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Education, health behavior, and working conditions during the pandemic: evidence from a German sample

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ABSTRACT

Education is a main cause of health inequality because it influences health behavior as well as structural conditions that impact health, such as living and working conditions. We examine how different educational groups reacted to the beginning of the COVID-19 pandemic in Germany by looking at health-related behavior – social distancing, increased hygiene, and mask wearing – as well as changes in working conditions – work from home, reduced working hours, and not working – as a structural indicator that can mitigate the risk of infection. More than three quarters of respondents in all educational groups complied with recommended social distancing and hand hygiene behaviors, and differences by education did not exceed ten percentage points. Regarding working conditions, highly educated respondents had a likelihood of over 45 percent to work from home during the pandemic. This number decreased to 17 and 11 percent for those with intermediate and low levels of education, respectively. It seems that education-based inequalities in the risk of infection with COVID-19 do not primarily stem from differences in health behavior but rather from structural causes, that is, inability to practice social distancing at work.

KEYWORDS Health behavior; health inequality; education; working conditions; coronavirus

Introduction

Across the world, education is a main cause of health inequality: Lower education is linked to poorer health outcomes on a variety of measures, from self-rated health to chronic disease, mental health, and morbidity (Mackenbach 2012; The Lancet Public Health 2020). There are multiple and complex causal pathways that link education to health, but they can

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be roughly grouped into two categories, which we will call *behavioral* and *structural* causes (see Ross and Wu 1995, for a similar distinction).

On the *individual level*, higher education increases health literacy and health consciousness and is therefore linked to *behavior* that improves health outcomes, including exercise, nutrition, higher capabilities to cope with external stressors, and lower likelihood of smoking and substance abuse (Brunello *et al*. 2016; Ross and Wu 1995). On the *structural level*, persons with higher levels of formal education tend to have healthier living conditions because they work in well-paid, non-hazardous white-collar occupations, live in safe, non-polluted neighborhoods, and have access to high-quality care (Ross and Wu 1995).

We acknowledge that the structural and behavioral level are linked, because many forms of health-related behavior are facilitated by structural conditions – such as easy access to nutritious food –, but argue that the distinction is nevertheless important for researchers as well as policy makers who want to address the causes of health inequality.

The role of education in COVID-19-related health outcomes in Germany

First evidence points to large inequalities in COVID-19-related health outcomes (Burgen and Jones 2020; Eligon *et al*. 2020; ICNARC 2020), but we are not aware of previous studies that have specifically focused on education as a predictor. This paper offers evidence on the link between education and risk of infection from the early stages of the pandemic in Germany. Specifically, we study to what extent different educational groups adopted a range of preventative health behaviors to decrease the risk of infection such as increased handwashing, social distancing, and mask wearing. In addition, we study whether different educational groups were able to adapt their working conditions – that is, work from home, temporarily stop working, or decrease working hours –, in response to the pandemic as an important indicator of structural risk of exposure.

For Germany, previous research on the link between education and health indicates that education-based health inequality is predominantly caused by differences in health *behavior*, while *structural* differences in access to health resources and differences in living and working conditions play a less important role. According to the OECD (2019), '[b]ehavioural risk factors, especially poor diet, smoking and alcohol consumption, are a major driver of morbidity and mortality in Germany',

and these in turn are more prevalent among lower-educated individuals. In contrast, a comprehensive welfare state, extensive work health-and-safety regulations, near-universal access to high quality health care and insurance, and comparatively low levels of income inequality limit the potential for health inequality due to structural conditions (Leopold and Leopold 2018). However, due to the strong link between education and occupation in Germany (Shavit and Müller 2003), lower-educated individuals are concentrated in the most hazardous sectors and occupations.

