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Does place matter? Regional variation in the SES-mortality gradient among retired German men

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ABSTRACT

There has been a long-standing debate concerning the relative importance of space and place vs. individual characteristics for mortality. In this paper, we analyze the association of lifetime SES-status/income and mortality at older ages among retired German men and its variation at the sub-national level. Does the income gradient in mortality differ across sub-national macro-regions and types of settlement? To answer this question we employ a large administrative dataset of the German Pension Fund consisting of 17 Mio person-years of exposure and 585.9 thousand deaths that have occurred over the period 2012–2017 among men aged 65–84. We estimate relative mortality risk using a Cox proportional hazard model. To quantify the steepness of the gradients and be able to compare them between different places of Germany we estimate the Slope Index of Inequality and the Relative Index of Inequality. Our preliminary results suggest a linear income-mortality relationship across all macro-regions and types of settlement: the risk of dying decreases as income increases. However, the degree of inequalities between different settlements and the steepness of mortality gradients vary substantially within the country. In particular, regardless of the sub-national macro-region, *big cities* reveal the highest degree of disparities across income groups.

Key words: Income gradient in mortality, sub-national differences, Germany, retired men

BACKGROUND AND AIM

There has been a long-standing debate in mortality research concerning the relative importance of space and place on the one hand and individual characteristics on the other. Some researchers argue that processes operating at the individual level are crucial for understanding health inequalities across regions while others suggest that these processes might operate differently in different places (Curtis&Jones 1998). Thus, regional variation in mortality can be broadly interpreted in terms of *compositional* and *contextual* effects (Macintyre et al. 1993). Previous research suggests the dominant role of the individual SES and moderate effects of contextual factors in predicting mortality risk (Pickett&Pearl 2001; Martikainen et al. 2003). In the context of Germany, the area-level unemployment rate was found to be an important contextual predictor (Latzitis et al. 2011; Kibele 2014; Rau&Schmertmann 2020). Several studies have reported the health advantage of individuals with lower SES residing in the better-off geographical areas (Chetty et al. 2016; Boylan&Robert 2017). In this paper, we explore the income-mortality relationship among retired German men at sub-national level. Does the income gradient in mortality differ across geographical areas and types of settlement? And if it is the case, what factors could explain this variation? These are the central research questions of this paper. Earlier research allows us to anticipate that the income–mortality association has a linear form, i.e. the risk of death decreases linearly as income increases (Martikainen et al. 2001). For our analysis we divide Germany in four subnational macro-regions (East, West, North, and South). This division allows capturing long-standing macro-regional differences in social and economic development as well as mortality differences in Germany reasonably well (Klüsener& Zagheni 2014). Within each entity, we further split the regions into three types of settlements: *big cities, other urban areas, and rural areas*. Our main hypothesis is that the mortality gradients do differ across our subnational regional categories in a way that they are steeper in economically disadvantaged places. This implies that depending on the place the same level of income is associated with different risks of dying.

DATA AND METHODS

Our analysis is based on individual pension records administrated by the German Pension Fund (DRV). For a six-year follow-up period (2012—2017) we linked records on living individuals (*Rentenbestand*) with corresponding death records (*Rentenwegfall*) and assigned to each individual the exposure time (in months) and the vital status (alive/deceased). The analysis is limited to men aged 65–89 at the baseline, who paid pension contributions for at least 20 years. We also excluded individuals with extremely low and high pension contributions. The final sample consists of 17032.9 thousand of person-years of exposure and 585.9 thousand deaths. As a proxy of individual income, we rely on the measure of a pension-point (PP). Over the working career, an individual earns PPs annually. The

amount of earning points depends on individual income: 1 PP corresponds to the average income; to get 1.5 PPs an individual should earn 50% more than the average; 0.8 PP implies an annual income of 20% less than average. Over the working career, the PPs are accumulated, and upon the retirement, they are converted into money according to the contemporary value of 1 PP. Thus, the accumulated PPs represent a lifetime income, which is a robust indicator of the socio-economic position. To make this measure even more reliable we adjust it for the duration of pension contributions. That is, in this analysis we use not the total number of accumulated PPs but the average annual PP (aaPP).

