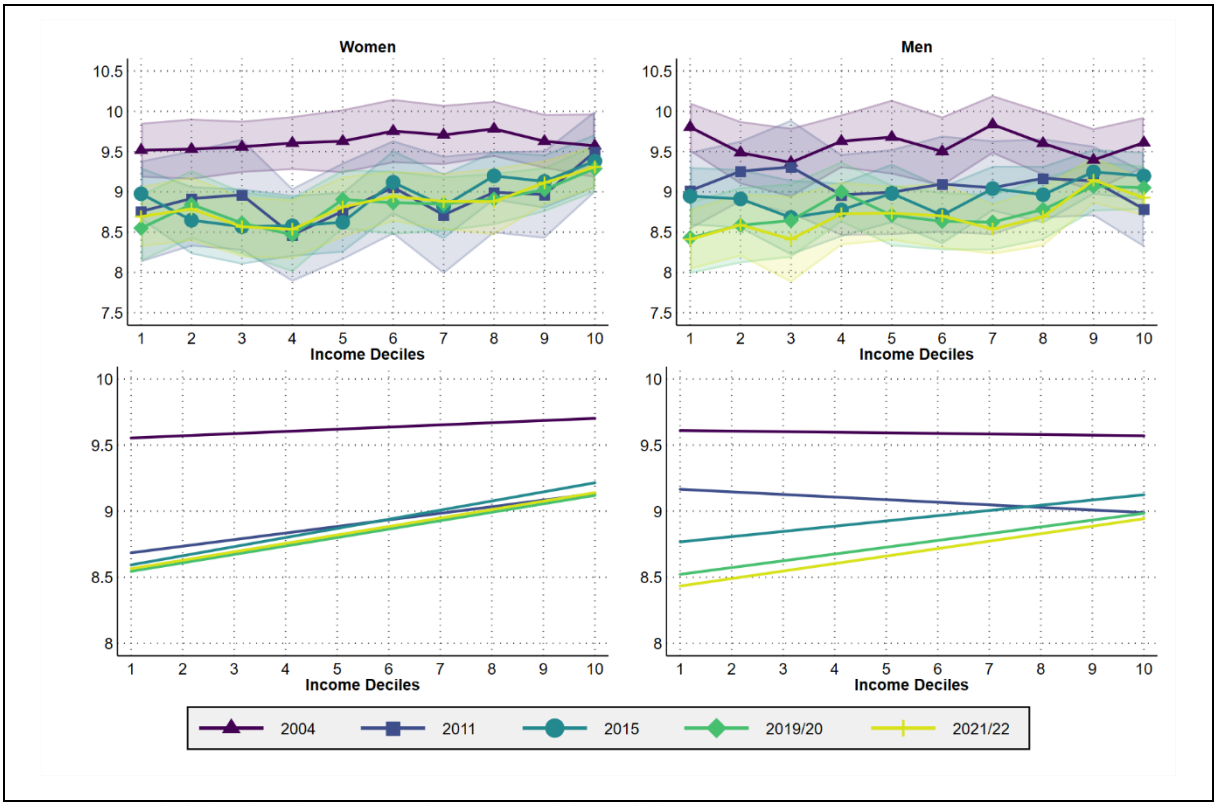



**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** We depict the slopes and the 95% confidence intervals over the years, which we retrieved from a linear regression of the health status on income deciles. The slopes are normalized by dividing them by the mean of the health outcome in Wave 9.

Figures 4 and 5 display diagnosed health, based on the number of conditions that a doctor has told the respondent. Wave 1 in 2004 features a much higher number (and similar Wave 2 in 2006). This is mostly due to the construction of this measure, since a one-time condition will trigger the measure to be one for the rest of the respondents' lives.

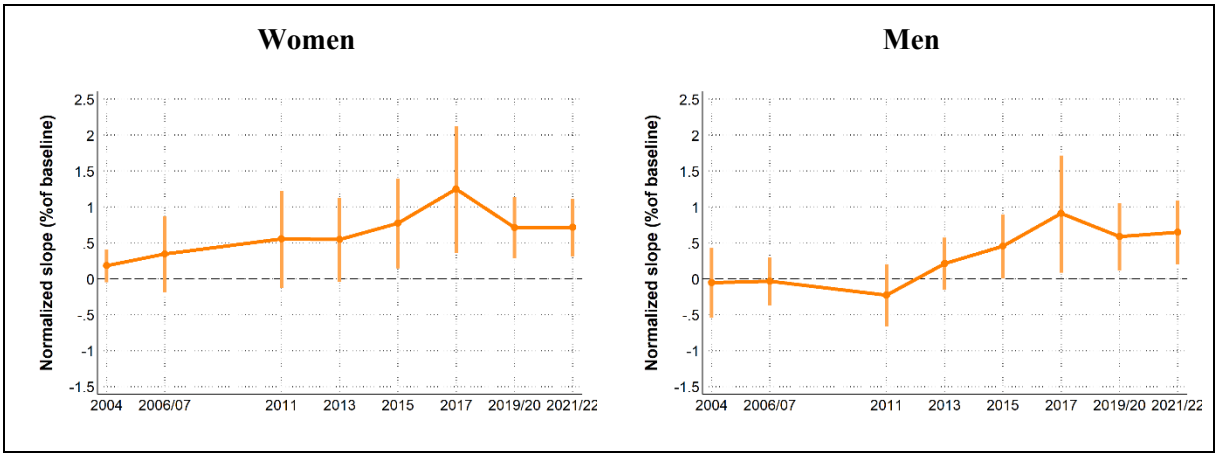
**Figure 4. Diagnosed health** based on number conditions told by doctor




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** In the upper panel, we plot the mean health status by income group over waves with the shaded areas depicting 95%-confidence bands around these means. In the lower panel, we plot a linear regression of the health status on income deciles and call this the *health gradient*.

