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ORIGINAL INVESTIGATION

Socioeconomic status and health in the second half of life: findings from the German Ageing Survey

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Abstract This study examined social inequalities in health in the second half of life. Data for empirical analyses came from the second wave of the German Ageing Survey (DEAS), an ongoing population-based, representative study of community dwelling persons living in Germany, aged 40–85 years ($N = 2{,}787$). Three different indicators for socioeconomic status (SES; education, income, financial assets as an indicator for wealth) and health (physical, functional and subjective health) were employed. It could be shown that SES was related to health in the second half of life: Less advantaged persons between 40 and 85 years of age had worse health than more advantaged persons. Age gradients varied between status indicators and health dimensions, but in general social inequalities in health were rather stable or increasing over age. The latter was observed for wealth-related absolute inequalities in physical and functional health. Only income-related differences in subjective health decreased at higher ages. The amount of social inequality in health as well as its development over age did not vary by gender and place of residence (East or West Germany). These results suggest that, in Germany, the influence of SES on health remains important throughout the second half of life.

Keywords Health · Social inequality · Second half of life · Cumulative advantage · Age-as-leveller · Continuity

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Introduction

Consistently, it has been shown that lower socioeconomic status (SES) is related to worse health (e.g. Adler et al. 1994; Mackenbach et al. 1997; Marmot et al. 1997). From a life span developmental perspective it is important to explore whether the strength of this relationship varies with age (Alwin and Wray 2005). Originally, studies examining social inequalities in health rarely paid attention to older people, but now evidence is mounting that SES plays a role for health in later life (e.g. Avendano et al. 2005; Berkman and Gurland 1998; Huisman et al. 2005; Pérès et al. 2005). Using data from the representative German Ageing Survey (DEAS), the present article addresses the question how the SES-health relationship develops over the adult life span.

Dynamics of social inequalities in health across the life span

Three contradictory theoretical assumptions concerning the influence of SES over the life span have been discussed in the literature (O'Rand and Henretta 1999). Proponents of *cumulation theory* (e.g. Dannefer 1987; Ross and Wu 1996) assume that the influence of SES on health increases continuously with age due to a socially stratified cumulation of resources as well as risks over the life span leading to a cumulative advantage or disadvantage. In the context of minority ageing the double jeopardy hypothesis states that age-related losses in resources amplify the effects of race or SES on health (Dowd and Bengtson 1978; Ferraro and Farmer 1996).

In contrast, representatives of the *age-as-leveller hypothesis* suggest that the strength of the SES–health relationship decreases in old age relative to middle adulthood due to a variety of factors. First, retirement may end

inequalities in the work context, and social policies may lead to less inequality in old age. Second, biological frailty could account for an accelerated health decline of high SES people in old age leading to a convergence of the status groups (Herd 2006). Third, selective survival might also eliminate socioeconomic differences in health in later life (Lynch 2003). Finally, it has been suggested that the influence of SES on health in the second half of life is characterised by *continuity* (O'Rand and Henretta 1999). This perspective assumes that one's status in earlier life still exerts an influence in later life and that SES continuously shapes life chances and activities in old age.

Inconsistencies in empirical results

Research has provided empirical evidence for all three potential age gradients mentioned above. A decrease of socioeconomic differences in morbidity and mortality in old age supporting the age-as-leveller hypothesis has been found by many investigators (e.g. Beckett 2000; Herd 2006; House et al. 1994; Marmot and Shipley 1996). There is, however, also evidence for continuity of social inequalities in health (Marmot and Fuhrer 2004; Rostad et al. 2009; Yao and Robert 2008), and support for an increasing impact of SES on health over the life span (Kim and Durden 2007; Ross and Wu 1996). The use of different SES and health indicators may be one reason for inconsistent results across studies.

Measuring the *socioeconomic status* of older adults is particularly difficult. Each of the most widely used indicators—education, income and occupation—entails problems (Grundy and Holt 2001). Robert and House (1996) suggested that indicators of wealth like financial assets are more appropriate indicators for older people's SES and reflect cumulative processes better. Moreover, it is increasingly recognised that different SES facets have different meanings and indicate access to different personal resources (e.g. education implies knowledge about health and health behaviour, income indicates the ability to purchase health services). Therefore, different indicators of SES cannot be used interchangeably (Geyer and Peter 2000). In addition, SES might have a different meaning for women and men. Gender might influence the association between SES and health and its development over age for various reasons, such as differential participation in the labour force (Broese van Groenou et al. 2003; Huisman et al. 2003; Lampert 2000).