Given the unique public health threat of the pandemic, it is important to investigate whether this general pattern also applies to the short-term health risk posed by COVID-19. Many of the most serious modern diseases in terms of morbidity and health care costs – such as cardiovascular diseases, cancer, and diabetes mellitus – are prevented by a long-term commitment to a combination of health-related behaviors whose connection to the outcome is often indirect and temporally delayed. In contrast, COVID-19 poses an immediate short-term health risk and can be prevented by short-term measures that are comparatively easy to understand and follow, such as increased handwashing, avoidance of large gatherings, and wearing face coverings. The pandemic dominated the news cycle in Germany and advice from public health officials was easily accessible. Thus, it is possible that education-based inequality in COVID-19-related health behavior does *not* follow the same pattern as more long-term health behavior.

Concerning working conditions, previous research from Germany shows that higher-educated employees were more likely to work from home during the pandemic, whereas employees with low or intermediate educational degrees were more likely to be affected by reduced hours, temporary layoffs, and job loss (Möhring *et al*. 2020). While the latter might lower the risk of infection at the work place, they come with obvious economic drawbacks. Furthermore, the majority of essential workers with the greatest risk of exposure – including delivery people, cashiers, and nurses – have low or intermediate levels of education. Thus, it seems that higher-educated individuals have a structural advantage when it comes to avoiding COVID-19 infections at work.

We hypothesize that there are differences according to education in COVID-19-related health behavior, with higher-educated groups being more likely to adopt preventative measures. We also expect that higher-educated people are more likely to experience a change in working conditions as a result of COVID-19 because they tend to work

in occupations that facilitate work from home. Taken together, this implies that higher education leads to a lower risk of infection with COVID-19 due to behavioral as well as structural causes.

Data and variables

Data set and time context of data collection

Our data source is the *GESIS Panel Special Survey on the Coronavirus SARS-CoV-2 Outbreak in Germany*, Data file Version 1.1.0 (GESIS Panel Team 2020). The GESIS panel collects longitudinal data from a nationally representative sample of respondents 18 and older living in Germany. In their current release, the special survey data are cross-sectional and contain only limited sociodemographic information. The special survey sample frame is restricted to online participants and thus not a random sample of the full population. 3238 respondents participated in the survey, which corresponds to roughly 60 percent of the full GESIS panel sample. Comparisons with German Microcensus data show that highly educated respondents are overrepresented in the survey (58% of survey respondents compared to 33% in the population), whereas those with the lowest levels of education are underrepresented (11% compared to 38%). There are also smaller biases in terms of gender, with men being overrepresented (51% compared to 49%), and age, with the youngest and oldest age groups (younger than 25 and older than 65) underrepresented and age groups 35–65 overrepresented.[1] Despite these drawbacks, this is currently the only German data set related to the pandemic that contains information on education, health behavior and working conditions, and is openly available to the scientific community.

Given the rapid development of COVID-19 infection numbers, public opinion, and policy measures, the temporal context of data collection matters. The data were collected from March 17 to March 29, in the early stages of the pandemic in Germany. First COVID-19 cases in Germany – isolated incidents that could be contained – were reported at the end of January. A coordinated public information campaign that described the disease and highlighted the importance of handwashing and other hygiene measures to reduce the spread of the virus was launched in mid-February, and news coverage of the virus increased

[1]A comparison of German Microcensus data with the GESIS panel online subsample in terms of age, gender, and education can be found at https://osf.io/2av4d/.

around the same time. Case numbers started to rise exponentially at the end of February.

During the time of data collection, case numbers as reported by the Robert Koch Institute increased from 12,558 (March 17) to 63,965 (March 29), and federal, state, and local authorities were adapting their responses accordingly. Schools and daycare facilities were closed in all federal states by March 18 and a nationwide *Kontaktverbot* (contact ban), which prohibited meetings between more than two people from different households and effectively shut down most public life, was announced on March 22. The *Kontaktverbot* marks an important breaking point regarding health-related behavior: From this point on, social distancing became mandatory instead of voluntary. However, 82.5 percent of respondents completed the survey before March 22 and 52.3 did so within the first two days of data collection.