**Figure 5:** Steepness of health-income gradient by wave, Diagnosed health

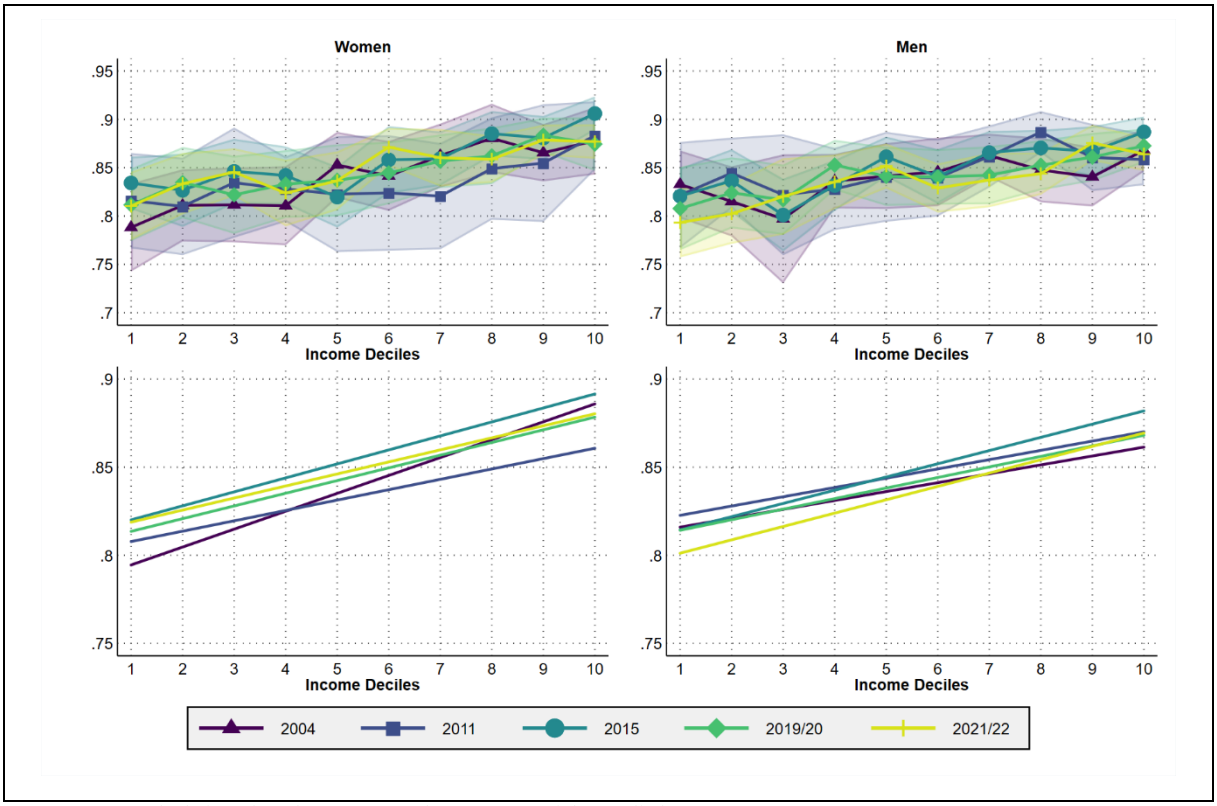



**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** We depict the slopes and the 95% confidence intervals over the years, which we retrieved from a linear regression of the health status on income deciles. The slopes are normalized by dividing them by the mean of the health outcome in Wave 9.

Figure 5 shows an increase in the slope for both women and men between 2004 and 2017, followed by a decline. However, this increase is not significant in the sense that a flat line would still fit into the range of the 95 percent confidence intervals.

**Figure 6.** Comprehensive health based on the health-deficiency index

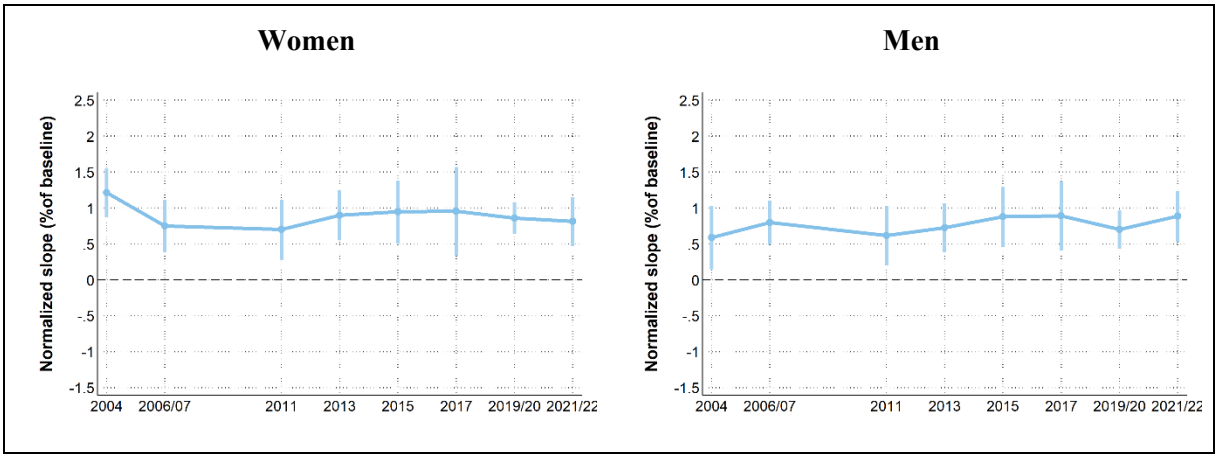



**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** In the upper panel, we plot the mean health status by income group over waves with the shaded areas depicting 95%-confidence bands around these means. In the lower panel, we plot a linear regression of the health status on income deciles and call this the *health gradient*.

Diagnosed health, based on doctors' diagnoses (Figures 6 and 7), shows a slight increase in the slope for men, but it is insignificant, and none for women.

