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Educational inequalities in subjective health in Germany from 1994 to 2014: a trend analysis using the German Socio-Economic Panel study (GSOEP)

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ABSTRACT

Introduction As trend studies have shown, health inequalities by income and occupation have widened or remained stable. However, research on time trends in educational inequalities in health in Germany is scarce. The aim of this study is to analyse how educational inequalities in health evolved over a period of 21 years in the middle-aged population in Germany, and whether the trends differ by gender.

Methods Data were obtained from the German Socio-Economic Panel covering the period from 1994 to 2014. In total, n=16 339 participants (106 221 person years) aged 30–49 years were included in the study sample. Educational level was measured based on the 'Comparative Analysis of Social Mobility in Industrial Nations' (CASMIN) classification. Health outcomes were self-rated health (SRH) as well as (mental and physical) health-related quality of life (HRQOL, SF-12v2). Absolute Index of Inequality (Slope Index of Inequality (SII)) and Relative Index of Inequality (RII) were calculated using linear and logarithmic regression analyses with robust SEs.

Results Significant educational inequalities in SRH and physical HRQOL were found for almost every survey year from 1994 to 2014. Relative inequalities in SRH ranged from 1.50 to 2.10 in men and 1.25 to 1.87 in women (RII). Regarding physical HRQOL, the lowest educational group yielded 4.5 to 6.6 points (men) and 3.3 to 6.1 points (women) lower scores (SII). Although educational level increased over time, absolute and relative health inequalities remained largely stable over the last 21 years. For mental HRQOL, only few educational inequalities were found.

Discussion This study found persistent educational inequalities in SRH and physical HRQOL among adults in Germany from 1994 to 2014. Our findings highlight the need to intensify efforts in social and health policies to tackle these persistent inequalities.

Strengths and limitations of this study

► This is among the first study examining trends in educational inequalities in SRH and mental and physical health-related quality of life in Germany.
► We used a large sample size representing the German population and offering the opportunity for a trend analysis covering 21 years (1994–2014) regarding different measures of health.
► No clear trend is evident in our results which might be explained by outlier values in some years.

increased over the last few decades.[2 5 8–13] This applies for adults' and adolescents' health.[14 15] However, the extent of inequalities depends eg, on gender, health measures, indicators of socioeconomic status as well as on relative or absolute measures of inequalities. For example, educational inequalities in SRH increased in Swedish women between 2000 and 2008, but remained stable in Swedish men.[5] Another study showed that in many European countries relative inequalities in mortality increased, while absolute inequalities in mortality decreased.[3] Furthermore, Dalstra et al,[16] analysing trends from the 1980s to the 1990s in the Netherlands, found that inequalities in SRH were more pronounced for income than for educational level. Additionally, different results were observed for different health outcomes. While social inequalities in SRH increased over time, other outcomes (eg, short-term and long-term health problems and chronic diseases) remained stable.

In the last few decades, several large societal changes have occurred in Germany. After the reunification of West and East Germany in 1990, the government faced slow economic growth, rising unemployment and debt.[17 18] Current research shows that income inequality increased in

INTRODUCTION

The existence of socioeconomic inequalities in health in Europe is well established[1 2] for a variety of health indicators, such as premature mortality,[3 4] morbidity[2] and self-rated health (SRH).[5–7] Most studies have revealed that these inequalities are stable or have

Germany from 1994 to 2013.[19] Until now, only a few studies have analysed trends in health inequalities in Germany, reporting stable[20] or increasing inequalities.[18 21] For example, inequalities in SRH by employment status increased between 1994 and 2008 in women in general and in men aged 30–59 years.[18] Another study revealed that income-related inequalities in SRH roughly doubled from 1994 to 2011.[21]

The majority of studies on this topic have focused on occupational or income-related inequalities in SRH in Germany. Less attention has been paid to educational inequalities. However, educational level is strongly related to social background[22] and can be considered as the foundation determining the opportunities for occupational status and income level and therefore also for standard of living and quality of life.[23] Since the 1950s, there has been an increasing participation in higher education which has resulted in an educational expansion in Germany. While the lowest educational track (lower secondary school) is now less pronounced, the participation in the highest educational track rose during that time.[24] A declining share of low educated people in a population has been suggested to increase negative selection into this group which may contribute to widening educational inequalities in health.[25–27] Besides the general increase in the number of higher educational degrees, a gender-specific development was also visible. While men showed higher educational attainment for a long period of time, women started catching up with them beginning in the late 1950s, with degrees of education being almost equal now. Therefore, gender needs to be taken into account when studying trends in education.[24]

A higher educational level is often associated with better health and health behaviour. However, the link between education and health is complex. Studies have found that different mechanisms mediate this relationship. Education is associated with different material, psychosocial and behavioural factors which in turn affect SRH.[23 28 29] Well-educated people have more advantages regarding these factors, for example, a healthier lifestyle which results in better health (mediation). However, moderating effects were also found, implying that the effects of lifestyle factors on health are at least partially dependent on educational level.[30] In addition, cognitive ability was found to be important for educational attainment and to enhance personal care of one's own health and well-being, for example, regarding a better understanding of educations messages and prevention. Education also increases a person's sense of control over his/her life, including better analytical and communication skills. A lack of personal control can be perceived as a stressor with negative physiological consequences.[22 31]

Analysing trends in health inequalities is essential for investigations into whether differences in health have changed and whether policy strategies have been successful in tackling inequalities affecting health.[12 13]

To date, existing trend analyses have either focused on adolescents[14 15] or have taken a wide age range into account.[17 21] The present study pays special attention to the middle-aged group of men and women (aged 30–49 years). This age group represents a highly important life period where work (eg, consolidation in the labour market) and private responsibilities (eg, having children) are very demanding. However, only limited information is available for this specific age group. The aim of this study is therefore (1) to analyse whether educational inequalities exist in three measures of subjective health (SRH, mental and physical health-related quality of life (HRQOL)) among early middle-aged adults in Germany between 1994 and 2014, (2) whether they have changed over 21 years and (3) whether the observed trends are consistent for both genders regarding SRH and HRQOL. We hypothesise (a) that educational inequalities will be found in all three health outcomes, (b) that these health inequalities either widened or remained stable and (c) that trends of educational inequalities in health will differ by gender.