Key variables

Education

The dataset distinguishes three levels of secondary education: (1) lower secondary degree (*Hauptschulabschluss*) or no degree (10.9 percent); (2) intermediate secondary degree (*Realschulabschluss*; 31.0 percent), and (3) higher secondary degree (*Abitur*; 58.1 percent). The current release of the data includes no information on post-secondary education.

Health-related behavior

Respondents were asked to indicate whether they had done any of the following in the last seven days:

- avoided certain (busy) places
- kept distance to other people (at least 1.5 meters)
- reduced personal meetings and contacts
- washed their hands more often and longer
- used disinfectants
- worn face masks

We constructed dummy variables for all of these items that are equal to 1 if the respective box was ticked by the respondent and 0 otherwise.

Change in working conditions

Respondents who were employed (*N* = 1909) or self-employed (*N* = 200) at the beginning of March were also asked whether their work situation had changed due to the pandemic. With regards to infection risk, we are interested in work changes that decrease contact with other individuals, which includes remote work, reduced hours, or temporary and permanent layoffs and business closures. We constructed the following binary variables:

- Increased home office. Sample is limited to respondents who did not indicate that they had stopped working due to the pandemic (*N* = 1877).
- Reduced working hours. Sample is limited to respondents who did not indicate that they had stopped working due to the pandemic (*N* = 1877).
- Temporary leave of absence or job loss (employed)/business closed temporarily (self-employed). 7.1 percent of respondents were on paid leave, 1.6 percent on unpaid leave and 0.3 had permanently lost their job. 2 percent of respondents were business owners who had temporarily closed their business. None of the self-employed respondents had permanently closed their business.

Control variables

We control for the following variables in all analyses:

Age

Due to educational expansion, older cohorts have lower levels of formal education. At the same time, since older generations are more at risk from COVID-19, we can expect them to adopt stricter preventative measures. The data only include age cohorts in five-year steps, so these were included as categorical variables.

Gender

Previous research shows that gender is linked to health behavior and health (Brunello *et al*. 2016) as well as education (Becker 2014).

Age x gender

We include the interaction effect of age and gender in our analysis because gender inequality in educational outcomes has shifted over

time, with women catching up to and then overtaking men in formal education (Becker 2014).

Interview date

At the time of data collection, news as well as public recommendations and restrictions regarding the pandemic changed daily. Thus, we include each day of data collection as a dummy variable.

Omitted variables

We do not control for mediators of the education-health relationship, such as income, occupation, or marital status.

Both educational attainment and health are influenced by social origin, race or ethnicity, and disability, as well as cognitive and noncognitive abilities (e.g. Conti *et al*. 2010; Leopold and Leopold 2018). Neither of these confounders can be held constant with the data at hand. Therefore, the conditional associations and group differences we report below should be interpreted as descriptive rather than causal.

Table 1 contains summary statistics for all key and control variables.

Analytic strategy

We use binary logistic regression models to estimate the likelihood of adopting each of the health measures presented above, given our set of control variables. The data set does not contain weights, so all estimates are unweighted. Full information on all variables of interest was available for 3186 out of 3238 respondents. Therefore, we did not use imputation methods and only analyzed complete cases. These cases form the basis of our analysis of health behavior. 2103 of these respondents had been employed or self-employed at the beginning of March. These cases formed the sub-sample for our analysis of changes in working conditions due to the pandemic.

Results are presented as *predicted probabilities* for each of the three educational groups, as well as *differences* in the predicted probabilities between all three groups, with all other variables held constant at their actual values. Since education enters our model as multiple dummy variables, these differences are *discrete change effects* or, synonymously, *average marginal effects* of education on the respective outcome (Long and Mustillo 2018; Mood 2010). The 95% confidence bars around the average marginal effects assess whether group differences are significantly different from zero: Confidence bars that *do not* overlap with the red

Table 1. Summary statistics for key and control variables.