**Figure 7:** Steepness of health-income gradient by wave, Comprehensive health

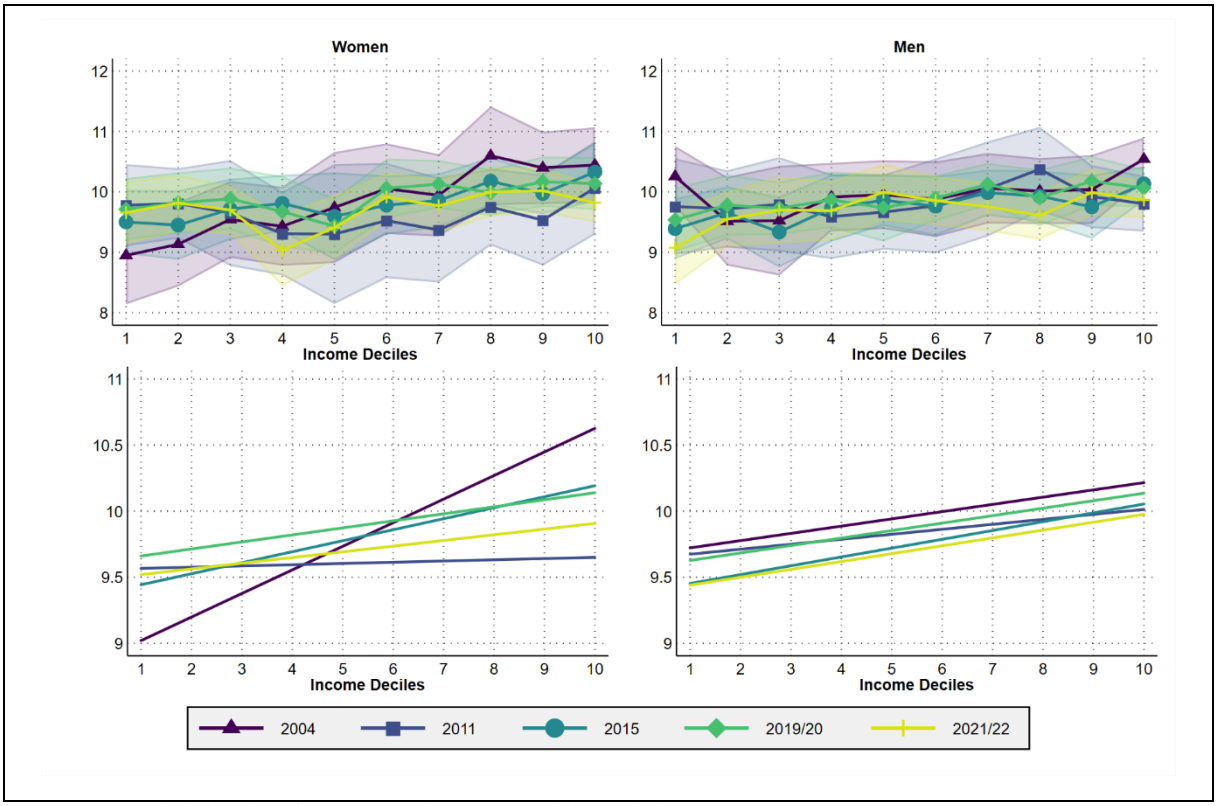



**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** We depict the slopes and the 95% confidence intervals over the years, which we retrieved from a linear regression of the health status on income deciles. The slopes are normalized by dividing them by the mean of the health outcome in Wave 9.

Figures 8 and 9 are devoted to mental health as measured by the Euro-D scale. There is no discernible increase in the slope of the health-income gradient.

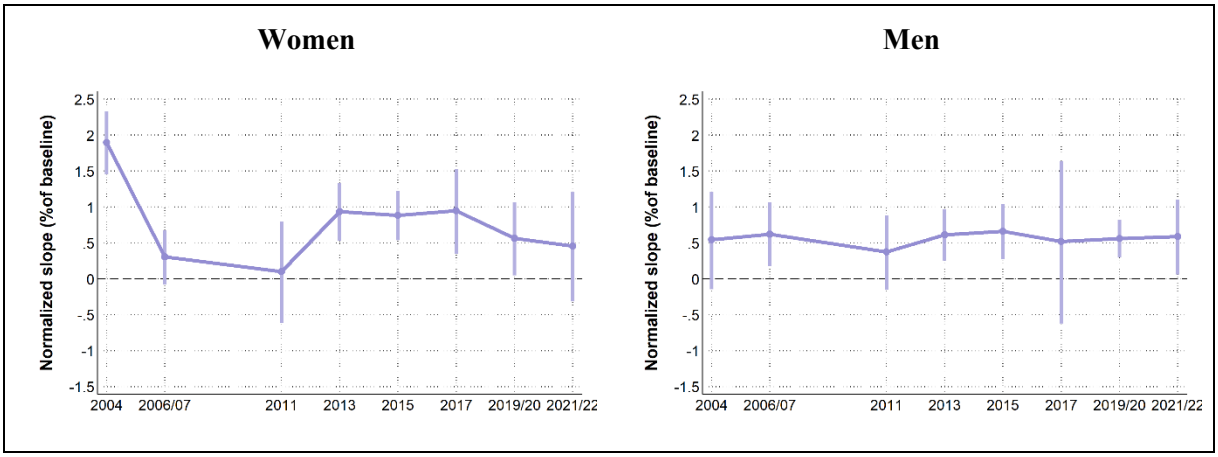
**Figure 8.** Mental health based on Euro-D scale




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** In the upper panel, we plot the mean health status by income group over waves with the shaded areas depicting 95%-confidence bands around these means. In the lower panel, we plot a linear regression of the health status on income deciles and call this the *health gradient*.

**Figure 9:** Steepness of health-income gradient by wave, Mental health

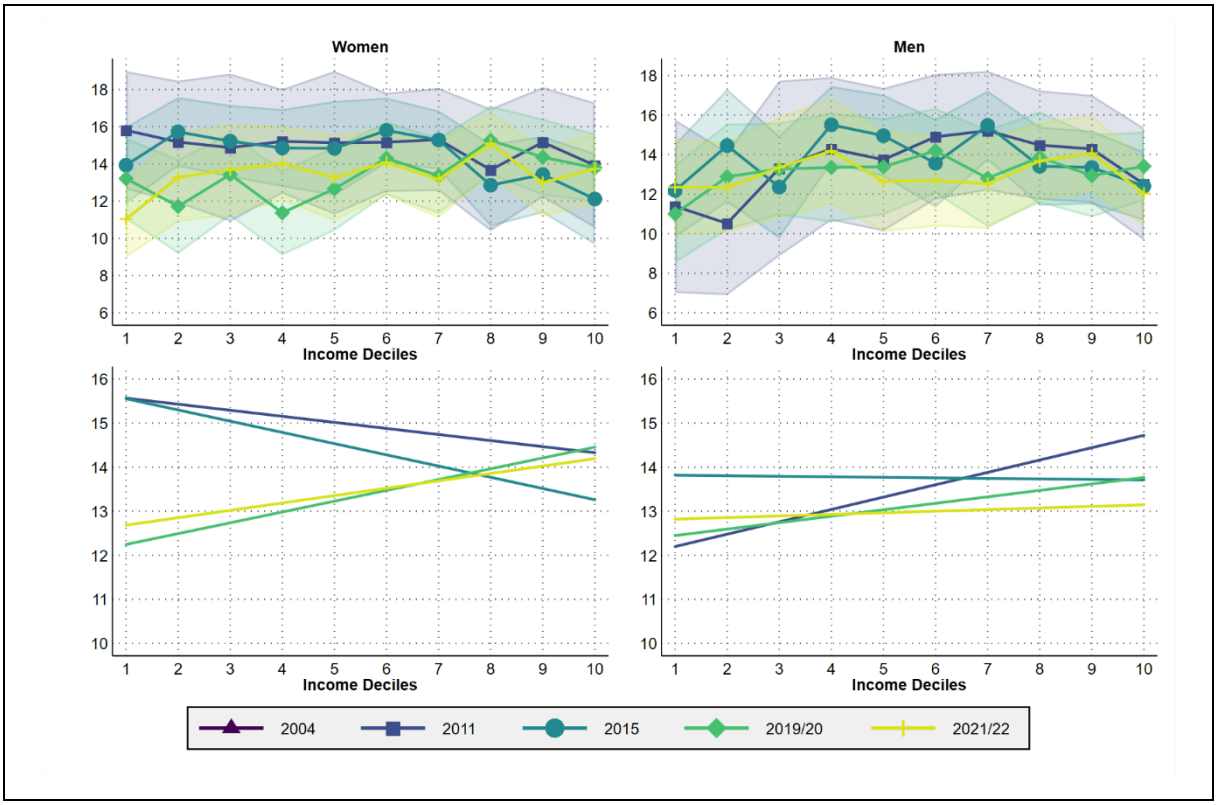



**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** We depict the slopes and the 95% confidence intervals over the years, which we retrieved from a linear regression of the health status on income deciles. The slopes are normalized by dividing them by the mean of the health outcome in Wave 9.