METHODS
The paper follows the Strengthening the Reporting of Observational Studies in Epidemiology guidelines for reporting observational studies.[32]

Data
The German Socio-Economic Panel (GSOEP) is the largest and longest-running household panel in Germany, having been established in 1984. The GSOEP surveys about 20 000 individuals yearly from more than 10 000 households and represents the residential population of Germany. Each participating household member aged 18 years and older is invited to fill out a personal questionnaire every year that includes a wide range of socioeconomic questions relevant to health. The longitudinal design and annual follow-up of the GSOEP survey offer the possibility to analyse social trends and dynamics.[33] Detailed information about the GSOEP can be found elsewhere.[34]

The analyses were based on 21 waves of the study covering the years 1994 through 2014. A weighting variable was used to facilitate the comparability over time with respect to age, gender, state of residence and refreshments of the survey participants over time.[18] For our analyses, we focused on the age group between 30 and 49 years ($n_{participants}$=16 339), because most people complete their educational training in the middle of their 20s, and it can be assumed that their occupational status stabilises by the age of 30. To avoid bias from the educational effects of including two generations (cohort effect), we limited our age group to 30–49. Cases with missing values on the outcome (203 observations) and/or educational level (27 355 observations) as well as the further independent variables (2484 observations) at annual level were excluded. In total, our analyses on SRH are based on the

data from 16 339 individuals and 106 221 observations of these individuals, respectively, resulting from repeated participation over the whole time period. As physical and mental HRQOL was surveyed only between 2002 and 2014, and only every 2 years, fewer participants ($n_{participants}$=13 099/$n_{observations}$=39 541) were included than for SRH. For the purposes of this study, 'participants' refers to individuals and 'observations' refers to the number of person years we used.

Patient and public involvement

No patients were involved in setting the research question or the outcome measures, nor were they involved in developing plans for design or implementation of the study. No patients were asked to advise on interpretation or writing up of results. There are no plans to disseminate the results of the research to study participants or the relevant patient community.

Measures

Educational level

Educational level was based on the 'Comparative Analysis of Social Mobility in Industrial Nations' (CASMIN) educational classification system and was recoded into 'low', 'medium' and 'high' educational levels.[20,35] The CASMIN classification distinguishes between hierarchically structured educational qualifications and provides international comparability. The high education group is defined as all persons with low or high tertiary degrees, the medium education group consists of those with a vocational degree (intermediate general qualification, intermediate vocational, general maturity certificate, vocational maturity certificate) and the lowest education group includes all respondents with inadequately completed general education, general elementary education or basic vocational qualification.

Self-rated health

SRH was assessed using the question 'How would you describe your current health?' The response options were 'very good', 'good', 'satisfactory', 'poor' and 'bad' and were dichotomised as 'rather good' (first two categories) and 'rather poor' (last three categories).[36] SRH has been shown to be a robust indicator for different health outcomes and a reliable predictor for mortality.[37–39] Data on SRH have been collected annually in the GSOEP since 1994.

HRQOL (SF-12v2) in mental and physical health

The Short Form 12 Health Survey (SF-12) was developed to measure health status based on 12 health-related questions. It is a subset of the SF-36v2 and is considered a reliable measure of overall health status covering two superordinate dimensions of physical and mental health.[40] Both scales have been included in the GSOEP since 2002, and related data were collected every 2 years until 2014. The Mental Component Summary Scale (MCS) measures episodes of emotional problems, melancholy and social limitations due to mental health problems within the last 4 weeks of the interview. The

Physical Component Summary Scale (PCS) summarises different aspects of physical health (eg, physical functioning, bodily pain, general health). The MCS and PCS range from 0 to 100, with higher values indicating better health. The mean value of the GSOEP 2004 population is set to 50 with an SD of 10.[40,41] We used the raw data of the subscales and transformed them using the algorithm from Andersen *et al*[40] separately for all years.

Confounder

All presented models were adjusted for family structure (no partner, married, living with partner), migration background (with or without migration background) and residence (East or West Germany). These sociodemographic determinants were known to be associated with socioeconomic status and/or with SRH. For example, residence in Germany is important, as there are higher rates of unemployment and poverty in East Germany compared to West Germany. Furthermore, migration background is associated with educational attainment, often resulting in lower educational degrees for men and women with migration background.[42] Additionally, family structure correlates with SRH, as well as physical and mental health problems.[43]

Statistical analysis

Analyses were stratified by gender. Bivariate analyses were used to describe trends in SRH, MCS and PCS, as well as in educational level from 1994 to 2014 (figures 1–4). For the analysis of educational inequalities in SRH, we used generalised linear regression models for binomial data with a logarithmic link function to calculate the Relative Index of Inequality (RII) and with an identity link function to compute the Slope Index of Inequality (SII).[44–46] The RII (SII) can be interpreted as the estimated relative rate ratio (absolute rate difference) for poor SRH between people with the lowest and highest levels of education. These two measures take into account the entire distribution of educational groups and are frequently used when comparing socioeconomic inequalities in health over time or between countries.[1,8,15,20,47,48] To calculate RII and SII, the educational groups were transformed into cumulative rank probabilities (ridit score) ranging from 0 (highest) to 1 (lowest).[15,49] The weighted ridits were generated for each year separately via the Stata wridit function.[49,50] The educational groups were sorted from highest to lowest, as high education was used as reference category, and each group was assigned a so-called ridit score.