Key variables			Control variables		
Variable	*N* valid	Percent	Variable	*N* valid	Percent
Education			Interview date		
Low	354	10.93	March 17	1009	31.16
Intermediate	1006	31.07	March 18	684	21.12
High	1878	58.00	March 19	274	8.46
Total	3238	100.00	March 20	428	13.22
			March 21	275	8.49
Health Behavior			March 22	164	5.06
Avoided places	2691	84.46	March 23	107	3.30
Kept distance to others	2558	80.29	March 24	58	1.79
Reduced contacts	2723	85.47	March 25	44	1.36
Washed hands	2901	91.05	March 26	34	1.05
Used disinfectants	1920	60.26	March 27	74	2.29
Worn face masks	117	3.67	March 28	47	1.45
Total valid answers[a]	3186	100.00	March 29	40	1.24
			Total	3238	100.00
Working conditions					
Stopped working	226	10.75	Gender		
Total valid answers[b]	2103	100.00	Male	1651	50.99
			Female	1587	49.01
Reduced hours	274	14.60	Total	3238	100.00
Increased home office	636	33.88			
Total valid answers[c]	1877	100.00	Age		
			18-30	272	8.40
			31-35	219	6.76
			36-40	276	8.52
			41-45	272	8.40
			46-50	312	9.64
			51-60	869	26.84
			61-65	347	10.72
			66-70	317	9.79
			≥71	354	10.93
			Total	3238	100.00

[a]Totals based on all valid responses. 52 survey participants did not answer the questions.

[b]Totals based on all valid responses for survey participants who were employed or self-employed at the beginning of the month (*N* = 2109). 6 survey participants did not answer the questions.

[c]Totals based on all valid responses for survey participants who were employed at the time of the survey (*N* = 1883). 6 survey participants did not answer the questions.

dashed line at 0 indicate group differences that are significantly larger or smaller than zero, confidence bars that *do* overlap with the red dashed line at 0 – and, thus, include 0 – indicate group differences that are *not* significantly different from zero.

All analyses were conducted using Stata 15.1. Syntax and full results can be found at https://osf.io/2av4d/.

Results

Figure 1 depicts results from all nine logistic regression models. The six panels in the first two rows show different measures of self-reported

