The Social Gradient and the ‘Deaths of Despair’ in Germany - Findings from the German National Cohort (NAKO)

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Abstract

Background: ‘Deaths of despair' have extensively researched, particularly in the United Kingdom and the United States, but this phenomenon is not limited to these countries. Germany, which experienced significant social inequalities during the economic transition of German reunification, continues to face specific social disparities in health and mortality. Nevertheless, the impact of the social gradient on the 'deaths of despair' in Germany has not received much attention.

Methodology: We used cause-specific mortality data from the German National Cohort (NAKO) for the period 2014–2023. A total of 2,820 deaths were considered for which complete information on the causes of death was available. A multiple-causes of death analysis was performed considering the complete death certificate information and additional medical records. The social gradient was derived from employment status, the European Socio-Economic Classification (ESeC), education (ISCED 11) and relative income position based on the NAKO baseline questionnaires.

Logistic regression models were used for statistical analysis, providing odds and relative risk ratios for the analyses of the 'deaths of despair' categories.

Results: The major outcome indicated that individuals with a low socioeconomic status were at a higher risk for the deaths of despair'. Those who had been unemployed for a long time and those with the lowest income levels were disproportionately affected. Surprisingly, educational attainment and occupational status had no significant influence on the risk for the 'deaths of despair'.

Conclusion: The social gradient is a significant predictor of the risk of the 'deaths of despair' in Germany.

Introduction

Increasing mortality trends in suicide, drug- and alcohol-related deaths, better known as 'deaths of despair', affecting mainly middle-aged people, have been well studies for the United Kingdom, the United States, and Spain.[1-6] However, this striking phenomenon of 'deaths of despair' is not limited exclusively to these countries. Despite the heterogeneity of the conceptualisations and definitions of the 'deaths of despair', this phenomenon has been documented in numerous countries worldwide.[7,8]

In this regard, Germany is a special case, as the rapid economic transformation in East Germany towards the West German economic system since the early 1990s has been a decisive factor in the country's unique development path. In the aftermath of German reunification, a substantial surge in mass redundancies was observed in the former GDR, resulting in heightened economic insecurity and a paucity of individual prospects for a significant segment of the population.[9]
In West Germany, analogous developments emerged in former industrial regions such as the Ruhr area, which also underwent a comparable transformation. However, the social and economic transformation has not had the same impact on all social groups. Individuals with lower levels of education and those in low-skilled occupations appeared to be more disadvantaged in the transformation process than those with higher levels of education and better job prospects. These socio-economic disadvantages faced by certain individuals can influence their individual risk of death, particularly for a death attributed as a ‘death of despair’. Although living conditions have converged between East and West Germany, there are still large socioeconomic differences that influence the remaining mortality disadvantage in East Germany.[10,11] Overall, the reduction in mortality inequality in Germany since 1990 has been driven mainly by improvements in mortality in the East German districts.[12,13] This is also evident in Kibele et al., who have found that many economically disadvantaged regions in West Germany have become hotspots of high mortality.[14] The question is how widespread 'deaths of despair' are in the German population, while people living in disadvantaged regions may be at increased risk from these specific causes.

A number of studies have previously employed aggregated data from the United States of America, the United Kingdom, Spain, and other European countries to demonstrate an increase in the 'deaths of despair' over a long-term period.[1-6,15-17]
However, the analysis of the specific socioeconomic risk factors that contribute to the phenomenon of 'deaths of despair' reveals a complex and multifaceted picture.[18]

It remains unclear whether socioeconomic differences exert a direct influence on the individual risk of a 'death of despair'. To date, only a few studies have demonstrated such an association, yet these findings are not readily transferable to the German context.[19,20,21,22]

Consequently, we investigate the influence of the socioeconomic gradient on the phenomenon of the 'deaths of despair' using multi-causal mortality data from a large prospective cohort in Germany. To the best of our knowledge, this is the first study to examine socioeconomic disparities in "deaths of despair" on the individual level in Germany.