Linear regression models were calculated for the association of MCS and PCS and educational level. In the analysis of educational inequalities in MCS and PCS, generalised linear regression models were used with logarithmic link functions to compute the RII and an identity link function to compute SII, respectively. In both cases, a Gaussian distribution family of MCS and PCS was set. Trend analyses were derived using
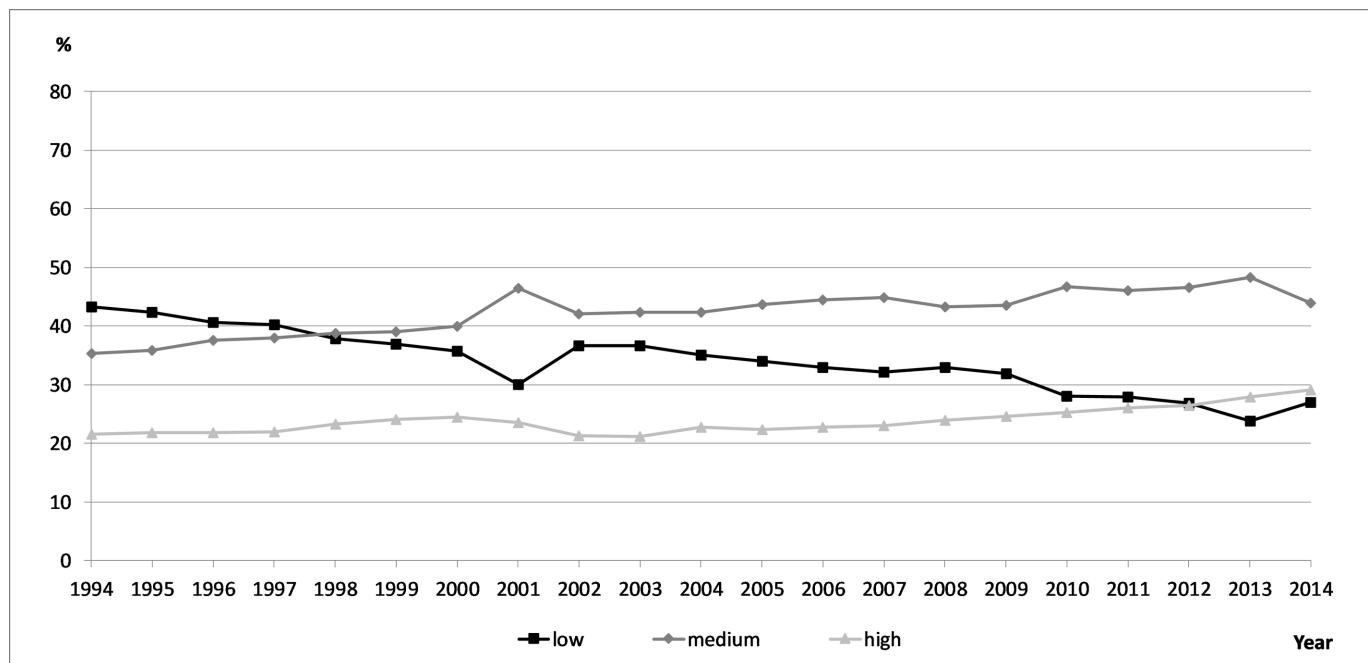
Figure 1 Trends in educational level in men, German Socio-Economic Panel, $n_{observations}$=106 221.

multivariate models that tested the main effects and interactions of dummy variables for education (ridit scores) and a continuous time trend variable. This trend variable was generated by recoding the calendar year in values from 0=1994 to 1=2014 implying, for example, 0.95 for 2013.[18 49] As the study did not focus on intraindividual changes and within difference in the outcome and the variables of control, all trend analyses were based on pooled data of the considered panel waves. The year-specific coefficients refer to cross-sectional data. Sensitivity analyses were also performed with different cut-off points for SRH. All analyses were carried out using STATA V.14 MP.

Ethics

Ethical approval for this study was not required as the data were extracted from the GSOEP set which did not contain any personally identifiable information.
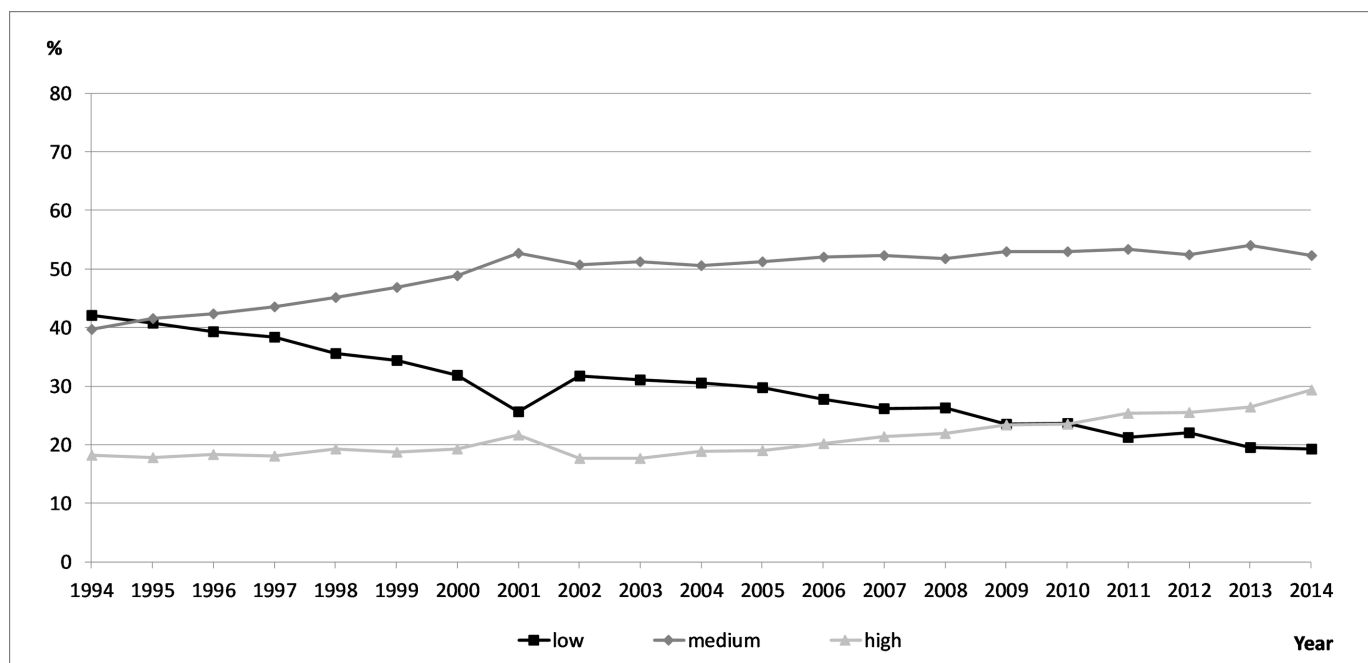