Finally, Figures 10 and 11 display how the distribution of cognitive health by income decile has developed over time. Note that we only have consistent data from Wave 4 onwards. The data is very noisy and some slopes are negative. For men, there is no sign of an increasing inequality. For women, there is a strong increase from the negative to the positive slopes, but it is not significant since one could not reject the hypothesis that the slope is flat.

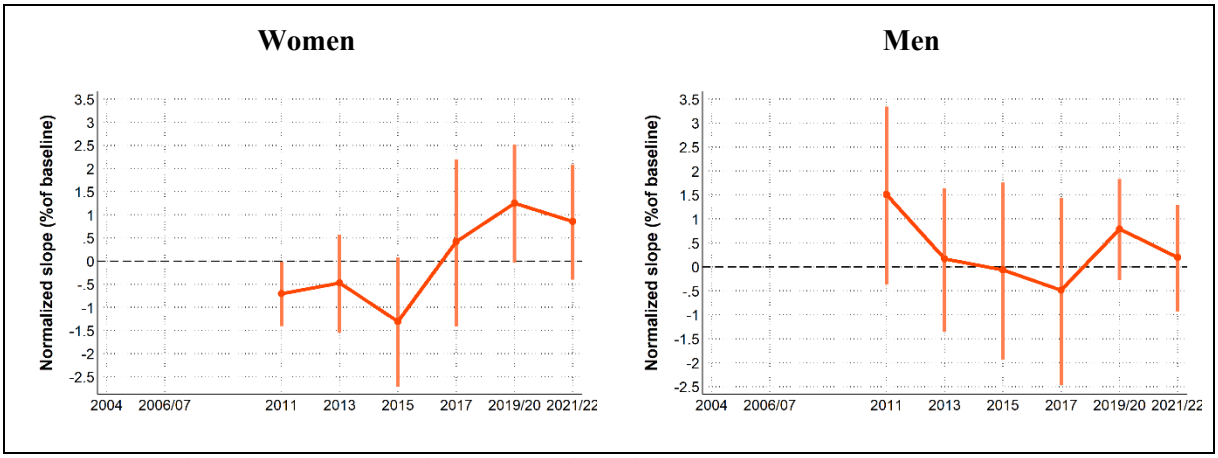
**Figure 10.** Cognitive health based on word recall and numeracy




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** In the upper panel, we plot the mean health status by income group over waves with the shaded areas depicting 95%-confidence bands around these means. In the lower panel, we plot a linear regression of the health status on income deciles and call this the *health gradient*.

**Figure 11:** Steepness of health-income gradient by wave, Cognitive health




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** We depict the slopes and the 95% confidence intervals over the years, which we retrieved from a linear regression of the health status on income deciles. The slopes are normalized by dividing them by the mean of the health outcome in Wave 9.

## 5. Number of years needed for poorer individuals to catch up with the health of richer individuals

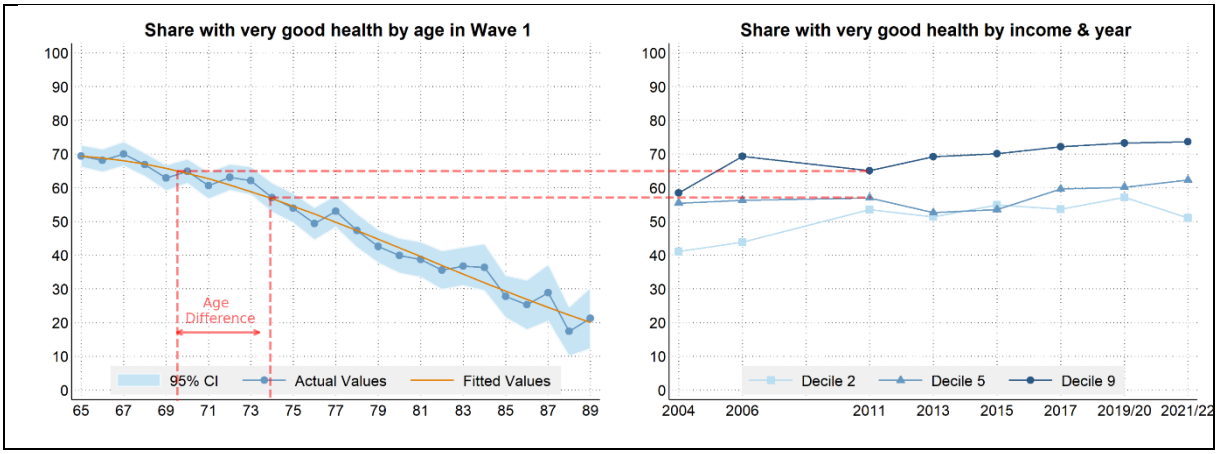
While we could not detect significant changes in health inequality, the preceding section showed substantial levels of health inequalities by income group for all five measures. The aim of this section is to convert the level differences into a metric that is comparable across health measures and has a real world meaning.

Figure 12 is based on functional health and serves as an example. We define "very good" functional health as having a functional health score that is better than the 66$^{th}$ percentile in the total distribution of all individuals age 65-89 in Wave 1, where we pool women and men. The left panel shows how the share of respondents with very good functional health declines by age. In the right panel, we show how this share changes over time for the second, the fifth and the ninth income decile. We then translate the differences between income deciles in the right panel into life years of the left panel, i.e., we calculate how many years earlier will an individual in the second decile be of the same health status than a much healthier individual in the fifth or ninth income decile. We call it the catch-up time: the number of years that a poorer individual would need to catch up to the same level of health as a richer individual.

In our example, the share of individuals with excellent functional health in Wave 4 (2011) is about 8 percentage points higher for the ninth income decile than for the fifth decile (right panel of Figure 12). This corresponds to 4.4 years longer in the state of very good health (left panel).

We do the same exercise for the difference between the second and the fifth, and then the large difference between the second and the ninth decile, and then continue for the other four health measures. Figures 12 through 16 show strictly declining health as age increases, and in general the expected line-up of health in the second, fifth and ninth income deciles.