Methods

Study Population

For this study we used data from the German National Cohort (NAKO) an interdisciplinary collaboration between scientists from the Helmholtz and Leibniz Associations, universities and other research institutes. The major aim of NAKO is to investigate the causes of the development of major chronic diseases, i.e. cardiovascular diseases, cancer, diabetes, neurodegenerative/psychiatric diseases, musculoskeletal diseases, respiratory diseases and infectious diseases, as well as their preclinical stages or functional health impairments. Across Germany, 18 regional study centres had recruited a random sample of the general population, including a total of 100,000 women and 100,000 men aged 20-69 years. Baseline examinations include a detailed interview and self-administered questionnaires, a wide range of medical examinations and the collection of various biomaterials.[23,24]

Multiple Cause of Death Analysis

We used mortality data from all deceased participants in the German National Cohort (NAKO) between 2014 and 2023 with completed cause of death records. The validation of the causes of death information was comprised in three steps. First, all information would be obtained from the original death certificates, including details of the immediate and direct causes of death, underlying causes, concomitant diseases and information from the epicrisis. Second, all information was coded using the IRIS V5.8.1 automated coding system for multiple causes of death. The IRIS software employs the Multicausal and Unicausal Selection Engine (MUSE), which uses decision algorithms based on the most recent version of the International Classification of Diseases, Tenth Revision (ICD-10).[25]

Third, supplementary information (if available) on the circumstances of death was obtained from medical records and then compared with the results of the previous validation steps.

Deaths of Despair Concept

The deaths were then categorised according to the International Classification of Diseases, 10th Revision (ICD-10), into alcohol-related, drug-related, suicides and other deaths (not related to 'deaths from despair'). As an essential condition, one of the 'death of despair' categories (alcohol, suicide, drug) had to be documented and coded at least once as a contributing factor on the official death certificate. There are deaths in which there are multiple indications of a 'death of despair' category as cause of death. However, these cases are coded identically, as if there were only a single indication of 'death of despair'. Then, the concept of Allik et al. was employed, wherein 'deaths of despair' were defined as drug-related (F11-F16, F18-F19, X40-X44, X85*), suicides (X60-X85, Y10-Y34, Y87.0, Y87.2), and alcohol-related (F10, K70, K73, X45, G31.2, G62.1, I42.6, K29.2, K74.0-K74.2, K74.6, K86.0).[2] It is hypothesised that this approach is most suitable for the German context.

The social gradient

The 'social gradient' is an indicator of the relationship between social status and health. The lower the social status, the poorer the health and life expectancy. Disadvantaged groups have a higher burden of disease and lower life expectancy.[26] The 'social gradient' is composed of several dimensions, such as labor force participation, occupational position, education and income. The social gradient was derived by following four dimensions: The employment status, the European Socio-Economic Classification (ESeC), the level of education (ISCED 2011) and the relative income position.

The employment status is predicated on the labour force concept, which is divided into three categories: The categories employed in this study are unemployed, employed and not economically active.[27]

The European Socio-economic Classification (ESC) was developed from the European Gross Product (EGP) scheme.[28] The categories are grouped according to the position of the occupation in the labour market and the type of labour regulation.

The categories employed in this study are as follows: large employers, higher managers/professionals', 'lower managers/professionals, higher supervisory/technicians', 'intermediate occupations', 'small employers and self-employed (non-agriculture)', 'small employers and self-employed (agriculture)', 'lower supervisors and technicians', 'lower sales and service', 'lower technical', 'routine'. The categories employed for the purpose of this study were as follows: 'high', 'medium', 'self-employed', and 'low'. '

The International Standard Classification of Education (ISCED-2011) is a categorisation system for educational programmes and qualifications.[29,30] The nine categories originally defined by UNESCO – 'below primary level', 'primary level', 'lower secondary level', 'upper secondary level', 'post-secondary non-tertiary education', 'short-cycle tertiary education', 'bachelor's or equivalent level', 'master's or equivalent level', and 'doctoral or equivalent level' – are grouped into three superordinate categories for this study: high, medium, and low.

The relative income position is calculated in relation to the overall social median and categorised accordingly, based on the net equivalent income of the European Union Statistics on Income and Living Conditions (EU-SILC).[31] The relative income categories are defined as follows: 'below 60% (risk of poverty) ', 'from 60% to below 80%', 'from 80% to below 100%', from '100% to below 150%', 'from 150% to above'.

Covariates

The control variables used in this study included age at the start of the study, gender (male, female), marital status ('single', 'married living together', 'married living apart', 'divorced', 'widowed') and the presence of a partner ('living with partner', 'not living with partner', 'without partner'). In addition, participants were divided were divided between East and West Germany according to the geographical location of their respective study centres.