Figure 2 Trends in educational level in women, German Socio-Economic Panel, $n_{observations}$=106 221.
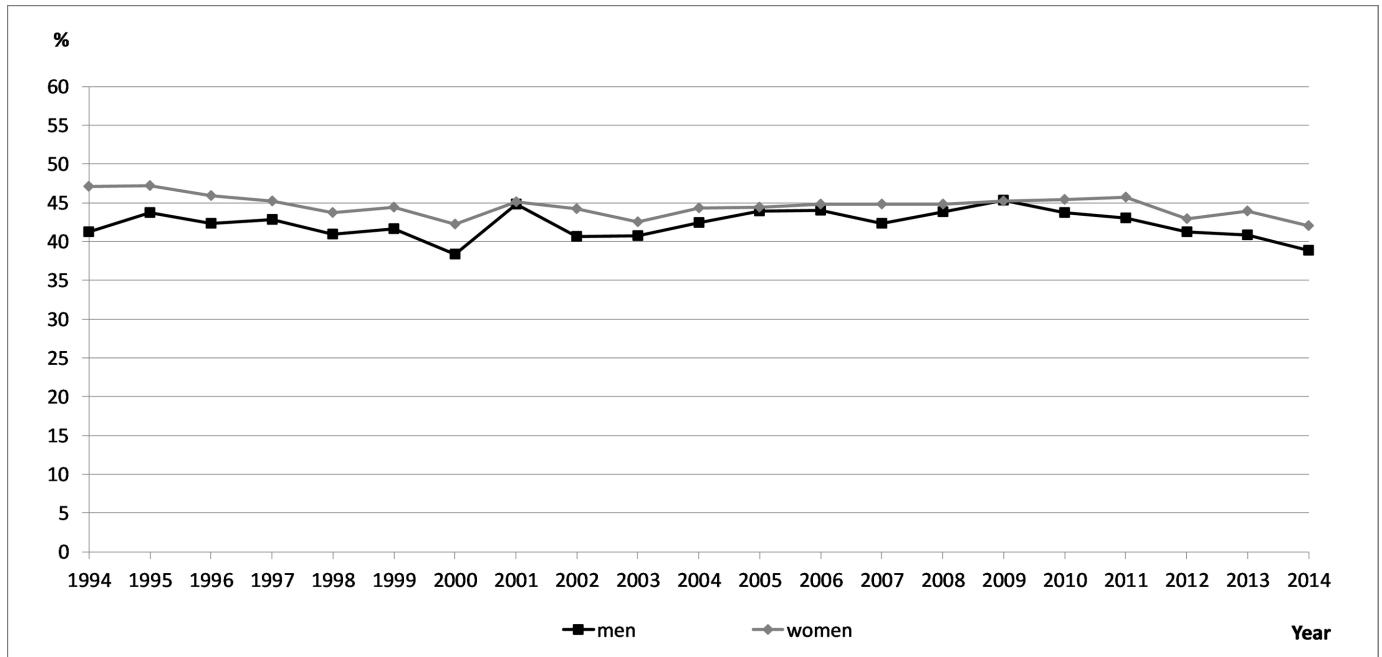
Figure 3 Trends in rather poor self-rated health in men and women, German Socio-Economic Panel, $n_{observations}$=106 221.

RESULTS

Study characteristics and trends in SRH and educational level

Table 1 presents the study population by age, gender, educational level, SRH, and mental and physical HRQOL. In total, 43.4% of participants reported rather poor health. Regarding educational level, 22% of the participants had a high and about one-third had a low level of education, whereas 45.4% of the participants were part of the medium educational group.

There were noticeable changes in educational level for the educational groups (figures 1 and 2). In the mid-1990s, 40% of men were classified as low educated, whereas 30% of men belonged to that group starting from 2010. From 1994 to 2014, more study participants fell in the high and medium educational groups. For women, the trend was similar, although with greater changes in the medium and high educational levels. The percentage of poor SRH remained stable between 1994 and 2014 (figure 3). In contrast, MCS slightly increased and PCS decreased to a small degree (figure 4).

Educational inequalities in SRH

Figures 5 and 6 present educational inequalities in poor SRH for men and women. Between 1994 and 2014, significant absolute (SII) and relative (RII) educational inequalities in SRH were observed. Relative inequalities ranged from 1.50 to 2.10 in men and 1.25 to 1.87 in women (RII) (table 2). Trend analyses showed no significant increase or decrease over time for either gender. However, educational inequalities in men were slightly higher than in women.
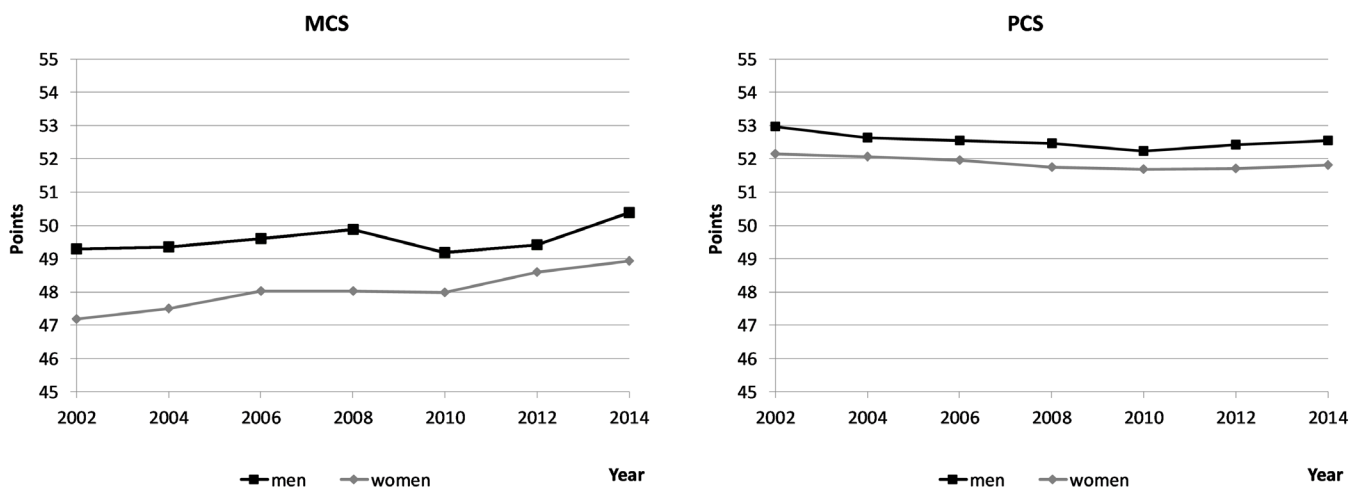

Figure 4 Trends in MCS and PCS in men and women, German Socio-Economic Panel, $n_{observations}$=39 541. MCS, Mental Component Summary Scale; PCS, Physical Component Summary Scale.