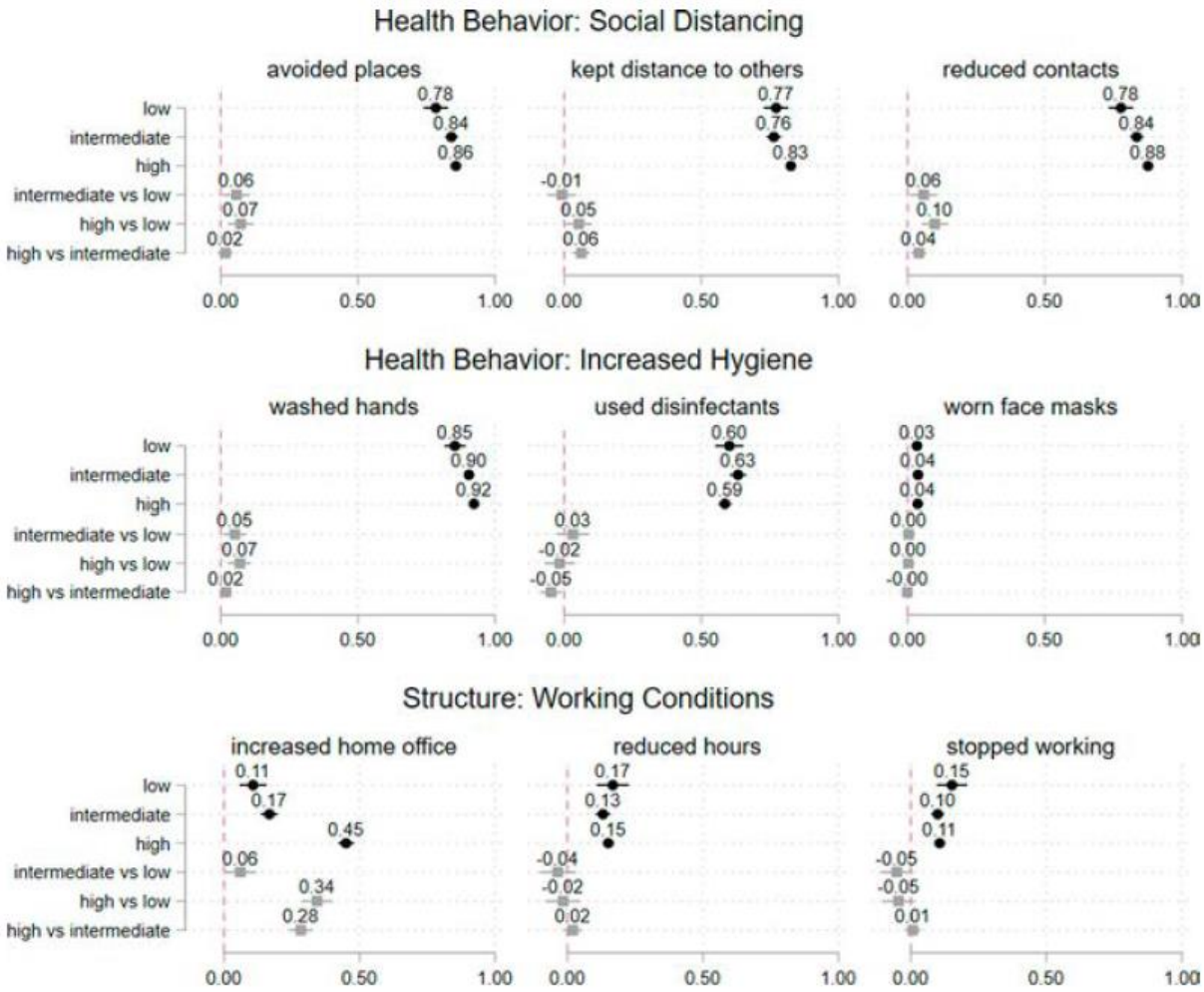

Figure 1. Health-related behavior and change in working conditions due to the COVID19 pandemic, by education. Black circles represent predicted probabilities for low, intermediate and high levels of education, with 95% confidence intervals. Gray squares represent the AME for all three contrasts, with 95% confidence intervals.

health-related *behavior* by education. Reported compliance with social distancing recommendations – avoiding busy places, keeping physical distance to others, and reducing personal contacts – ranged between 76 and 88 percent. Consistently, highly educated respondents were most likely to practice social distancing and the differences between the three educational groups are statistically significant at the five-percent level for almost all contrasts. The two exceptions are the difference between high and intermediate education for avoiding places (p = .26) and the difference between intermediate and low education for keeping distance (p = .75). A similar picture emerges for handwashing, the most popular health-related behavior among our indicators. Once again, respondents with high educational attainment are most likely to report increased handwashing (pr = .92), followed by those with an intermediate (pr = .90) and low education (pr = .85). The difference between intermediate and high education is not statistically significant (p = .12).

A slightly different picture emerges for use of disinfectants: Although a majority of respondents in all educational groups report that they used disinfectants, the numbers are lower than for social distancing and hand washing, and differences by education are smaller, ranging from 2 to 5 percentage points. Highly educated respondents are least likely to report disinfectant use, and the contrast between this group and those with an intermediate degree is significant at the 5-percent level, whereas the two other contrasts are not. Finally, education was not a statistically significant predictor of the likelihood of wearing face masks, a behavior that was reported by less than four percent of respondents.

Concerning working conditions – that is, on the *structural* level – there are no statistically significant differences between educational groups when it comes to reduced hours and layoffs, although those with low educational attainment have the highest predicted probabilities for both indicators. However, there are sharp contrasts when it comes to increased home office times. While those with a high education had a likelihood of 45 percent to increase their time working from home, that likelihood was 28 percentage points lower for those with an intermediate degree and 34 percentage points lower for those with a low degree. Contrasts between all educational groups are statistically significant at the five-percent level.