Statistical analysis

We compared the means, proportions and estimated odds ratios (ORs) from multivariate logistic regression for each participant who died from despair or other causes from September 2014 to December 2023. For categorial analysis of ‘death of despair’ categories (alcohol, suicide, drug), we estimated relative risk ratios (RRR) using multi-nominal logistic regression with other causes of death as base. The multiple cause of death analysis was conducted, which identified a total of 359 (12,7%) deaths as 'deaths of despair'. Of these, 255 deaths were attributed to alcohol, 84 deaths to suicide, and 20 deaths to drug-related causes, 2,461 deaths (87.3%) were from other causes (not defined as ‘death of despair’), and 202,220 have survived until December 2023.

Selectivity analysis

To account for the correlation between the selected covariates, we used logistic lasso (penalised) regression. This approach aimed to identify a parsimonious set of variables that jointly explain the risk of dying from 'death of despair' or from other causes of death, and to estimate their joint (and mutually adjusted) effects. To assess whether the set of selected variables might have been driven by outlying observations, we examined the stability of variable selection by fitting LASSO logistic models to (N =1000) random 80% subsamples of the study population. Each subsample included the same proportion of despair deaths and non-despair deaths representative of those observed in the full German National Cohort sample. All analyses were performed with STATA 19.

Preliminary Results

A comprehensive descriptive analysis has been conducted for all the variables under consideration: sex age (at baseline), family status, partner status, occupational status, geographical location (East or West Germany), European Socio-economic classification (ESeC), educational attainment (ISCED 11), income relative to peers, and the deaths of despair (binary: yes or no) and the ‘deaths of despair’ categories (alcohol, suicide, and drug) in Table 1. The results of the study demonstrate that there is a statistically significant relationship between the social gradient and the deaths of despair risk, as shown in Table 2.

Consequently, women exhibited a significant reduced mortality risk (OR 0.42, 95% CI 0.30, 0.57) from causes of death ascribed to the 'deaths of despair' in comparison to men. In addition, age is associated with a significant reduced mortality risk from a 'deaths of despair' (OR 0.95, 95% CI 0.94, 0.97).

Unemployed individuals exhibited a significant higher risk for a ‘death of despair’ (OR 1.92, 95% CI 1.23, 3.01) in comparison to those who had not experienced unemployment. Conversely, NAKO participants who held the lowest income position (at poverty risk level) demonstrated a significant elevated mortality risk (OR 2.14, 95% CI 1.35, 3.39) in comparison to individuals from the highest income position.

No statistical correlation was identified for family status, partner status and geographical location (i.e. living in East or West Germany).

The present study revealed no statistical correlation between the ESec and education (ISCED 11) and the ‘deaths of despair’. Table 3 presents the covariate-adjusted correlations between social gradient and the ‘deaths of despair’ categories (alcohol, suicide and drug). The mortality risk attributable to harmful alcohol consumption is significantly lower for women than for men (RRR 0.41, 95% CI 0.28, 0.60).

Again, unemployed individuals exhibited a substantially elevated risk of mortality due to alcohol (RRR 2.44, 95% CI 1.49, 3.99) in comparison with those who were not unemployed.

NAKO participants in the lowest income position had a significant higher mortality risk from causes associated with harmful alcohol consumption (RRR 3.10, 95% CI 1.72, 5.59) compared to participants with the highest income position. There is no statistical correlation between family status, partner status, geographical location the ESec and education (ISCED 11) and the risk of death from alcohol.

For suicide, there are only significant associations for women, who have a lower risk than men (RRR 0.50, 95% CI 0.28, 0.92) and a lower age-specific risk (RRR 0.90, 95% CI 0.87, 0.92). Similar findings can be defined for drug-related deaths, with a lower risk in women (RRR 0.12, 95% CI 0.15, 0.91) and with age (RRR 0.91, 95% CI 0.87, 0.97).

The general trend in deaths caused by despair could also be explained by the correlation between social gradient and the alcohol-related deaths.

Results of selectivity analysis are not presented here, will be provided with the full version of the manuscript.