Table 1 Sample characteristics, GSOEP 1994–2014, n_{obs}=106 221

	%	n
Years		
1994–2014 (persons)		3782–7376
Total participants		16 339
Total observations		106 221
Sex		
Women	49.6	52 657
Men	50.4	53 564
Educational level		
High	22.0	23 411
Medium	45.4	48 207
Low	32.6	34 603
SRH		
Rather good	56.6	60 114
Rather poor	43.4	46 107
MCS*		
Mean	48.8	39 541
SD	9.9	
PCS*		
Mean	52.2	39 541
SD	8.3	

*The MCS and PCS range from 0 to 100, with higher values indicating better health. 50 represents the mean value, values above 50 indicate better health.
GSOEP, German Socio-Economic Panel; MCS, Mental Component Summary Scale; obs, observations, men and women aged 30–49 years; PCS, Physical Component Summary Scale; SRH, self-rated health.

Educational inequalities in mental and physical HRQOL

Regarding the mental component scale of HRQOL, the results do not show significant inequalities by education in contrast to the physical component scale (figures 7 and 8). Men with the lowest educational level rated their physical health between 4.5 and 6.6 points lower than those with the highest educational level (SII, absolute difference) (figure 9). A difference of 3.3–6.1 points in physical health between the lowest and the highest educational groups was also observed in women, to the disadvantage of the lowest educational group (figure 10). For women, educational inequalities in physical health increased over time (p<0.10), whereas men showed stable inequalities (table 3) that failed to reach significance level.

DISCUSSION
Summary of the results
This study is among the first to analyse time trends in educational inequalities in SRH and mental and physical HRQOL in the middle-aged population over a time period of up to 21 years in Germany. Our results indicate
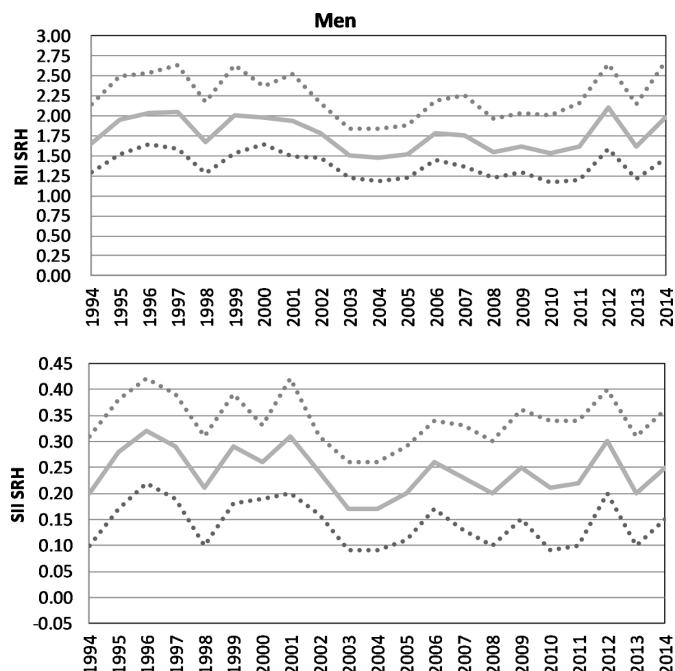

Figure 5 Absolute and relative educational inequalities in SRH in men, German Socio-Economic Panel, 1994–2014, $n_{observations}$=106 221. RII, Relative Index of Inequality; SII, Slope Index of Inequality; SRH, self-rated health.

that our first hypothesis can be largely confirmed. A significant social gradient for SRH and HRQOL in physical health among men and women aged 30–49 years was observed to the disadvantage of lower educated people in almost every survey year. However, no educational inequalities were found in HRQOL regarding mental
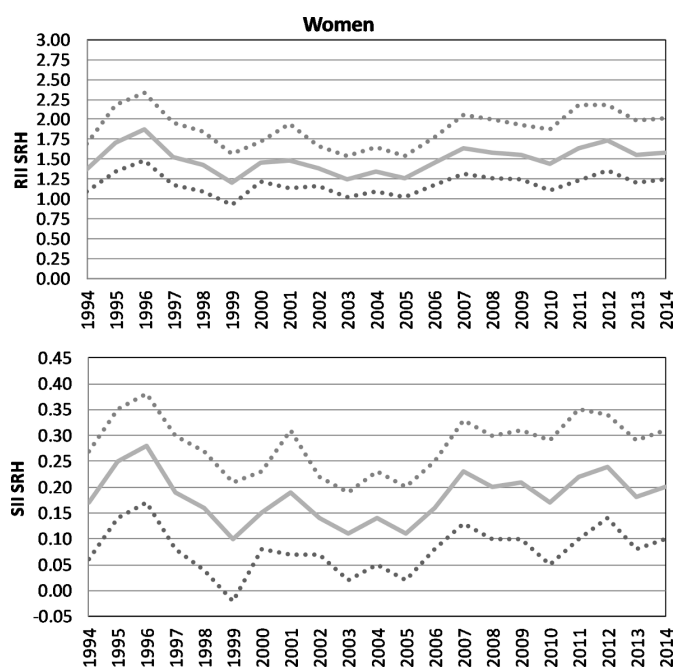

Figure 6 Absolute and relative educational inequalities in SRH in women, German Socio-Economic Panel, 1994–2014, $n_{observations}$=106 221. RII, Relative Index of Inequality; SII, Slope Index of Inequality; SRH, self-rated health.

Table 2 Relative and absolute inequalities in SRH, RII and SII, GSOEP, n_{obs}=106 221