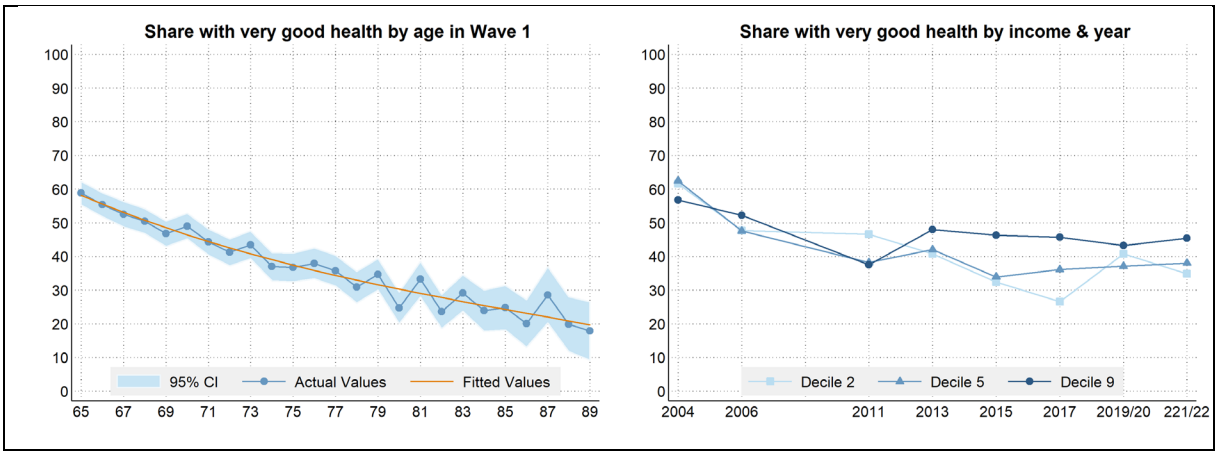
**Figure 12.** Functional health




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** The left panel shows the share of individuals in very good health (defined as the top 34% of the distribution) in 2004, by age. The right panel shows the share of respondents who are in very good health by three income groups over the years. How our measure *catch-up time* is translated from the difference being in good share by income decile in years of aging is depicted as an example in 2011 for the difference between Decile 9 and Decile 2 by the red lines.

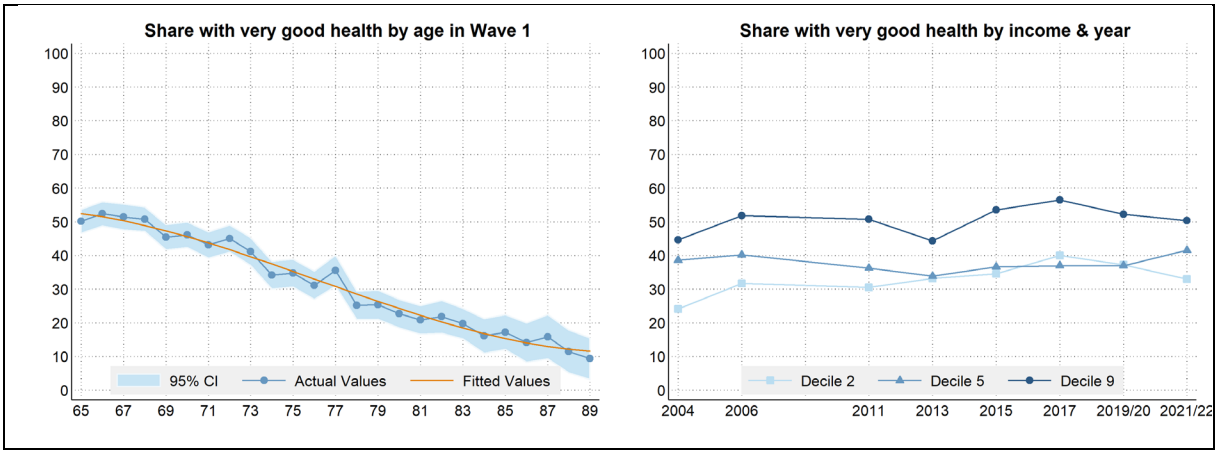
**Figure 13.** Diagnosed health




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** The left panel shows the share of individuals in very good health (defined as the top 34% of the distribution) in 2004, by age. The right panel shows the share of respondents who are in very good health by three income groups over the years.

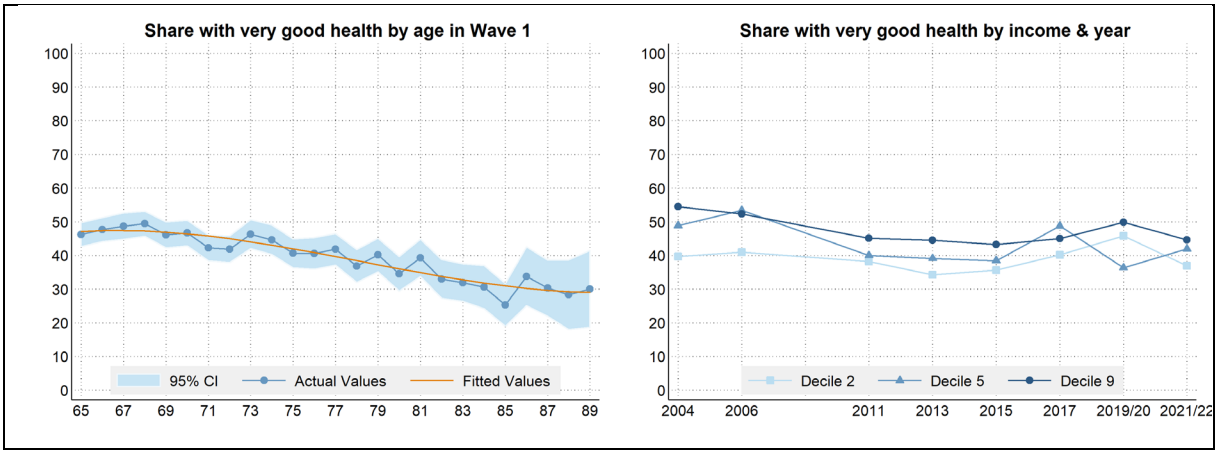
**Figure 14.** Comprehensive health




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** The left panel shows the share of individuals in very good health (defined as the top 34% of the distribution) in 2004, by age. The right panel shows the share of respondents who are in very good health by three income groups over the years.