Moreover, it has long been recognised that *health* is a multidimensional construct as well. According to Liang (1986) there are three related but distinct aspects: the physical aspect (absence of disease), the functional aspect (capacity for task performance) and the subjective evaluation of one's health (taking into account more of the psychological aspect). Studies that address different health dimensions suggest that social inequalities might develop differently according to the health indicator considered. As Lampert (2000) has shown, for example, using a sample aged 70 to 100+ years, small socioeconomic differences in multimorbidity (physical aspect of health) up to the age of 90 were followed by significant differences in the group of 90+ years. A contrasting picture emerged for functional health where socioeconomic differences were significant at age 70–79 and disappeared in the older age groups.

Furthermore, there might be differences between countries in the development of social inequalities in health over the life span due to different health insurance regimes and differences in the extent of social inequalities. As has been already mentioned, most studies seem to find decreasing influences of SES on health in old age, but the majority of these studies have been conducted in the United States and Great Britain. It is not clear whether these results also hold for Germany. One study using several SES and health indicators and a sample limited to an age range of 60 years and older showed only slight age variation in the effect of SES on health in Germany, supporting the continuity hypothesis (Knesebeck et al. 2003).

Germany, however, has a unique history. Between 1949 and 1990, there existed two German states with distinct differences in political and economic structure. Hence, place of residence, i.e. living in East Germany or West Germany, might be related to health in later life. On average, residents of the former East experienced lower standards of living and a worse health care system relative to those living in the former West. Differences in the treatment of diseases, related to the quality of the health care system, may partly explain differences in more distal health outcomes such as mortality and subjective health that have been reported (Lüschen et al. 1997). Although a general health advantage for those living in West Germany is under debate (e.g. Mielck et al. 2000), two studies found that older East Germans report worse health than their western counterparts, which has been attributed to an overall unfavourable situation for older people in the former East (Hillen et al. 2000; Lüschen et al. 1997). Of special interest in this context are effects of place of residence on socioeconomic differences in health. In communist societies such as the former East Germany, for example, income had been distributed more equally and was less important for the access to goods than in West Germany. Thus, some studies found income-related health inequalities to be larger in West Germany (Mielck et al. 2000). As the studies mentioned here have been conducted shortly after the German reunification, an interesting question is whether differences in health as well as in the amount of social inequality in health between East and West Germany are still observed in more recent studies.

The present study

Thus far, there are comparatively few studies on the development of social inequalities in health in later life, especially in Germany. Moreover, empirical research has provided inconsistent results. We assume that some of the empirical ambiguity is due to between-study differences in the SES and health indicators used. Therefore, the present study examines the linkages of three SES indicators (education, income, financial assets as an indicator for wealth) to three health aspects (physical, functional and subjective health). By using data from a nationally representative study covering a broad age range (40–85 years) the analyses allow a comprehensive understanding of the specific German situation regarding social health inequalities in the second half of life. We investigate the association between SES and health in relation to age in order to determine whether social inequality in health is characterised by an increase, decrease or stability across adult development. An increase in the strength of the SES–health association is expected if the cumulative disadvantage or the age as double jeopardy hypothesis is true. A decreasing influence of SES on health is expected if the age-as-leveller hypothesis is true. Finally, the continuity hypothesis predicts only little age differences or stability in the SES–health relationship. Theoretical assumptions suggest that gender and place of residence might influence the association between SES and health and its development. Thus, our analyses account for these influences.

Methods

Sample

Data for empirical analyses came from the second wave of the German Ageing Survey, an ongoing population-based, representative study of community dwelling persons living in Germany, aged 40–85 years. Data collection took place in 2002 and occurred via in-home interviews and additional self-administered questionnaires. The sample was drawn by means of national probability sampling. Here, only those respondents were included who completed both interview and questionnaire ($N = 2{,}787$), which is 90.4% of the original sample. Selectivity analyses according to Lindenberger et al. (2002) indicated that selectivity effects for all variables in this study were very small ($d < 0.20$).

The sample was systematically stratified by gender, place of residence (about one-third from East Germany) and age group (about equal proportions of 40–54, 55–69 and 70–85-year-old participants; Engstler and Wurm 2006). The group of 40–54-year-old people represents those that are predominantly part of the labour force. The 55–69-year-old people are primarily situated shortly before, at or shortly after the transition to retirement, whereas the oldest age group (70–85 years old) represents those that have retired some time ago or the "young old" (e.g. Baltes and Smith 2003). Information about the sample, by age group and in total, can be found in Table 1. Comparing the age groups, it can be seen that especially in the oldest age group a larger proportion of the sample had no partner, low education, low income (with a non-linear age trend regarding financial assets), and poor physical, functional and subjective health.