	Men				Women			
	RII	CI	SII	CI	RII	CI	SII	CI
1994	1.66***	1.29 to 2.14	0.20***	0.10 to 0.31	1.37**	1.10 to 1.70	0.17**	0.06 to 0.27
1995	1.95***	1.52 to 2.49	0.28***	0.17 to 0.38	1.71***	1.35 to 2.18	0.25***	0.14 to 0.35
1996	2.04***	1.64 to 2.54	0.32***	0.22 to 0.42	1.87***	1.49 to 2.34	0.28***	0.17 to 0.38
1997	2.05***	1.59 to 2.64	0.29***	0.19 to 0.39	1.52**	1.18 to 1.96	0.19***	0.08 to 0.30
1998	1.67***	1.28 to 2.18	0.21***	0.10 to 0.31	1.43**	1.10 to 1.84	0.16**	0.04 to 0.27
1999	2.01***	1.53 to 2.63	0.29***	0.18 to 0.39	1.21	0.93 to 1.57	0.10	−0.02 to 0.21
2000	1.98***	1.65 to 2.37	0.26***	0.19 to 0.33	1.45***	1.22 to 1.72	0.15***	0.08 to 0.23
2001	1.94***	1.49 to 2.52	0.31***	0.20 to 0.42	1.48**	1.13 to 1.95	0.19**	0.07 to 0.31
2002	1.79***	1.48 to 2.16	0.24***	0.16 to 0.31	1.39***	1.16 to 1.66	0.14***	0.07 to 0.22
2003	1.50***	1.23 to 1.84	0.17***	0.09 to 0.26	1.25*	1.02 to 1.54	0.11*	0.02 to 0.19
2004	1.48***	1.19 to 1.84	0.17***	0.09 to 0.26	1.34**	1.10 to 1.65	0.14**	0.05 to 0.23
2005	1.52***	1.23 to 1.88	0.20***	0.11 to 0.29	1.26*	1.02 to 1.54	0.11*	0.02 to 0.20
2006	1.78***	1.45 to 2.19	0.26***	0.17 to 0.34	1.45***	1.18 to 1.78	0.16***	0.08 to 0.25
2007	1.76***	1.37 to 2.26	0.23***	0.13 to 0.33	1.64***	1.31 to 2.05	0.23***	0.13 to 0.33
2008	1.55***	1.22 to 1.97	0.20***	0.10 to 0.30	1.58***	1.26 to 2.00	0.20***	0.10 to 0.30
2009	1.62***	1.29 to 2.04	0.25***	0.15 to 0.36	1.55***	1.25 to 1.93	0.21***	0.10 to 0.31
2010	1.53**	1.17 to 2.00	0.21***	0.09 to 0.34	1.44**	1.11 to 1.88	0.17**	0.05 to 0.29
2011	1.61**	1.20 to 2.16	0.22***	0.10 to 0.34	1.64***	1.23 to 2.18	0.22***	0.10 to 0.35
2012	2.10***	1.59 to 2.65	0.30***	0.20 to 0.40	1.73***	1.36 to 2.18	0.24***	0.14 to 0.34
2013	1.61**	1.21 to 2.14	0.20***	0.10 to 0.31	1.55***	1.21 to 1.99	0.18***	0.08 to 0.29
2014	1.98***	1.46 to 2.68	0.25	0.15 to 0.36	1.58***	1.24 to 2.01	0.20***	0.10 to 0.31
Trend	0.88	0.65 to 1.18	−0.03	−0.16 to 0.09	1.07	0.82 to 1.40	0.02	−0.01 to 0.14

Adjusted for age, migration, family structure and residence.
*P<0.05; **P<0.01; ***P<0.001.
GSOEP, German Socio-Economic Panel; obs, observations, men and women aged 30–49 years; RII, Relative Index of Inequality; SII, Slope Index of Inequality; SRH, self-rated health.

health for men and women. The second hypothesis can also be confirmed as the existing inequalities in health remained stable over time. Exceptions were educational inequalities with respect to the physical components of HRQOL in women which increased significantly from 2002 to 2014. Therefore, our third hypothesis is partially true as there are gender differences, for example, in educational level or in the extent of educational inequalities in health. We found a decline in poor SRH and an increase in educational level over time, most notably among women.

Comparing and explaining the results

In accordance with other studies, we found persistent health inequalities over time.[5–7 17 51] The few previous studies that examining trends in educational inequalities in SRH among adults in Germany also found rather stable inequalities between 1994 and 2006.[52 53] Consistent with our results, Pförtner and Elgar[20] found constant inequalities by material deprivation in SRH. To date, no studies have analysed the trends in educational inequalities in HRQOL in Germany. However, previous research has shown that health

inequalities by income and occupational status increased over the last few decades.[17 21] Similar results were found for educational inequalities in life expectancy[54] and health behaviours, such as smoking and leisure-time physical activity.[46 48] The persistence of health inequalities over time highlights how strongly health inequalities are embedded in Western societies.[16 47] Trend studies often illustrate social inequalities in health over time, but they rarely try to explain why these inequalities persist by including mediating determinants. However, Granström et al[5] showed that the lower educated group reported poor SRH which was associated with lack of financial resources, smoking and low optimism in all survey waves in a cross-sectional survey in 2000, 2004 and 2008 in Sweden. Their results suggest that the same explanations found for cross-sectional studies, namely unequal distribution of material/structural, psychosocial and behavioural factors,[5 23 55–58] have not changed much over time and persist in producing health inequalities. However, future studies need to concentrate on explaining the persistence of education-related health inequalities. People with lower socioeconomic status tend to live and
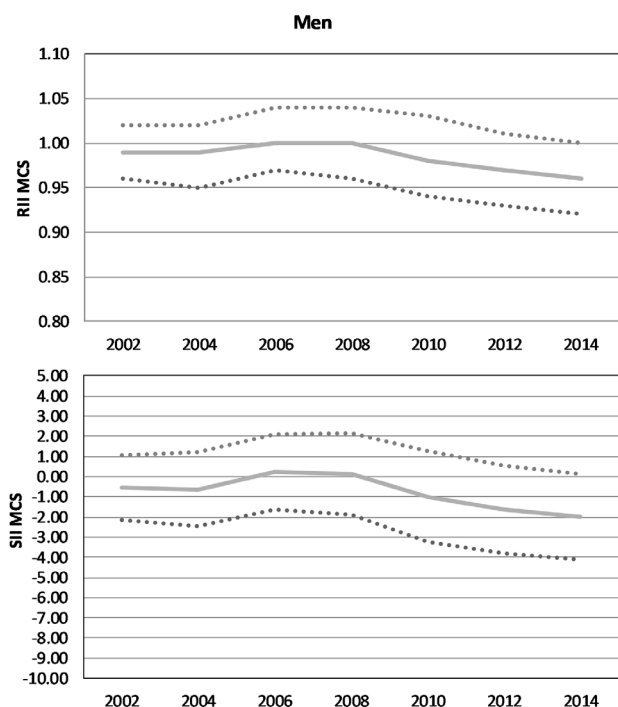
Figure 7 Absolute and relative educational inequalities in mental health-related quality of life in men, German Socio-Economic Panel, 2002–2014, $n_{observations}$=39 541. MCS, Mental Component Summary Scale; RII, Relative Index of Inequality; SII, Slope Index of Inequality.
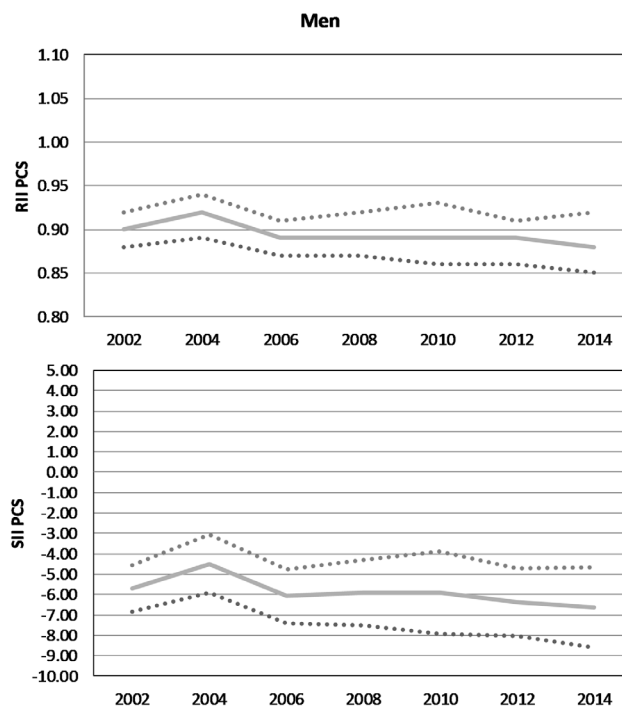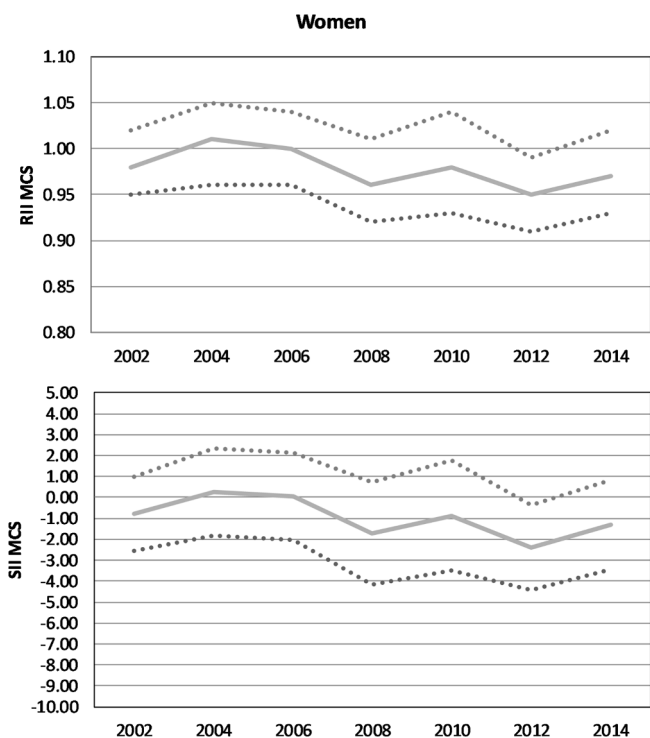