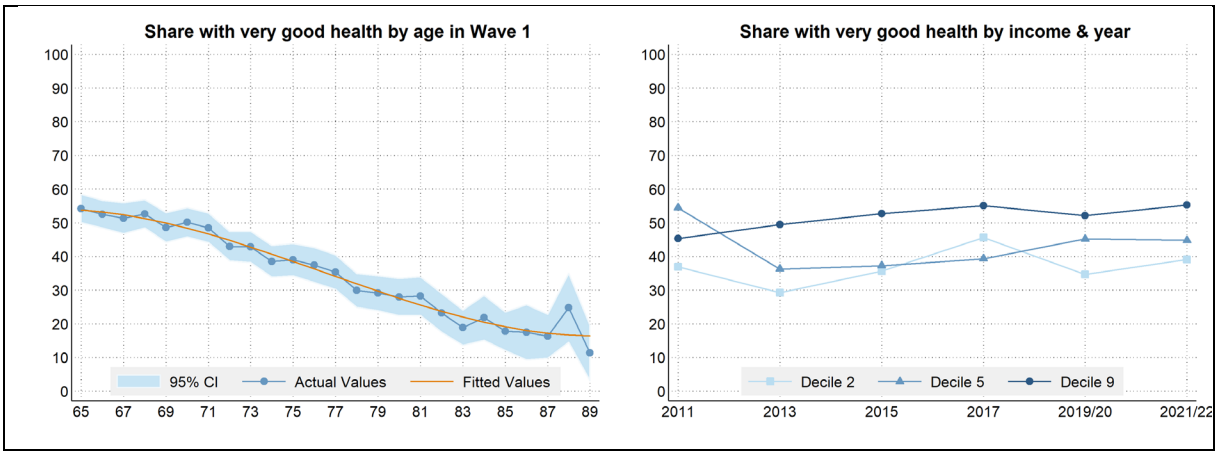
**Figure 15.** Mental health




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** The left panel shows the share of individuals in very good health (defined as the top 34% of the distribution) in 2004, by age. The right panel shows the share of respondents who are in very good health by three income groups over the years.

**Figure 16.** Cognitive health




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** The left panel shows the share of individuals in very good health (defined as the top 34% of the distribution) in 2004, by age. The right panel shows the share of respondents who are in very good health by three income groups over the years.

We summarize these results in Table 2, which displays all differences between the second, fifth, and ninth deciles expressed as the number of years to catch up, for all five health measures. We consider the years 2004 (Wave 1), 2011 (Wave 4) and 2021/22 (Wave 9). Moreover, in addition to "very good" health (i.e., health in the top 34 percent of the health distribution), we also display results for only "good" health as defined by the upper 66 percent of the health distribution. Note that cognitive health is not available for the first wave in 2004.

Some of these differences are strikingly large. The pattern of change, however, is rather mixed, as summarized in Table 3. It does not support the notion of a consistent increase in health inequality.

**Table 2.** Catch-up years

**a) % in excellent health (>66% percentile in Wave 1)**

| | 2004 | | | 2011 | | | 2021/22 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2nd to 5th | 2nd to 9th | 5th to 9th | 2nd to 5th | 2nd to 9th | 5th to 9th | 2nd to 5th | 2nd to 9th | 5th to 9th |
| Functional health | 5.7 | 7.1 | 1.4 | 1.5 | 5.9 | 4.4 | 5.2 | 11.5 | 6.3 |
| Diagnosed health | 0.0 | -0.4 | -0.4 | -4.5 | -4.9 | -0.4 | 2.0 | 6.0 | 4.0 |
| Comprehensive health | 6.5 | 9.4 | 2.9 | 2.5 | 10.3 | 7.8 | 3.8 | 8.9 | 5.1 |
| Mental health | 12.0 | 12.0 | 0.0 | 1.5 | 6.4 | 4.9 | 4.2 | 6.9 | 2.7 |
| Cognitive health | - | - | - | 10.7 | 4.0 | -6.7 | 2.7 | 9.7 | 7.0 |

**b) % in good health (>33% percentile in Wave 1)**

| | 2004 | | | 2011 | | | 2021/22 | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2nd to 5th | 2nd to 9th | 5th to 9th | 2nd to 5th | 2nd to 9th | 5th to 9th | 2nd to 5th | 2nd to 9th | 5th to 9th |
| Functional health | 8.4 | 8.0 | -0.4 | 4.6 | 7.8 | 3.3 | 8.9 | 12.7 | 3.8 |
| Diagnosed health | 0.1 | 0.1 | 0.0 | -2.5 | 0.1 | 2.6 | 2.1 | 6.4 | 4.3 |
| Comprehensive health | 8.1 | 8.3 | 0.2 | 5.0 | 11.1 | 6.0 | 5.6 | 12.8 | 7.2 |
| Mental health | 14.5 | 25.0 | 10.5 | -3.4 | 2.1 | 5.5 | -0.2 | 10.8 | 11.1 |
| Cognitive health | - | - | - | 5.3 | 2.9 | -2.4 | 3.9 | 8.8 | 4.9 |

**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** This table displays the catch-up years for the second, fifth, and ninth income deciles in 2004, 2011, and 2021/22, respectively. It can be read as follows: For respondents in 2004, the difference in health between the second and the fifth income deciles would amount to 5.7 years of aging. For cognitive health, we have information on the health status only from 2011 onward.

**Table 3.** Change in catch-up years from 2004 to 2021/22

| | Very good health | | | Good health | | |
|---|---|---|---|---|---|---|
| | 2nd to 5th | 2nd to 9th | 5th to 9th | 2nd to 5th | 2nd to 9th | 5th to 9th |
| Functional health | -0.5 | 4.4 | 4.9 | 0.5 | 4.7 | 4.2 |
| Diagnosed health | 2 | 6.4 | 4.4 | 2 | 6.3 | 4.3 |
| Comprehensive health | -2.7 | -0.5 | 2.2 | -2.5 | 4.5 | 7 |
| Mental health | -7.8 | -5.1 | 2.7 | -14.7 | -14.2 | 0.6 |
| **Average** | -2.25 | 1.3 | 3.55 | -3.675 | 0.325 | 4.025 |

**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** This table summarizes how catch-up years changed between 2004 and 2021/22 for very good health (being in the top 34% distribution relative to the Wave 1 distribution) and good health (being in the top 67% distribution). Cognitive health is missing in this table as it can be measured only from 2011 onward.