Measures

Socioeconomic and demographic indicators

Level of education, income and financial assets were used as SES indicators. Participants reported their highest level of completed school education with reference to the German education scheme. Due to the limited extent of differentiation in the oldest age group where 75% did not obtain any degree or had left school at the compulsory level, only two levels of education were distinguished: low (corresponding to less than 10 years of school education) and medium to high (at least 10 years of school education).

Respondents provided the total net income per month for the household. To adjust for household size, this was divided by the weighted number of household members according to the new OECD scale[1] (Figini 1998). Income was divided in tertiles for the analyses.

Respondents specified the amount of financial assets owned by them or their partners, including bank accounts, life-insurances and stocks, but excluding real estate. Three categories were distinguished (low: up to 5,000 €, medium: 5,000 € – up to 25,000 €, high: 25,000 € or more) that divided the sample in roughly equal proportions.

Age was used as a continuous variable but also split into the three groups (40–54 years, 55–69 years and 70–85 years) for some of the analyses. Gender (1 = men, 2 = women) and place of residence (1 = West Germany, 2 = East Germany) were included in all analyses. Moreover, we controlled for partner status (1 = no partner, 2 = partner) to avoid spurious associations of SES and health (Murphy et al. 1997).

Health indicators

Comprehensive health measures were applied to include different aspects of health (Liang 1986). Physical health was assessed by using a checklist of 11 health problems (e.g. cardiovascular diseases, diabetes; see Appendix for

[1] This scale assigns a value of 1 to the household head, of 0.5 to each additional adult member and of 0.3 to each child.

Table 1 Sample characteristics by age group: percentage or mean

Characteristics	40–54 years $n = 959$	55–69 years $n = 941$	70–85 years $n = 887$	Total $N = 2,787$
Age (years)	46.9	62.2	75.9	61.3
Female	51.6	49.2	48.5	49.8
East Germany	66.0	67.2	67.3	66.8
Partner	86.6	83.7	61.0	77.5
School education				
Low	31.9	63.5	75.5	56.5
Medium to high	68.1	36.5	24.5	43.5
Income				
Low	29.0	33.5	40.6	34.2
Medium	29.1	32.8	35.9	32.5
High	41.9	33.7	23.6	33.3
Financial assets				
Low	40.5	35.4	46.7	40.7
Medium	31.5	38.5	32.2	34.1
High	28.0	26.1	21.1	25.2
Physical health				
Three or more diseases	19.4	39.3	59.2	38.3
Functional health				
Lowest quartile	7.3	22.8	49.2	25.9
Subjective health				
Less than good	29.3	43.9	62.5	44.8

the complete list). A sum score based on the absolute number of self-reported illnesses was computed for each person. Using a sum score has various advantages compared to the use of single self-reported illnesses, concerning, for example, parsimony and accordance between medical reports and self-reports (Ferraro and Farmer 1996; Katz et al. 1996). Furthermore, global scores of self-reported illnesses turned out to be a good predictor of 1-year mortality (Chaudhry et al. 2005). Suffering from three or more diseases, a criterion that has been employed by other studies (e.g. Hewitt et al. 2003), was used as an indicator of poor physical health in this study.[2]

Functional health was measured by the subscale physical functioning of the SF-36, (version 1.0, Bullinger and Kirchberger 1998; Ware and Sherbourne 1992). Impairments in 10 activities (e.g. climbing stairs, walking several blocks) are rated on a three-point scale, higher values indicating less impairment. For the present analyses, belonging to the lowest quartile of the distribution indicated poor functional health (Sekine et al. 2006; Stansfeld et al. 2003).

Subjective health was assessed by a single item asking "How do you assess your current state of health?" (1 = very good to 5 = very bad). Consistent with other studies, we used a rating of "less than good", i.e. having a value of three to five, as indicator for poor subjective health (e.g. Huisman et al. 2003; Kunst et al. 2005).

Statistical analysis

All analyses were done with Mplus version 5. To examine the association between SES and health, we firstly estimated logistic regression models, containing the SES indicator, age, gender, place of residence and partner status as predictors. In the models examining the effect of income and financial assets, we also controlled for education. SES variables were treated as categorical, the most advantaged group being the reference category. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated.

Age differences in the association between SES and health were explored in several ways. First, we added interaction terms between age and the SES indicator to the logistic regression models and tested whether this improved model fit significantly (Tabachnick and Fidell 2007). A significant interaction suggests that relative differences in odds between the status groups vary by age. We also estimated absolute effects and absolute differences on a risk scale. For this purpose, we created dummy variables

[2] Because a large portion (about 60%) of our sample had two or more diseases, we did not use the criterion of two or more diseases (e.g. Avendano et al. 2005). This ensured comparability with the cut-off scores for the other two health indicators used here.

for the combination between SES and three age groups (40–54 years, 55–69 years and 70–85 years), treating the 40–54 year old with high SES as reference group. The odds ratios obtained from these models, again controlling for the covariates, were calculated into risk ratios (Zhang and Yu 1998). Finally, the risk ratios were multiplied with the prevalence rate in the reference group to estimate absolute effects, i.e. rates of poor physical, functional and subjective health by level of SES and age group. For education, we tested if rate differences between the two groups were significant for each age group and whether they varied between age groups. For income and financial assets, we tested if there was a significant linear increase in rates with decreasing SES and whether this effect differed between the age groups.