Discussion

Our results indicate that most respondents complied with public health recommendations at the time of the survey. This is evidenced by high prevalence – ranging between 76 and 92 percent – of increased handwashing and social distancing, which were the two forms of preventative behavior that were most strongly recommended by public health experts, followed by use of disinfectants, which was not encouraged to the same degree, and a low prevalence of mask wearing, which was actively discouraged at the time except for medical personnel and high-risk groups. While we do see statistically significant differences between different educational groups in the expected direction for most of the indicators, these range between 4 and 10 percentage points. Overall, it seems that, in their *individual health behavior,* respondents from all educational groups followed public health advice as a reaction to the pandemic to similar degrees.

Regarding working conditions – that is, *structural* determinants of health – a very different picture emerges. While highly educated

respondents had a likelihood of over 45 percent to work from home during the pandemic, this number decreased to 17 and 11 percent for those with intermediate and low levels of education, respectively. This means that those with the lowest levels of education were more likely to have stopped working altogether (pr = .15) than to work from home (pr = .11). Economic hardship from temporary and permanent layoffs are buffered by the German welfare state in the short term, but in the long run, ceasing to work as a means of avoiding infection is neither feasible on the individual nor societal level.

Compared to Möhring *et al*. (2020), we find smaller and statistically not significant differences by education in the likelihood to work reduced hours or having been laid off, although the pattern in our data is similar. We analyzed data collected mid to late March, whereas Möhring *et al*. cover late March to early April. Thus, it is possible that education-based inequalities with regard to working hours and layoffs increased over time. However, both data sources agree that inequalities in working from home were much more pronounced.

Overall, it seems that education-based inequalities in the risk of infection with COVID-19 do not primarily stem from different health *behavior* but rather from *structural* causes, that is, differences in the opportunity to practice social distancing at work. Given that preexisting conditions such as obesity, type 2 diabetes, and cardiovascular diseases – all of which are more common among lower educated individuals – are risk factors for severe illness from COVID-19, these differences in structural conditions further compound existing health inequalities. To fully appreciate meaning and relevance of the results presented here, it is important to note the limitations of our analysis. Firstly, results are based on observational data with a limited set of control variables from a sample that is not representative of the full population. Comparisons with German Microcensus data revealed biases in terms of gender, education, and age. We control for these variables in all models, so these biases should *not* affect our point estimates, though resulting smaller case numbers for lower educated respondents lead to increased standard errors. Still, the sample is likely biased in other unobserved and uncontrolled ways. Therefore, results should be understood as descriptive and not easily generalizable.

Secondly, the data were collected in the very early stages of the pandemic and do not allow conclusions about changes in behavior over time. For instance, official recommendations on wearing face masks have reversed since the collection of the data. Thirdly, the data are self-reported and

might be affected by social desirability bias. This could not only affect the levels of self-reported behavior but also bias the estimate of the effect of education on self-reported behavior, should respondents with different levels of formal education differ in their knowledge of which behavior is socially desirable or in their motivation to act according to social norms. Fourthly, the response options offered – yes versus no – might be too broad to capture finer nuances in health-related behavior. For instance, it is possible that, while all educational groups increased the frequency of handwashing, they did so to different degrees and thus, the data underestimate the true amount of inequality. Finally, since the data do not include long-term information on COVID-19 infections, we are unable to link health behavior and working conditions to health outcomes.

Fortunately, many of these limitations are temporary. Release of future waves of the panel data set will include more information on respondents' background and lives before the pandemic, as well as information on respondents who did not participate online. These data will also enable longitudinal research on how respondents adapted to the pandemic over time and whether they were infected. The GESIS panel as well as other German surveys has also begun to collect more information on health-related behavior and outcomes, as well as more detailed information on working and living conditions. Thus, there are ample opportunities for future research on the effect of education on COVID-19-related health behavior and outcomes.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The data that support the findings of this study are publicly available from GESIS Data Archive at http://doi.org/10.4232/1.13520.

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