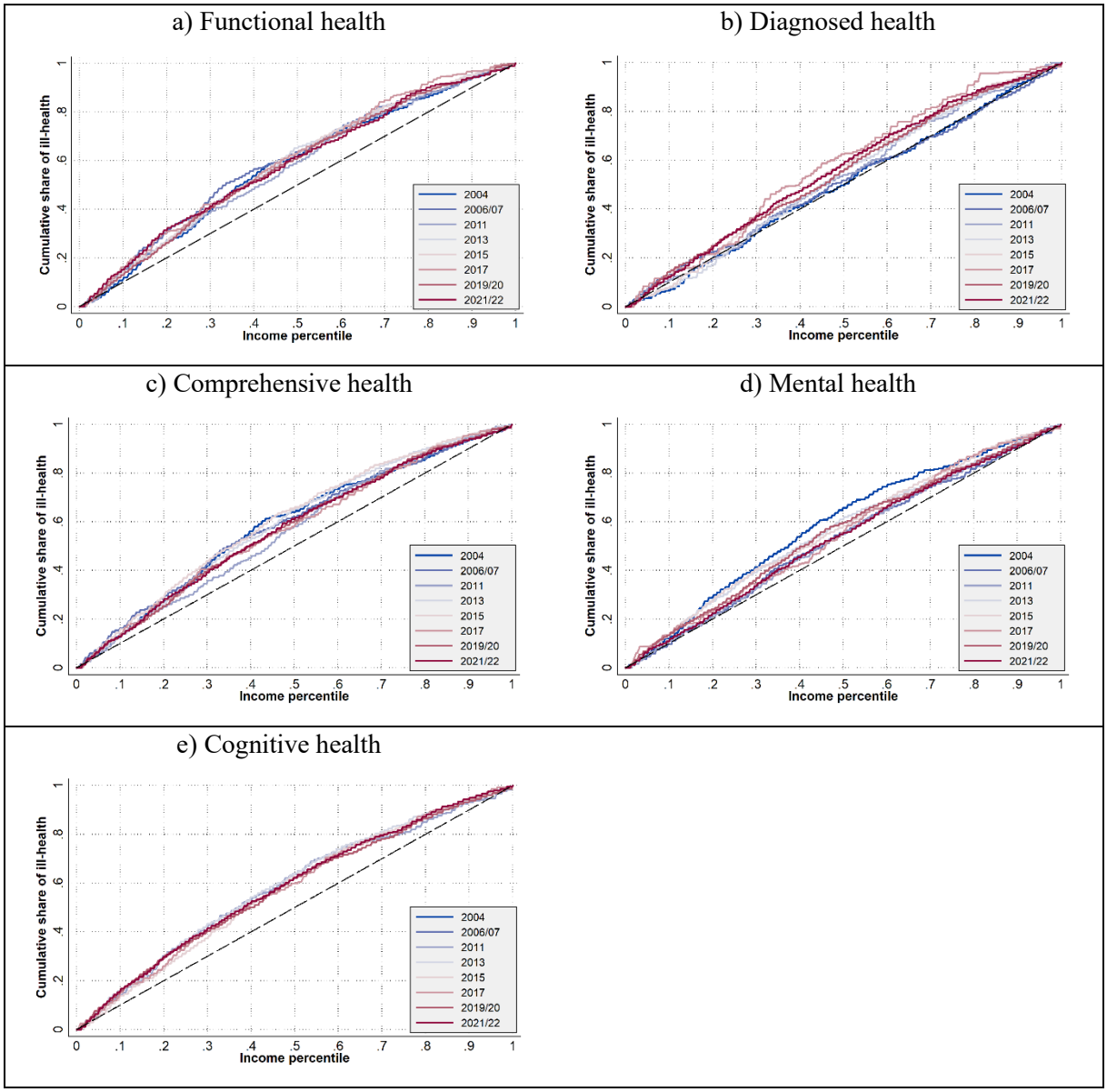
## 6. Concentration indices

Another way to measure inequality is based on the concentration curve, a variant of the Lorenz curve. The concentration index *CI* – hence the correspondence to the Gini coefficient – is defined as

$$CI = \frac{1}{n}\sum_{i=1}^{n}\frac{h_i}{\bar{h}}(2R_i - 1)$$

where $h_i$ is the health status of individual *i* and $R_i$ the income percentile of individual *i*.

**Figure 17.** Concentration indices




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

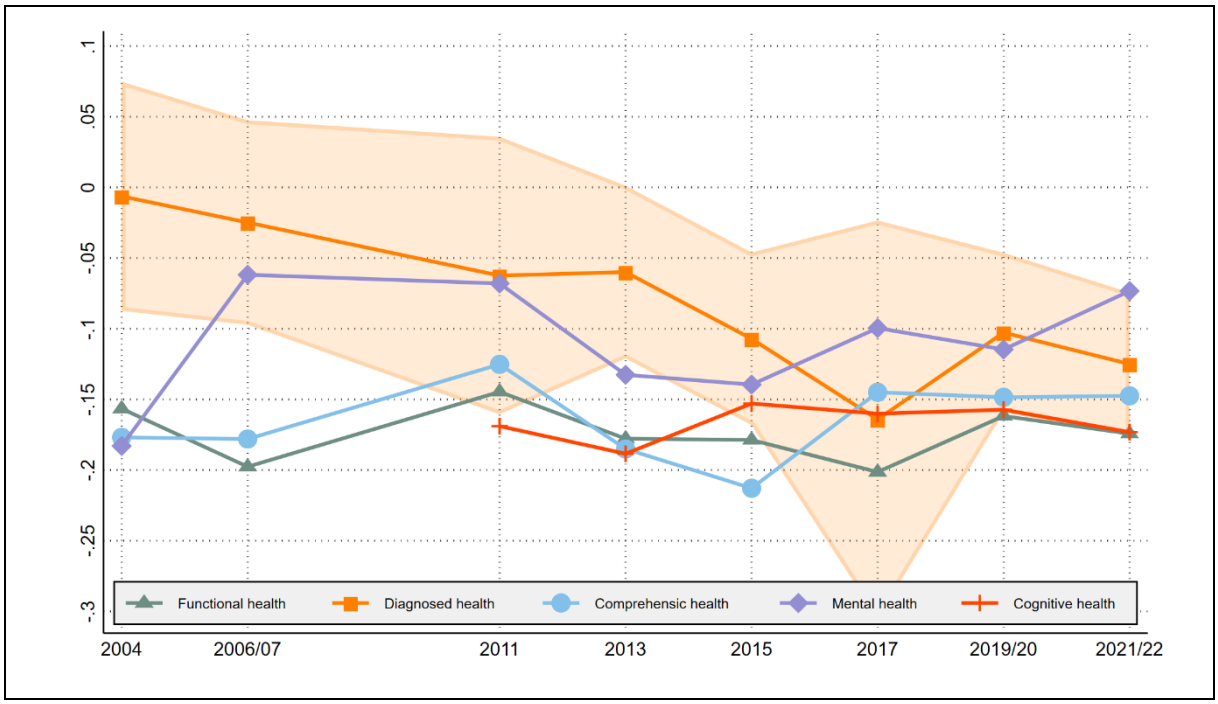
**Note.** These graphs show the concentration curves, which plot the cumulative share of individuals with bad health against the percentiles of income. No inequality is represented by the 45 degree line. The further the concentration curve is to the left of the 45 degree line, the more inequality is present.

Figure 17 shows the concentration curve for each wave of the SHARE data. It plots the cumulative share of individuals with bad health against the percentiles of income. No inequality is represented by the 45 degree line. The further the concentration curve is to the left of the 45 degree line, the more inequality is present.

A visual inspection of the curves yields no discernible changes between waves for functional health, comprehensive health, and cognitive health, while diagnosed and mental health show differences but in opposite directions.

Figure 18 displays the development of the concentration indices from wave to wave for the five health measures. Zero implies perfect equality. A larger inequality implies a more negative value of the concentration index. Only the concentration index based on diagnosed health (calculated from the number of conditions told by a doctor) shows an unambiguous decline and thus an increase in health inequality, while all four other health measures are essentially flat. However, the 95-percent confidence intervals are large, and the hypothesis that the change of diagnosed health from 2004 to 2021/22 is flat cannot be rejected. The full list of concentration indices, including all 95%-confidence intervals, can be found in Appendix Table A3.