The interplay between SES, gender and place of residence, and age was examined by adding two- and three-way interaction terms to the regression models.

Single missing values were supplemented by data imputation with the expectation maximisation method (Dempster et al. 1977). Results were compared to those obtained by including only participants who provided complete data; the results were virtually identical.

We included the stratification variables age, gender and place of residence in all analyses. Methodological studies have shown that unbiased coefficients are obtained if variables on which sampling is based are included in the models, nullifying the need for sample weights (Winship and Radbill 1994; see also, Lynch 2003). Repeating analyses with weighted data yielded largely equivalent results.

Results

The association between SES and health over age

Results are presented for each SES indicator (education, income and financial assets) separately. Tables 2, 4 and 6 display ORs and 95% CIs obtained with logistic regressions including the SES indicator and the covariates. Tables 3, 5 and 7 show rates and rate differences across age and SES groups controlled for covariates. Statistically significant effects ($p < 0.05$) are indexed by an asterisk. Whether or not interactions between SES and age were significant can be found in the last rows of Tables 2, 4 and 6 and in the last columns of Tables 3, 5 and 7. In the text, we also report marginally significant results ($p < 0.10$) with exact p values.

Education

As can be seen in Table 2a, education was significantly related to physical health, functional health and subjective health after adjusting for covariates ($ps < 0.05$). The interaction between education and age was not significant in any case (Table 2b).

Table 3 shows that level of education accounted for significant rate differences in poor physical and functional health in all age groups ($ps < 0.05$). For subjective health level of education accounted for rate differences in the youngest and middle aged group only ($ps < 0.05$), and just failed to reach significance for the oldest age group ($p = 0.07$). The rate differences due to education did not vary between age groups in any case (interaction physical health: $B = -0.01$, SE = 0.03, n.s.; functional health: $B = 0.03$, SE = 0.02, n.s.; subjective health: $B = -0.02$, SE = 0.03, n.s.).

Income

Table 4a shows that after controlling for confounders, income was significantly related to functional health and subjective health ($ps < 0.05$) but not to physical health ($p = 0.09$ for low income). The interaction between income and age was not significant for physical health and functional health, but was significant for subjective health ($p < 0.05$, Table 4b). The interaction effect was mainly due to the decreased influence of low income on subjective health at higher ages.

Table 2 Education and health over age: results of the logistic regression models

	Physical health	Functional health	Subjective health
(a) Main effects: odds ratios (and 95% CIs) of poor physical, functional and subjective health, by education and covariates			
Gender (female)	0.95 (0.81–1.08)	1.74* (1.43–2.13)	0.90 (0.77–1.06)
Place of residence (East Germany)	1.11 (0.93–1.31)	1.16 (0.94–1.41)	1.33* (1.13–1.58)
Partner status (partner)	0.88 (0.72–1.08)	0.69* (0.55–0.87)	0.74* (0.61–0.90)
Age	1.06* (1.05–1.07)	1.09* (1.08–1.10)	1.04* (1.03–1.05)
Education (low)	1.43* (1.19–1.71)	1.57* (1.27–1.94)	1.50* (1.27-1.78)
(b) Interaction effect: interaction between education and age			
$\Delta\chi^2$ (1)	0.26 (n.s.)	0.17 (n.s.)	0.46 (n.s.)

* $p < 0.05$

Table 3 Rates (%) of poor physical, functional and subjective health in the German Ageing Survey ($N = 2{,}787$), by level of education and age group. Rate difference by age group

	Medium–high education	Low education	Difference between levels of education	Interaction: levels of education by age
Physical health				
40–54 years	16.3	26.9	10.6*	n.s.
55–69 years	35.0	42.2	7.2*	
70–85 years	51.7	60.6	8.9*	
Functional health				
40–54 years	5.7	11.3	5.6*	n.s.
55–69 years	17.7	26.6	8.9*	
70–85 years	40.0	50.8	10.8*	
Subjective health				
40–54 years	26.5	37.1	10.6*	n.s.
55–69 years	35.5	49.6	14.1*	
70–85 years	56.2	63.1	6.9	