As indicated in the motivation, we divide Germany in four bigger macro-regions (East, West, North, and South), which are at the district level further subdivided into settlement type (*big cities, other urban areas, and rural areas*). To estimate the effect of income on relative mortality risk we use a Cox proportional hazard model. In contrast to the standard Cox model we estimate a smooth effect of income ("aaPP") on mortality using spline interpolation (Therneau 2021). To quantify the degree of inequalities between income groups we estimate the Slope Index of Inequality and the Relative Index of Inequality (Mackenbach & Kunst 1997). This allows us to quantify and compare amounts of health inequality according to the income-mortality gradients across our four macro-regions and types of settlements within these macro-regions.

SELECTED FINDINGS

The relationship between income and mortality is depicted by Figure 1. Each line represents the relative mortality risk (RR) in relation to our measure of lifetime income for the combinations of macro-region and type of settlement. The big cities located in the South (see panel "South") represent the reference category. That is, the income of this group (aaPP) has the value of 1, which corresponds to RR=1. The value of aaPP=1.6 corresponding to RR≈0.5 implies that individuals residing in big cities and having an income 60% higher than the average are 50% less likely to die (compared to the reference group).

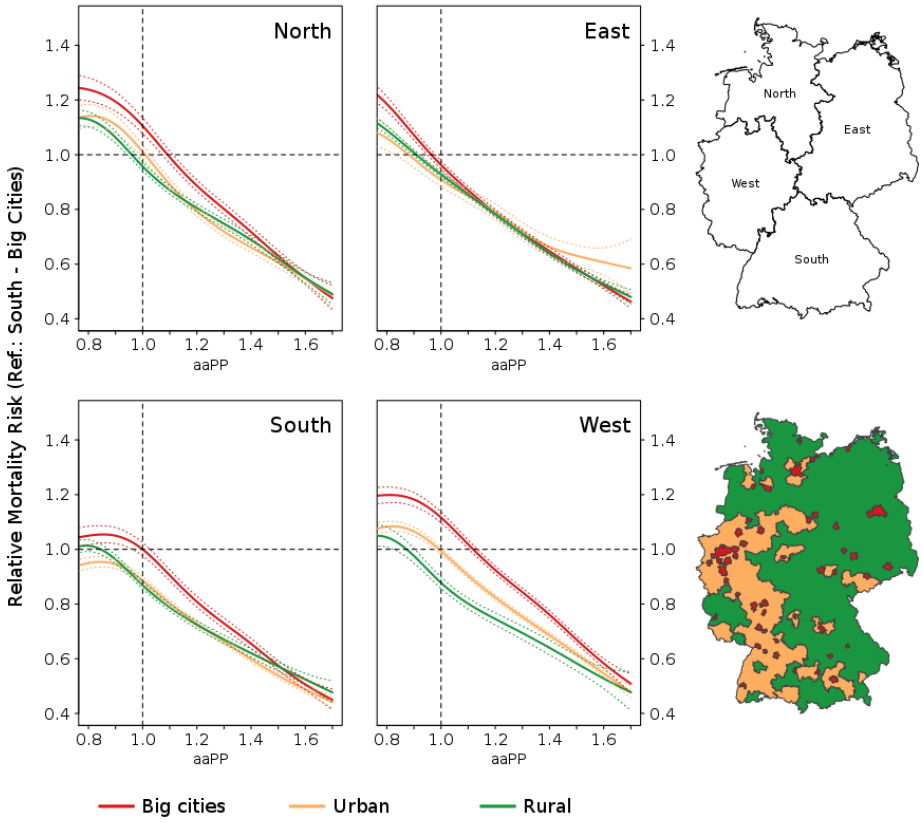

Figure 1. Relative mortality risk by area and type of settlement, Germany, men 65–84, 2012–2017

Note: the dashed lines are 95% confidence intervals

Across all geographical areas and types of settlement we can observe almost linear income-mortality relationships. However, the degree of inequalities varies substantially between the regions. For example, in the South, having an income 20% below the average does not result in substantially higher mortality risks (for other urban areas it is even slightly lower). On contrary, for those residing in big cities in the North, West, and East the 20% income disadvantage is associated with a roughly 20% elevated risk of dying. Overall, regardless of the geographical area of Germany, big cities exhibit the steepest income-mortality gradients as compared to the urban and rural settlements. This visual observation is confirmed by the Slope Index of Inequality and the Relative Index of Inequality (Figure 2).