Figure 9 Absolute and relative educational inequalities in physical health-related quality of life in men, German Socio-Economic Panel, 2002–2014, $n_{observations}$=39 541. PCS, Physical Component Summary Scale; RII, Relative Index of Inequality; SII, Slope Index of Inequality.

Figure 8 Absolute and relative educational inequalities in mental health-related quality of life in women, German Socio-Economic Panel, 2002–2014, $n_{observations}$=39 541. MCS, Mental Component Summary Scale; RII, Relative Index of Inequality; SII, Slope Index of Inequality.
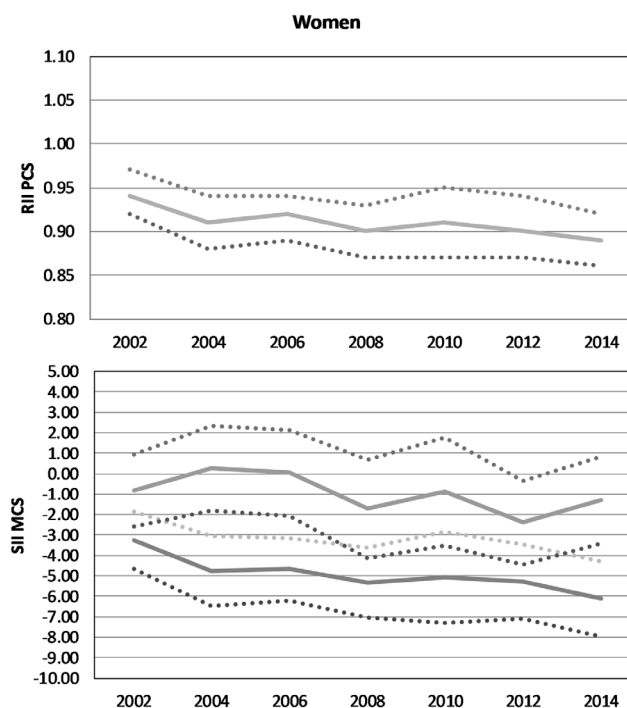

Figure 10 Absolute and relative educational inequalities in physical health-related quality of life in women, German Socio-Economic Panel, 2002–2014, $n_{observations}$=39 541. PCS, Physical Component Summary Scale; RII, Relative Index of Inequality; SII, Slope Index of Inequality.

work in rather health-detrimental circumstances, have fewer psychosocial resources, more hazards and engage in more risky behaviour, such as substance use and less physical activity. Furthermore, the results show that health inequalities persist, even though efforts have been made to attenuate the consequences of social disadvantages. Therefore, one can assume that policy-makers should find alternative ways to enhance health for the less privileged.

In accordance with other studies, our results showed that the proportions of the different levels of education changed over the last few decades. The group of people with a higher educational level increased while the low educational group decreased.[5] However, SRH did not increase over time. Although the (overall) level of education increased, educational inequalities in health did not; they remained stable over time. As all socioeconomic groups (to different degrees) benefit from educational expansion,[24] it can be assumed that the social gap remains and continues to result in educational inequalities in health. Results from a study in 18 European countries show that widening educational inequalities (here in mortality) can partly be attributed to educational expansion.[27] Our results, using RII and SII in SRH, support these assumptions and confirm that the difference between the lowest and highest educational group still has not narrowed.