Note: controlled for gender, place of residence and partner status

* $p < 0.05$

Table 4 Income and health over age: results of the logistic regression models

	Physical health	Functional health	Subjective health
(a) Main effects: odds ratios (and 95% CIs) of poor physical, functional and subjective health, by income and covariates			
Gender (female)	0.95 (0.80–1.12)	1.71* (1.40–2.01)	0.89 (0.76–1.04)
Place of residence (East Germany)	1.06 (0.89–1.27)	1.02 (0.83–1.26)	1.20* (1.01–1.43)
Partner status (partner)	0.89 (0.73–1.10)	0.72* (0.57–0.90)	0.77* (0.63–0.94)
Education (low)	1.35* (1.11–1.64)	1.33* (1.06–1.67)	1.31* (1.09–1.57)
Age	1.06* (1.05–1.07)	1.09* (1.08–1.10)	1.04* (1.03–1.05)
Income (medium)	1.11 (0.89–1.38)	1.28 (0.98–1.66)	1.27* (1.03–1.55)
Income (low)	1.22 (0.97–1.52)	1.78* (1.36–2.31)	1.63* (1.31–2.01)
(b) Interaction effect: interaction between income and age			
$\Delta\chi^2$ (2)	0.58 (n.s.)	1.19 (n.s.)	7.93*

* $p < 0.05$

For physical health, statistical tests revealed no significant linear increase in rates of poor health with decreasing income in any age group (Table 5) and no significant variation in rate differences due to income between age groups (interaction: $B = 0.00$, SE $= 0.01$, n.s.). There was a significant linear increase in rates of poor functional health with decreasing income in the youngest and oldest age group ($ps < 0.05$), but not in the middle age group ($p = 0.06$). The effects due to income did not differ significantly between the age groups (interaction: $B = 0.02$, SE $= 0.01$, n.s.). For subjective health, there was a significant linear increase in rates of poor health with decreasing income for the youngest and middle age group ($ps < 0.05$), but not for the oldest age group. The significant interaction ($B = -0.06$, SE $= 0.03$, $p < 0.05$) points to smaller rate differences in subjective health due to income in the oldest age group.

Financial assets

In the overall sample, physical health was largely unrelated to financial assets after controlling for confounders ($p = 0.07$ for low assets), as can be seen in Table 6a. In contrast, functional and subjective health were significantly associated with financial assets ($ps < 0.05$). For physical health, adding the interaction coefficients between financial assets and age to the regression did not significantly improve model fit (Table 6b). However, a post hoc test revealed that the positive interaction between low financial assets and age just failed to reach significance ($\Delta\chi^2$ (1) $= 3.32$, $p = 0.07$). For functional health and subjective health, adding the interaction terms hardly changed model fit (Table 6b).

Analyses of rates and rate differences are depicted in Table 7. For physical health, there was a significant linear increase in rates of poor health with decreasing financial

Table 5 Rates (%) of poor physical, functional and subjective health in the German Ageing Survey ($N = 2{,}787$), by level of income and age group. Rate difference by age group

	High income	Medium income	Low income	Linear difference between levels of income	Interaction: levels of income by age
Physical health					
40–54 years	16.2	21.4	19.0	1.6	n.s.
55–69 years	33.3	32.5	40.0	3.3	
70–85 years	52.9	52.7	53.7	0.5	
Functional health					
40–54 years	4.2	6.0	11.3	3.5*	n.s.
55–69 years	17.2	19.2	23.5	3.3	
70–85 years	35.7	40.8	48.1	6.4*	
Subjective health					
40–54 years	21.9	27.2	36.8	7.4*	*
55–69 years	33.0	39.4	45.7	6.4*	
70–85 years	54.9	54.6	56.8	1.1	

Note: controlled for gender, place of residence, partner status and education

* $p < 0.05$

Table 6 Financial assets and health over age: results of the logistic regression models

	Physical health	Functional health	Subjective health
(a) Main effects: odds ratios (and 95% CIs) of poor physical, functional and subjective health, by financial assets and covariates			
Gender (female)	0.94 (0.79–1.11)	1.66* (1.36–2.04)	0.86 (0.73–1.02)
Place of residence (East Germany)	1.07 (0.90–1.24)	0.99 (0.81–1.22)	1.20* (1.01–1.42)
Partner status (partner)	0.91 (0.74–1.13)	0.79* (0.62–0.99)	0.82 (0.67–1.00)
Education (low)	1.37* (1.14–1.65)	1.29* (1.03–1.61)	1.32* (1.11–1.58)
Age	1.06* (1.05–1.07)	1.09* (1.08–1.10)	1.04* (1.03–1.05)
Financial assets (medium)	1.05 (0.84–1.32)	1.56* (1.18–2.07)	1.28* (1.03–1.59)
Financial assets (low)	1.23 (0.98–1.55)	2.62* (1.99–3.46)	1.91* (1.54–2.38)
(b) Interaction effect: interaction between financial assets and age			
$\Delta\chi^2$ (2)	3.87 (n.s.)	1.51 (n.s.)	0.50 (n.s.)