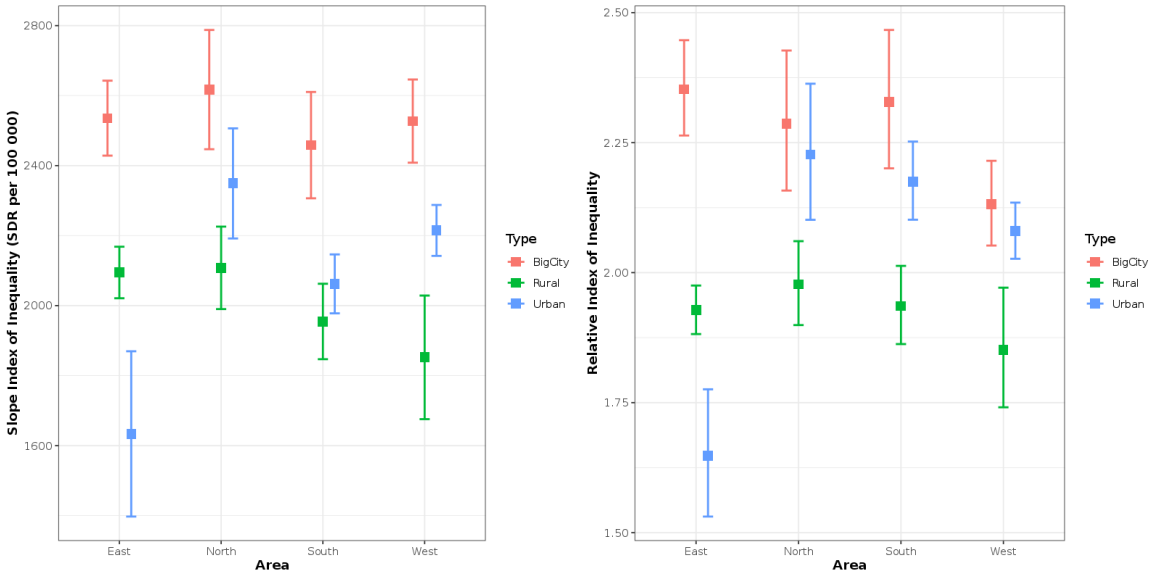

Figure 2. Slope Index of Inequality (SII) and Relative Index of Inequality (RII) by area and type of residence, Germany, men 65–84, 2012–2017

Note: bars around point estimates are 95% confidence intervals

The left-hand side panel of Figure 2 shows the absolute difference in mortality levels between the richest (aaPP=1.7) and the poorest (aaPP=0.8) income groups. As expected from Figure 1, *big cities* have the highest differentials among all types of areas as measured by both absolute and relative inequality measures. The absolute mortality difference between the richest and the poorest groups of the income distribution varies between 2458 deaths (*South*) to 2617 deaths (*North*) per 100 000 population. In relative terms, this difference varies from 2.13 in the *West* to 2.35 times in the *East.* In all geographical areas, the *rural areas* reveal the lowest degree of mortality inequality. Urban areas in the East having the lowest SII and RII is a notable exception of the observed patterns.

OUTLOOK

Between now and the time of the conference in December we intend to work on testing the robustness of the obtained results by performing various sensitive checks. Also, we would like to investigate whether the SES-mortality gradient varies within each macro-region by area-level household income. For this, we have gathered the district-level data (401 units), and classified these regions by the average household income into *low*, *medium*, and *high* income areas. Finally, we intend to deepen the theoretical background of our study so that the reported findings could be integrated in the current state of knowledge on the topic.

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