Discussion

The findings of this study demonstrate that individuals with a lower social gradient are more susceptible to dying from 'deaths of despair' in comparison to those with a higher social gradient, irrespective of their geographical location within Germany. Specifically, individuals who are unemployed and who belong to the group with the lowest relative income position (at poverty level) are at a higher risk of deaths of despair. Women tend to have lower risk of dying from 'deaths of despair' than men. Separate analyses for alcohol-related deaths support a social gradient, with higher risk mortality for the socially deprived. For suicide and drug-related deaths, the effect of social deprivation should be smaller and more heterogeneous within the NAKO population. Our findings are therefore consistent with other international studies.

A study using data from the National Longitudinal Study of Adolescent to Adult Health in the United States found a strong association between low educational attainment and financial loss, supporting Case and Deaton's hypothesis that financial loss has a greater impact on deaths of despair among the less educated.[19] They confirm that the higher risk of financial loss among the less educated is associated with more intensive drug use and suicidal behaviour, but not with frequent binge drinking. They also found that the risk of increased drug use and suicide is 20 per cent higher for those with less than a high school education than for those with a college degree.[20] Similar to the US, the increase in deaths of despair in Scotland and England is associated with socio-economic status (SES), with much higher increases in deprived areas.[32,33,34] Consequently, effective public health interventions are needed to address not only mental health or addiction problems, but also intergenerational disadvantage, socio-economic inequalities and lack of opportunities for upward social mobility.

Strength and Limitations

The study has several notable strengths. A significant benefit of this study is the utilisation of data from a substantial prospective cohort in Germany. Given the lack of research on socioeconomic inequalities in deaths by despair in the German context, our findings can be applied to the specific study regions of NAKO. Another important distinguishing feature is that we have access to all information on the cause of death documented in death certificates. Consequently, our results do not depend on the underlying cause of death, which is the only information available in the official cause of death statistics for Germany.

Furthermore, due to the nature of the dataset, which contains comprehensive information on the socioeconomic gradient, we were able to estimate the association for categories of all socioeconomic variables.

It should be noted that this study is not without limitations. First, due to its design, which links baseline characteristics to cause of death, this study was unable to identify any changes in socioeconomic status and control variables over time during the follow-up period. Second, individuals may experience fluctuations in socioeconomic status throughout their lifespan, the estimation of the link between socioeconomic status and deaths of despair may be susceptible to upward or downward bias.[35] It is conceivable that each socioeconomic variable may interact with others in a way that indirectly affects the risk of deaths by despair.[36,37,38] Third, it is only possible to approve this association for the NAKO recruitment regions. It is not feasible to extend this approval to all geographic small areas that represent Germany, because three federal states – Hesse, Rheinland-Pfalz and Thuringia – were not included in NAKO. The NAKO study population is comparatively younger than the German general population, so the prevalence of the 'deaths of despair' is likely underestimated. However, as the study population ages, an increase in mortality is to be expected. Notwithstanding the aforementioned limitations, the study makes a significant contribution to research on the social gradient and the 'deaths of despair' in Germany.

Conclusion

Overall, a social gradient is evident for the 'deaths of despair' in the German National Cohort (NAKO). Further research is required in order to quantify the impact of the social gradient for the 'deaths of despair' to understand the full mechanism of social deprivation in premature death. Future research should continue to examine data at the individual level and consider long-term trends to enable a more nuanced understanding of this important public health issue, bearing in mind that the link between the social gradient, particularly individual income position, and health becomes significantly stronger over time. Measures to reduce income inequality must increasingly be assessed for their likely impact on mortality rates.

Table 1 Descriptive Statistics of used in the analysis, German National Cohort (NAKO)