* $p < 0.05$

Table 7 Rates (%) of poor physical, functional, and subjective health in the German Ageing Survey ($N = 2{,}787$), by financial assets and age group. Rate difference by age group

	High assets	Medium assets	Low assets	Linear difference between levels of assets	Interaction: levels of assets by age
Physical health					
40–54 years	19.8	19.4	17.9	−0.9	*
55–69 years	33.5	34.8	38.6	2.4*	
70–85 years	48.3	50.5	58.8	5.8*	
Functional health					
40–54 years	3.4	5.6	10.3	3.9*	*
55–69 years	13.4	19.9	25.9	7.7*	
70–85 years	30.9	38.0	53.4	11.4*	
Subjective health					
40–54 years	22.8	26.1	34.0	5.8*	n.s.
55–69 years	34.0	37.6	47.5	6.9*	
70–85 years	45.0	54.7	63.9	9.4*	

Note: controlled for gender, place of residence, partner status, and education

* $p < 0.05$

assets for the middle and oldest age group ($ps < 0.05$), but not for the youngest age group. The significant interaction ($B = 0.03$, SE $= 0.01$, $p < 0.05$), pointed to larger absolute differences in poor physical health due to financial assets at higher ages. For functional health, there was a significant linear increase in rates of poor health with decreasing financial assets for all age groups ($ps < 0.05$). Again, the significant interaction indicates larger rate differences at higher ages ($B = 0.04$, SE $= 0.01$, $p < 0.05$). Linear increases in rates of poor subjective health with

decreasing financial assets were significant in each case ($ps < 0.05$) but did not vary between age groups (interaction: $B = 0.03$, SE = 0.03, n.s.).

Effects of gender and place of residence

As can be seen in Tables 2, 4 and 6, gender was significantly related to functional health above and beyond the other predictors ($ps < .05$). Further analyses (results not shown) revealed a tendency for stronger gender differences with increasing age to the disadvantage of older women (model with education: $p = 0.08$, model with income: $p = 0.09$, model with assets: $p = 0.05$).

Moreover, people living in East Germany were more likely to report poor subjective health ($ps < 0.05$). For physical health as the outcome, there was a consistent significant interaction between age and place of residence ($ps < 0.05$). Age had a stronger influence for people living in East Germany than for their western counterparts. We did not find, however, stable and statistically significant interactions between SES and gender, SES and place of residence, or between SES, gender/place of residence and age on any health outcome (results not shown).

Discussion

This study examined social inequalities in health in the second half of life, using data from the German Ageing Survey. Socioeconomic status was related to health in the second half of life: In general, less advantaged persons between 40 and 85 years of age had worse health than more advantaged persons. Our analyses showed that age gradients of social inequalities in health vary between SES indicators (education, income, financial assets), health dimensions (physical, functional, subjective) and measure (absolute vs. relative differences). A summary of results is displayed in Table 8.

SES and health in the second half of life

Education had a stable effect on all three health measures across the adult life span both in terms of relative differences in odds and absolute or rate differences between the groups. Hence, for education, our results lend some support to the continuity hypothesis. The educational background continuously shapes life chances and activities and thus influences health across the entire life span, including old age.

Income was unrelated to physical health, exerted a stable influence across the second half of life on functional health, and had a decreasing influence on the subjective health of the oldest adults. Hence, for income, the results provide some evidence for the continuity hypothesis for functional health and the age-as-leveller hypothesis for subjective health. While it is not clear why this was only found for subjective health in this study, one reason for a decreasing influence of income with increasing age is probably that income does not adequately reflect the financial situation in old age (see also, Huisman et al. 2003).

To overcome this, we used wealth indicated by financial assets as an additional predictor. Wealth reflects cumulative processes and is thus a better indicator for the financial situation in later life (e.g. Robert and House 1996). For financial assets, we found a more complex picture. The association between financial assets and physical health increased with age, although the interaction only reached significance for absolute health inequalities (rate differences). The influence of financial assets on functional health was stable over age if one looks at relative differences in odds and increased with age if one looks at absolute or rate differences between the status groups. There was little age variation in the robust relationship between financial assets and subjective health. Hence, for financial assets, both cumulative (dis)advantage and continuity hypothesis seem plausible.