**Figure 18.** Concentration indices over waves




**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** This graph shows the concentration indices over years by health outcome. Lower values indicate more inequality. We depict the 95%-confidence interval only for diagnosed health, as it is the only health outcome that does not appear to be flat.

## 7. Conclusions

This paper investigated the impact of benefit-reducing and retirement-age-increasing pension reforms on health inequality among retirees in Germany. We used panel data provided by the Survey of Health, Ageing and Retirement in Europe (SHARE) that span the time between 2004 and 2022 and five different health measures, including functional, mental and cognitive health. All five measures displayed substantial health inequality by income decile. Our research question was then whether this inequality has increased over time, and, if so, could it be due to pension reform?

We first looked whether the steepness of the health-income gradient increased. We could not reject the hypothesis that the health-income gradient remained flat from 2004 through 2022. We then computed the number of years for individuals in a lower income bracket needed to catch up with the health of individuals in a higher income bracket. We neither found a systematic pattern nor a statistically significant measure that would indicate that these years to catch up increased from 2004 to 2022. Finally, we computed the concentration index of health by income. It stayed flat from 2004 to 2022 for four out of five health measures. Only the number of conditions diagnosed by a doctor increased, but insignificantly so. We conclude that health inequality has neither significantly nor materially increased during the time period in which benefits decreased and retirement ages went up.

There are two main caveats. First, the data is rather noisy. We find irregular patterns in the data, such as negative health-income gradients and frequent ups and downs in our inequality measures. Second, the data may mask heterogeneities. There may well be occupation groups which have suffered from the pension reforms. Examples are blue collar jobs such as construction or steel workers. The sample size (some 5,400 individuals) is sufficiently large to separate healthy and unhealthy individuals in each income decile, but not large enough to further stratify by occupation. Arduous jobs make up only a small share of all occupations in Germany.[4] Hence, while reducing pension benefits and increasing the retirement age may be a policy option without negative health effects for most, policy makers may want to combine them with special programs if they want to protect workers in arduous occupations.

[4] Germany has no official definition of "arduous jobs". Neighboring Austria has a special pathway to retirement for arduous jobs ("Schwerarbeit"). The share of such pensions is 6.2% (https://diesubstanz.at/soziales-pensionen/schwerarbeitspension-weniger-zugaenge/).

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## 9. Appendix

**Table A1 –** List functional health

| | | | |
|---|---|---|---|
| ph048d1 | Walking 100 meters | ph049d1 | Dressing, including putting on shoes and socks |
| ph048d2 | Sitting for about two hours | ph049d2 | Walking across a room |
| ph048d3 | Getting up from a chair after sitting for longer periods | ph049d3 | Bathing or showering |
| ph048d4 | Climbing several flights of stairs without resting | ph049d4 | Eating, such as cutting up your food |
| ph048d5 | Climbing one flight of stairs without resting | ph049d5 | Getting in or out of bed |
| ph048d6 | Stooping, kneeling, or crouching | ph049d6 | Using the toilet, including getting up or down |
| ph048d7 | Reaching or extending your arms above shoulder level | ph049d7 | Using a map to figure out how to get around in a strange place |
| ph048d8 | Pulling or pushing large objects like a living room chair | ph049d8 | Preparing a hot meal |
| ph048d9 | Lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries | ph049d9 | Shopping for groceries |
| ph048d10 | Picking up a small coin from a table | ph049d10 | Making telephone calls |

**Table A2 –** List comprehensive health

| | | | |
|---|---|---|---|
| ph006d1 | A heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure | ph006d10 | Cancer or malignant tumour, including leukaemia or lymphoma, but excluding minor skin cancers |
| ph006d2 | High blood pressure or hypertension | ph006d11 | Stomach or duodenal ulcer, peptic ulcer |
| ph006d3 | High blood cholesterol | ph006d12 | Parkinson disease |
| ph006d4 | A stroke or cerebral vascular disease | ph006d13 | Cataracts |
| ph006d5 | Diabetes or high blood sugar | ph006d14 | Hip fracture or femoral fracture |
| ph006d6 | Chronic lung disease such as chronic bronchitis or emphysema | | |

**Table A3 –** Concentration indices

| | 2004 | | 2006/07 | | 2011 | | 2013 | | 2015 | | 2017 | | 2018/19 | | 2021/22 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Conc. Index** | **95%-CI** | **Conc. Index** | **95%-CI** | **Conc. Index** | **95%-CI** | **Conc. Index** | **95%-CI** | **Conc. Index** | **95%-CI** | **Conc. Index** | **95%-CI** | **Conc. Index** | **95%-CI** | **Conc. Index** | **95%-CI** |
| **Functional Health** | -0.157 | [-0.219, -0.094] | -0.198 | [-0.272, -0.123] | -0.145 | [-0.228, -0.061] | -0.178 | [-0.229, -0.127] | -0.179 | [-0.228, -0.13] | -0.201 | [-0.31, -0.093] | -0.162 | [-0.208, -0.115] | -0.174 | [-0.228, -0.12] |
| **Diagnosed Health** | -0.006 | [-0.087, 0.075] | -0.025 | [-0.097, 0.047] | -0.062 | [-0.161, 0.036] | -0.06 | [-0.121, 0.001] | -0.107 | [-0.168, -0.046] | -0.129 | [-0.221, -0.037] | -0.103 | [-0.159, -0.046] | -0.125 | [-0.176, -0.074] |
| **Comprehensive Health** | -0.177 | [-0.238, -0.115] | -0.178 | [-0.247, -0.109] | -0.125 | [-0.201, -0.05] | -0.185 | [-0.23, -0.14] | -0.213 | [-0.263, -0.163] | -0.143 | [-0.235, -0.051] | -0.149 | [-0.195, -0.102] | -0.147 | [-0.193, -0.102] |
| **Mental Health** | -0.183 | [-0.251, -0.115] | -0.062 | [-0.141, 0.017] | -0.068 | [-0.142, 0.006] | -0.133 | [-0.182, -0.083] | -0.14 | [-0.193, -0.086] | -0.1 | [-0.204, 0.004] | -0.115 | [-0.17, -0.06] | -0.073 | [-0.121, -0.026] |
| **Cognitive Health** | | | | | -0.169 | [-0.257, -0.081] | -0.188 | [-0.242, -0.135] | -0.153 | [-0.208, -0.098] | -0.16 | [-0.26, -0.06] | -0.157 | [-0.206, -0.108] | -0.173 | [-0.221, -0.126] |

**Source.** Own calculations, based on SHARE release 9.0.0. Weights applied.

**Note.** This table lists the concentration indices for our five health measures over years. Cognitive health includes serial-7s, which is available in SHARE only from 2011 onward. Lower values indicate more inequality.