Our study found no educational inequalities for HRQOL in mental health. Only a few studies have analysed HRQOL in mental and physical health domains, either separately or apart from SRH or over time. Although, for specific mental disorders, a social gradient was often reported (eg, for depression[59]), other studies have provided heterogeneous results. For example, Lahelma et al[60] have found no occupational class inequalities in mental health, but have reported them in physical health. Others have found inequalities in mental health, and additional studies have found weak, no or reversed inequalities in mental health. An explanation for the absence of health inequalities in association with education in our study might be due to the specific study population. It may be that a higher socioeconomic status based on educational level or high occupational position is mentally demanding resulting in fewer or no inequalities.[60] This might be even more important for men and women between aged 30-49 years, as they are more likely to build their career and, especially in the beginning, might be struggling with financial burdens due to raising young children. Since this development is evident in all social positions, it might not affect single positions, especially with respect to educational level. This assumption is highlighted by the design of the MCS and PCS which

Table 3 Relative and absolute educational inequalities in health related quality of life in MCS and PCS health and educational level, RII and SII, GSOEP, n_{obs}=39 541

	Men				Women			
	RII	CI	SII	CI	RII	CI	SII	CI
MCS								
2002	0.99	0.96 to 1.02	−0.53	−2.15 to 1.08	0.98	0.95 to 1.02	−0.81	−2.57 to 0.96
2004	0.99	0.95 to 1.02	−0.64	−2.48 to 1.19	1.01	0.96 to 1.05	0.28	−1.80 to 2.36
2006	1.00	0.97 to 1.04	0.24	−1.65 to 2.12	1.00	0.96 to 1.04	0.05	−2.05 to 2.15
2008	1.00	0.96 to 1.04	0.13	−1.89 to 2.14	0.96	0.92 to 1.01	−1.73	−4.16 to 0.70
2010	0.98	0.94 to 1.03	−0.99	−3.23 to 1.24	0.98	0.93 to 1.04	−0.87	−3.51 to 1.76
2012	0.97	0.93 to 1.01	−1.64	−3.81 to 0.54	0.95*	0.91 to 0.99	−2.39*	−4.43 to −0.35
2014	0.96	0.92 to 1.00	−2.00	−4.12 to 0.12	0.97	0.93 to 1.02	−1.30	−3.42 to 0.81
Trend	0.97	0.92 to 1.02	−1.40	−3.86 to 1.05	0.96	0.92 to 1.01	−1.75	−4.18 to 0.67
PCS								
2002	0.90***	0.88 to 0.92	−5.70***	−6.85 to −4.55	0.94***	0.92 to 0.97	−3.26***	−4.68 to −1.84
2004	0.92***	0.89 to 0.94	−4.50***	−5.93 to −3.07	0.91***	0.88 to 0.94	−4.77***	−6.47 to −3.06
2006	0.89***	0.87 to 0.91	−6.09***	−7.42 to −4.76	0.92***	0.89 to 0.94	−4.68***	−6.22 to −3.14
2008	0.89***	0.87 to 0.92	−5.91***	−7.51 to −4.30	0.90***	0.87 to 0.93	−5.33***	−7.05 to −3.61
2010	0.89***	0.86 to 0.93	−5.91***	−7.93 to −3.90	0.91***	0.87 to 0.95	−5.06***	−7.29 to −2.83
2012	0.89***	0.86 to 0.91	−6.39***	−8.03 to −4.74	0.90***	0.87 to 0.94	−5.29***	−7.09 to −3.49
2014	0.88***	0.85 to 0.92	−6.63***	−8.59 to −4.67	0.89***	0.86 to 0.92	−6.12***	−7.95 to −4.28
Trend	0.98	0.94 to 1.01	−1.19	−3.18 to 0.81	0.96†	0.92 to 1.00	−2.08†	−4.22 to 0.07

Adjusted for age, migration, family structure and residence.
*P<0.05; **P<0.01; ***P<0.001.
†P<0.10.
GSOEP, German Socio-Economic Panel; MCS, Mental Component Summary Scale; obs=observations, men and women aged 30–49 years; PCS, Physical Component Summary Scale; RII, Relative Index of Inequality; SII, Slope Index of Inequality.

measure HRQOL instead of mental or physical health itself.

Strengths and limitations

The strength of this study is the large sample size representing the German population and offering the opportunity for a trend analysis covering a 21-year time span. In addition, as the GSOEP represents the residential population of Germany, we believe that the results can be generalised for Germany. However, the study also has some limitations that need to be considered. First, rather modest effect sizes in the extent of social inequalities in SRH were observed. Effect size might differ between studies due to the cut-off point of 'less than good' in the measurement of SRH. Also, variation exists in the categorisation of SRH, with some studies categorising SRH as we did[5 51 55 61] and others including 'satisfactory' in the good health group.[17 20 23 56] We have therefore conducted a sensitivity analysis, in which 'satisfactory' was part of the reference category 'good health'. As we anticipated, the RII increased, while the slope index decreased. Consequently, the relative risk for people with a low level of education to assess their own health as only poor or bad is even higher, but the absolute difference of people with poor SRH in the lower and upper educational groups (ridit scores) is smaller. Second, no clear trend is evident in our results, potentially as a result of outlier values in some years, which might be due to sample refreshments in the respective years. However, as we used a weighting variable controlling for the study participants, we do not expect a strong bias. Third, although we found increased educational inequalities in the physical component of HRQOL in women between 2002 and 2014, the p value was significant only at the 10% level. Therefore, the results may be interpreted with caution. Fourth, the results might also be biased because of the subjective measure of SRH. Studies have found that the predictive ability of SRH for mortality weakens with increasing socioeconomic advantage among middle-aged individuals in the short-term and over a follow-up period.[62] There are studies showing that groups may differ in their use of response categories, for example, lower and higher educated people rate their health differently (response category differential item functioning; DIF). A method to consider such differences is to create anchoring vignettes to adjust for SRH item. For instance, one study found that those with higher education rate their health more positively than those with lower education, but that this relationship weakened when DIF was considered.[63] However, the evidence is heterogeneous,[64] and further studies are needed, taking these differences in rating styles into account to prevent misestimation the effect strength.

Conclusion

The current study contributes to overcoming the lack of research on time trends in educational inequalities in different health outcomes in Germany over the last few decades. The findings suggest that educational inequalities in SRH as well as in mental and physical HRQOL among the population aged 30–49 years were persistent and did not notably change.

Although no increase in educational inequalities in health was found in our study, a public health problem remains as these inequalities also did not decrease either. Therefore, it can be assumed that previous efforts have not been successful in reducing health inequalities. Further studies should focus on explaining why these inequalities persist over time and what strategies might be more effective in tackling educational inequalities in SRH and HRQOL. The results would help policy-makers develop and implement more adequate strategies for tackling socioeconomic inequalities in health.

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