When analysing the age gradient in the association between financial assets and functional health, we obtained differential results depending on the measure, i.e. relative differences in odds versus absolute differences in rates. This

Table 8 Summary of results for the relation between socioeconomic status and health in the second half of life

	Physical health	Functional health	Subjective health
Education			
Relative difference	Stability	Stability	Stability
Absolute difference	Stability	Stability	Stability
Income			
Relative difference	–	Stability	Decrease
Absolute difference	–	Stability	Decrease
Financial assets			
Relative difference	–	Stability	Stability
Absolute difference	Increase	Increase	Stability

difference is caused by the interaction of strong (relative) rate differences between asset groups at younger ages and the strong age effect on functional health. To illustrate this, we predicted age trends for poor functional and subjective health by combining the linear increases associated with age with the rate differences between financial asset groups at younger ages (mean age = 46 years).

Figure 1 shows that these two factors lead to increasing absolute or rate differences in functional health (Fig. 1a) but not in subjective health (Fig. 1b), because in contrast to functional health the relative rate differences in subjective health at younger ages were smaller and the age trend less pronounced. In summary, although the relative increase of risk of poor functional health with age was the same for people belonging to different financial asset groups (continuity), looking at the larger absolute differences in rates at older ages one might still speak of a cumulation effect at the population level.

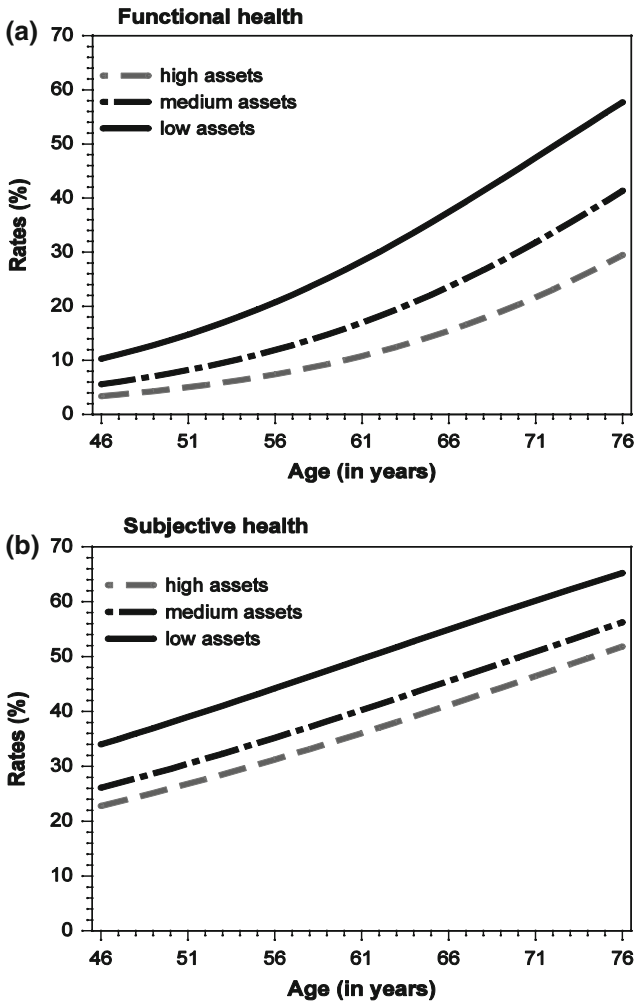

Fig. 1 Age trends in rates of poor functional health (**a**) and poor subjective health (**b**) for three groups with different amount of financial assets (low, medium, high)

These results fit into the broader discussion how to define and measure cumulative effects (Wilson et al. 2007). Ideally, one would have to take into account the duration of exposure to certain factors, which makes it more likely to find diverging health inequalities for income as well (Kim and Durden 2007). Moreover, as our results suggest, different perspectives, reflected by different measures, should be taken into account.

Continuity and cumulation, but no levelling off?

In contrast to other studies, our results point to the continuity and the cumulative (dis)advantage hypothesis (only the association between income and subjective health decreased with age). Why is this the case? First of all, we did not include a measure of (former) occupational status in the analyses. The age trend may differ for this indicator as occupationally based measures most closely represent working conditions, which might lose their relevance for health upon retirement. Secondly, the oldest participants were 85 years of age, thus our sample does not include the oldest old. As some of the processes being discussed as potential sources of decreasing inequalities in old age, i.e. biological frailty, may have a stronger impact in the most advanced ages, this might have prevented us from detecting such changes.

The third reason might be a theoretically substantial one. The finding of continuing social inequalities across the life span could be a consequence of the societal context. In contrast to the American health system, no change in the health insurance regime is associated with becoming 65 years in Germany. Furthermore, as there are larger social inequalities in health during midlife in the United States compared to Germany, the SES–health association in the USA might be attenuated in old age to a larger extent due to a stronger influence of selective mortality in earlier stages of life. These facts render the age-as-leveller hypothesis less likely in Germany (see also, Knesebeck et al. 2003). One has to keep in mind, however, that there are German studies as well as European-wide studies including German samples that find decreasing inequalities in health with increasing age for some health indicators and in some subsamples (e.g. Huisman et al. 2003; Lampert 2000).