	Male	Female	Total
N	1,914 (67.9%)	906 (32.1%)	2,820 (100.0%)
Ageclass at baseline			
20 - 29	12 (0.6%)	6 (0.7%)	18 (0.6%)
30 - 39	20 (1.0%)	9 (1.0%)	29 (1.0%)
40 - 49	144 (7.5%)	81 (8.9%)	225 (8.0%)
50 - 59	446 (23.3%)	232 (25.6%)	678 (24.0%)
60 - 69	1,119 (58.5%)	495 (54.6%)	1,614 (57.2%)
70 - 79	173 (9.0%)	83 (9.2%)	256 (9.1%)
Family status			
married	1,186 (62.0%)	514 (56.7%)	1,700 (60.3%)
unmarried	334 (17.5%)	114 (12.6%)	448 (15.9%)
divorced	313 (16.4%)	175 (19.3%)	488 (17.3%)
widowed	74 (3.9%)	102 (11.3%)	176 (6.2%)
missing	7 (0.4%)	1 (0.1%)	8 (0.3%)
Partner			
living with a partner	1,265 (66.1%)	545 (60.2%)	1,810 (64.2%)
living apart toegether with a partner	141 (7.4%)	67 (7.4%)	208 (7.4%)
living without a partner	500 (26.1%)	293 (32.3%)	793 (28.1%)
missing	8 (0.4%)	1 (0.1%)	9 (0.3%)
Occupational status			
employed	768 (40.1%)	377 (41.6%)	1,145 (40.6%)
unemployed	138 (7.2%)	36 (4.0%)	174 (6.2%)
not employed	986 (51.5%)	487 (53.8%)	1,473 (52.2%)
missing	22 (1.1%)	6 (0.7%)	28 (1.0%)
Living in East or West Germany			
West Germany	1,083 (56.6%)	538 (59.4%)	1,621 (57.5%)
East Germany	831 (43.4%)	368 (40.6%)	1,199 (42.5%)
European Socio-economic classification (ESeC)			
high	703 (36.7%)	299 (33.0%)	1,002 (35.5%)
medium	183 (9.6%)	251 (27.7%)	434 (15.4%)
self-employed	127 (6.6%)	36 (4.0%)	163 (5.8%)
low	834 (43.6%)	267 (29.5%)	1,101 (39.0%)
missing	67 (3.5%)	53 (5.8%)	120 (4.3%)
Education (ISCED 11) class			
high	963 (50.3%)	337 (37.2%)	1,300 (46.1%)
medium	848 (44.3%)	481 (53.1%)	1,329 (47.1%)
low	91 (4.8%)	80 (8.8%)	171 (6.1%)
missing	12 (0.6%)	8 (0.9%)	20 (0.7%)
Relative income position			
>150% of equivalent income	319 (16.7%)	96 (10.6%)	415 (14.7%)
60%-150% of equivalent income	979 (51.1%)	521 (57.5%)	1,500 (53.2%)
less than 60% (at risk of poverty)	509 (26.6%)	209 (23.1%)	718 (25.5%)
missing	107 (5.6%)	80 (8.8%)	187 (6.6%)
Death of despair yes or no			
no	1,620 (84.6%)	841 (92.8%)	2,461 (87.3%)
yes	294 (15.4%)	65 (7.2%)	359 (12.7%)
Causes of death category			
alcohol	210 (11.0%)	45 (5.0%)	255 (9.0%)
suicide	66 (3.4%)	18 (2.0%)	84 (3.0%)
drug	18 (0.9%)	2 (0.2%)	20 (0.7%)
other	1,620 (84.6%)	841 (92.8%)	2,461 (87.3%)

Table 2 Logistic Regression to examine association of social gradient characteristics and the 'deaths of despair' (yes, or no), N=2.830, German National Cohort (NAKO, Germany, 2014-2023)

	Model 1 Odds Ratio (CI)	Model 2 Odds Ratio (CI)
Sex (female, ref. male)	0.42*** (0.30, 0.57)	0.42*** (0.30, 0.59)
Age	0.95*** (0.94, 0.97)	0.95*** (0.94, 0.97)
Family status (ref. married)		
unmarried	0.82 (0.51, 1.30)	0.83 (0.52, 1.32)
divorced	1.14 (0.73, 1.76)	1.15 (0.74, 1.78)
widowed	0.68 (0.34, 1.36)	0.70 (0.35, 1.40)
Partner (ref. living with a partner)		
living apart toegether with a partner	1.18 (0.68, 2.04)	1.18 (0.68, 2.05)
living without a partner	1.60* (1.05, 2.45)	1.60* (1.04, 2.45)
Occupational (ref. employed)		
unemployed	1.92** (1.23, 3.01)	1.89** (1.21, 2.96)
not employed	1.24 (0.91, 1.70)	1.26 (0.92, 1.73)
Living in East of West-Germany (ref. West Germany)		
East Germany	0.99 (0.77, 1.28)	0.99 (0.77, 1.28)
Income position (ref. >150% of equivalent income)		
60%-150% of equivalent income	1.38 (0.91, 2.07)	1.27 (0.83, 1.93)
less than 60% (at risk of poverty)	2.14*** (1.35, 3.39)	1.90** (1.16, 3.10)
European Socio-economic classification (ESeC) (ref. high)		
medium		1.30 (0.86, 1.99)
self-employed		1.34 (0.78, 2.31)
low		1.33 (0.95, 1.86)
Education (ISCED 11) class (ref. high)		
Medium		1.01 (0.76, 1.36)
Low		0.76 (0.42, 1.39)
Nagelkerke's Pseudo r-squared	0.07	0.08