Effects of gender and place of residence

Apart from replicating the well-known gender difference in functional health (e.g. Arber and Ginn 1993), which is especially pronounced at higher ages, we did not find any systematic effects of gender. Of special interest had been whether gender influences the amount of social inequality in health as well as its development over age, which was not the case. This is in line with other studies on this topic (e.g. Arber and Ginn 1993). In contrast, Huisman et al.

(2003) found that the influence of SES decreased over age for women but not men. However, their sample was slightly older than ours, which might partly explain the inconsistencies between the studies.

We also looked at the effects of place of residence. Interestingly, more than a decade after the German reunification, we still found people living in East Germany to be more likely to report poor subjective health than those living in West Germany. We also found older people in East Germany to be particularly disadvantaged with regard to physical health. This replicates and extends results from studies that were conducted shortly after the political transition in 1989/90 (e.g. Hillen et al. 2000; Lüschen et al. 1997). Contrary to some of these studies, however, we did not find meaningful differences in the amount of health inequality and no differences in age trends according to place of residence. In former communist societies, such as East Germany, income had been distributed more equally and was not such an important indicator for access to goods. After the political transition, however, income inequalities became larger in East Germany, which might have reduced differences in the amount of income-related health inequality between East and West Germany in the present study.

Limitations

The cross-sectional nature of the data set limits the interpretation of the results. No stringent conclusions about causality can be made. Especially for income and financial assets as indicators of SES, it would have been equally plausible that deterioration in health exerts a negative influence on one's SES, at least for the younger groups. Although other studies suggest that these selection effects are not primarily responsible for social inequalities in health (e.g. Blane et al. 1993; Chandola et al. 2003), this effect cannot be ruled out completely. Moreover, cross-sectional analyses confound age- and cohort-effects, which might cancel each other out (Lynch 2003). In general, longitudinal data are preferable for investigating processes unfolding over the life span, which are underlying the hypotheses examined here.

Another limitation concerns the composition of the sample. The fact that institutionalised people are not included in the baseline samples of the DEAS limits the generalisability of the results. Moreover, as both poor health and low SES are linked to higher risk of institutionalisation (Gaugler et al. 2007), we probably underestimated SES differences in health in the oldest group (see also, Huisman et al. 2003).

A final concern regards the indicators used. Firstly, one might criticise the categorisation we used for the SES indicators. Concerning education, we distinguished only two levels as a large majority of the oldest age group had a low education. Regarding income, a study by Grundy and Sloggett (2003) found more consistent relations to a variety of health indicators than we did. Their income measure distinguished recipients of income-support from non-recipients only. While this might be more meaningful than using tertiles, it is an indicator of poverty and thus ignores some of the health differences between status groups. Secondly, health was measured only by self-reports. It thus cannot be concluded without doubt that the present findings generalise to objective measures of physical health. A high accordance between self-reported health and physician-evaluated health has been shown, however, for physical health (e.g. Bush et al. 1989). Moreover, equally large educational inequalities in self-reported and performance-based measures of functional health and disability have been reported for older adults from the Netherlands (Huisman et al. 2005).

Addressing mechanisms: outlook on future analyses

Future research needs to examine the mechanisms underlying the association between SES and health in the second half of life. In this context, it should be considered that the influence of SES indicators varies by health aspect. Our results show that education was more consistently related to poor physical health than the financial indicators. Income, which was completely unrelated to physical health, was significantly related to functional and subjective health. We argue that this pattern of results is due to different mechanisms linking SES factors to varying aspects of health. Education exerts its influence on health via knowledge, attitudes towards health and health behaviour (e.g. Geyer and Peter 2000): These factors are relevant for the prevention of disease. In contrast, financial resources may be more important for dealing with and adapting to existing health problems. In line with this view, a study by House et al. (2005) showed that education was more important for the onset of health problems, whereas income and financial assets were more relevant for the progression of functional limitations. In addition, it should be analysed whether mechanisms relating SES to health differ over age. One of the few studies on this topic indicated that while health behaviour mediated the association between education and functional health in a group of 55–70-year-old people, for older people psychosocial factors became more relevant (Koster et al. 2006).

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Appendix

See Table 9.

Table 9 The complete list of health problems assessed in the German Ageing Survey

Cardiovascular diseases
Circulatory problems
Back or joint diseases
Diabetes
Gastro-intestinal diseases
Respiratory diseases
Cancer
Liver or kidney diseases
Bladder trouble
Diseases of the eye
Diseases of the ear

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