Table 3 Multi-nominal logistic regression to examine association of social gradient characteristics and the 'deaths of despair' categories (alcohol, suicide, drug) and other causes of death as base, N=2.830, German National Cohort (NAKO, Germany, 2014-2023)

	RRR CI	RRR CI
Alcohol		
Sex (female, ref. male)	0.41*** (0.28, 0.60)	0.44*** (0.30, 0.64)
Age	0.98 (0.96, 1.00)	0.98 (0.96, 1.01)
Family status (ref. married)		
unmarried	1.01 (0.59, 1.75)	1.02 (0.59, 1.77)
divorced	1.36 (0.83, 2.23)	1.38 (0.84, 2.26)
widowed	0.86 (0.40, 1.82)	0.86 (0.40, 1.84)
Partner (ref. living with a partner)		
living apart toegether with a partner	1.23 (0.67, 2.28)	1.23 (0.66, 2.28)
living without a partner	1.36 (0.84, 2.22)	1.36 (0.83, 2.22)
Occupational (ref. employed)		
unemployed	2.44*** (1.49, 3.99)	2.40*** (1.47, 3.92)
not employed	1.23 (0.85, 1.77)	1.23 (0.85, 1.78)
Living in East of West Germany (ref. West Germany)		
East Germany	1.06 (0.79, 1.41)	1.06 (0.79, 1.42)
Income position (ref. >150% of equivalent income)		
60%-150% of equivalent income	1.85* (1.07, 3.20)	1.66 (0.95, 2.91)
less than 60% (at risk of poverty)	3.10*** (1.72, 5.59)	2.59** (1.39, 4.82)
European Socio-economic classification (ESeC) (ref. high)		
medium		1.07 (0.63, 1.80)
self-employed		1.23 (0.65, 2.31)
low		1.40 (0.95, 2.07)
Education (ISCED 11) class (ref. high)		
medium		1.02 (0.73, 1.43)
low		0.89 (0.47, 1.71)
Suicide		
Sex (female, ref. male)	0.50* (0.28, 0.92)	0.49* (0.26, 0.91)
Age	0.90*** (0.87, 0.92)	0.89***(0.87, 0.92)
Family status (ref. married)		
unmarried	0.55 (0.22, 1.36)	0.57 (0.23, 1.42)
divorced	0.50 (0.18, 1.36)	0.50 (0.18, 1.38)
widowed	0.43 (0.08, 2.15)	0.47 (0.09, 2.34)
Partner (ref. living with a partner)		
living apart toegether with a partner	0.40 (0.08, 1.95)	0.40 (0.08, 1.94)
living without a partner	2.16 (0.93, 5.00)	2.17 (0.93, 5.09)
Occupational (ref. employed)		
unemployed	0.65 (0.20, 2.01)	0.65 (0.20, 2.11)
not employed	1.30 (0.69, 2.45)	1.37 (0.72, 2.61)
Living in East of West Germany (ref. West Germany)		
East Germany	1.06 (0.65, 1.76)	1.07 (0.64, 1.79)
Income position (ref. >150% of equivalent income)		
60%-150% of equivalent income	0.67 (0.36, 1.28)	0.67 (0.34, 1.29)
less than 60% (at risk of poverty)	0.80 (0.35, 1.80)	0.85 (0.35, 2.03)
European Socio-economic classification (ESeC) (ref. high)		
medium		1.53 (0.73, 3.23)
self-employed		2.01 (0.77, 5.23)
low		1.04 (0.53, 2.06)
Education (ISCED 11) class (ref. high)		
medium		1.05 (0.58, 1.87)
low		0.00 (no observations)

Drug		
Sex (female, ref. male)	0.12* (0.15, 0.91)	0.08* (0.01, 0.71)
Age	0.91**(0.87, 0.97)	0.92**(0.86, 0.97)
Family status (ref. married)		
unmarried	0.34 (0.05, 2.10)	0.36 (0.06, 2.13)
divorced	1.45 (0.30, 7.08)	1.71 (0.36, 8.01)
widowed	0.00 (no observations)	0.00 (no observations)
Partner (ref. living with a partner)		
living apart toegether with a partner	5.35 (0.83, 34.5)	4.86 (0.77, 30.47)
living without a partner	5.49* (1.00, 30.0)	4.91 (0.96, 25.20)
Occupational (ref. employed)		
unemployed	1.68 (0.38, 7.57)	1.79 (0.40, 8.10)
not employed	0.96 (0.25, 3.66)	0.91 (0.23, 3.54)
Living in East of West Germany (ref. West Germany)		
East Germany	0.29* (0.09, 0.93)	0.30* (0.09, 0.98)
Income position (ref. >150% of equivalent income)		
60%-150% of equivalent income	0.00 (no observations)	0.00 (no observations)
less than 60% (at risk of poverty)	0.00 (no observations)	0.00 (no observations)
European Socio-economic classification (ESeC) (ref. high)		
medium		3.86 (0.76, 19.6)
self-employed		0.00 (no observations)
low		1.48 (0.33, 6.68)
Education (ISCED 11) class (ref. high)		
medium		0.93 (0.27, 3.20)
low		1.78 (0.28, 11.50)
Nagelkerke's Pseudo r-squared	0.10	0.11

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Appendix

Baseline Recruitement Information German National Cohort (NAKO), 2014-2019

Study centre	Time period of recruitment	Sex		Age group					Total
		Female	Male	20–29	30–39	40–49	50–59	60+	
Augsburg	06/2014–09/2019	10,172	10,437	2,034	2,08	5,453	5,5	5,541	20,609
Berlin-Mitte	04/2014–01/2019	5,428	5,601	1,133	1,11	3,006	2,963	2,818	11,029
Berlin-Nord	06/2014–04/2019	5,134	4,96	986	1,05	2,629	2,731	2,697	10,094
Berlin-Sued	09/2014–04/2019	5,232	4,776	1,008	997	2,688	2,583	2,732	10,008
Bremen	03/2014–11/2018	5,318	5,171	1,083	1,16	2,679	2,794	2,772	10,489
Duesseldorf	06/2014–06/2019	4,684	4,45	978	958	2,305	2,471	2,422	9,134
Essen	03/2014–09/2019	5,336	5,316	1,118	1,29	2,782	2,756	2,708	10,652
Freiburg	06/2014–04/2019	5,032	5,049	995	1,03	2,668	2,698	2,69	10,081
Halle	05/2014–03/2019	5,247	4,881	939	967	2,585	2,821	2,816	10,128
Hamburg	09/2014–07/2019	5,16	4,927	992	1,07	2,599	2,738	2,687	10,087
Hannover	03/2014–11/2018	5,162	4,878	968	956	2,543	2,666	2,907	10,04
Kiel	04/2014–06/2019	4,866	4,628	925	1,04	2,422	2,578	2,527	9,494
Leipzig	08/2014–10/2018	5,413	5,443	1,091	1,15	2,894	2,873	2,844	10,856
Mannheim	05/2014–09/2019	5,182	5,108	1,069	1,1	2,699	2,72	2,7	10,29
Muenster	05/2014–06/2019	5,027	4,988	981	998	2,661	2,686	2,689	10,015
Neubrandenburg	03/2014–02/2019	10,917	11,079	1,837	2,58	5,272	6,086	6,224	21,996
Regensburg	04/2014–05/2019	4,992	5,032	951	995	2,673	2,72	2,685	10,024
Saarbruecken	06/2014–04/2019	5,169	4,858	899	1,14	2,574	2,625	2,788	10,027
Total		103,471	101,582	19,987	21,7	53,132	55,009	55,247	205,053
Proportion (%)		50	50	10	11	26	27	27	

Study centres and central infrastructures of the German National Cohort (NAKO)