Geographical and socioeconomic inequalities in premature cancer and circulatory mortality in Italy

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1. Introduction

Socioeconomic inequalities in mortality represent one of the most pressing global public health concerns (Beenackers et al., 2016). These well-documented disparities have widened in recent years, amplified by both the economic crisis and the COVID-19 pandemic (Bambra et al., 2020), particularly in Italy. Addressing these disparities is relevant not only to ensure equal opportunities for long and healthy lives, but also for their broader economic benefits, as reducing inequalities enhances workforce productivity and reduce healthcare costs (Marmot, 2006; Bambra et al., 2020). Among indicators of socioeconomic status (SES), educational attainment is the most employed in health research, given its strong associations with health, employment, income, health literacy, and behavioral risk factors such as smoking and obesity (Rogers et al., 2010). Individuals with less education consistently experience poorer health and elevated mortality risks. Previous research has shown that socioeconomic inequalities are particularly pronounced in cause-specific mortality from cardiovascular and respiratory diseases, and from external causes related to high-risk occupations (Marí-Dell'Olmo et al., 2015; Rogers et al., 2010). In Italy, cancer and circulatory diseases are the leading causes of death. Men face higher disparities in cancer, HIV/AIDS, and respiratory mortality, while women experience greater inequalities in diabetes, circulatory, and genitourinary mortality (Alicandro et al., 2018). Despite these recognized inequalities, few studies have explored regional differences in Italy, a gap that is significant given that health policies are managed regionally and can influence healthcare access.

2. Aim of the study

This study addresses this gap by examining geographical and socioeconomic differences in all-cause and cause-specific mortality across Italian regions, testing whether disparities vary by cause of death, age group, sex, and region. Given the regional healthcare governance in Italy, differences in policies, resources, and service accessibility may either exacerbate or mitigate these inequalities. By jointly analyzing level of mortality and inequality across regions, the study offers valuable insights for region-specific public health interventions.

3. Data and Method

Data come from the Mortality Inequality Database (ISTAT, 2024), that is based on the integration of the Italian National Register of Causes of Death (2019–2022) and the National Base Register of individuals (98.5% linkage success). The dataset covers all 21 Italian regions (including Trento and Bolzano provinces) and provides deaths and person-years stratified by sex, education, region, cause of death, and 5-year age groups (30–34 to 95+). Original education categories are four: (1) no education or primary school, (2) middle school, (3) high school, and (4) university degree or more. To address small sample sizes and ensure statistical robustness, educational categories are aggregated as follows: for ages 30–69, levels (1) and (2) are combined into (1); for ages 70–84 and 85+, levels (3) and (4) are merged into (3). These aggregations take into account cohort effects, reflecting the progressive increase in educational attainment among younger generations. In older cohorts, primary education was more prevalent, and holding a secondary school diploma often represented a relatively high level of education. Final categories are low (1), medium (2), and high (3). To quantify inequalities, we estimate the Relative Index of Inequality (RII) (Alicandro et al., 2018; Moreno-Betancur et al., 2015). The socioeconomic rank is calculated as the cumulative proportion of the population with higher education. RII is estimated using a multiplicative Poisson regression with a log-link, including 5-year age groups and the median socioeconomic rank, with person-years as offset. The RII, derived by exponentiating the coefficient of the median socioeconomic rank, reflects relative inequalities: ratio of mortality in the lowest versus highest socioeconomic level. An RII of 1 indicates no inequality and an RII > 1 (<1) indicates higher mortality in the lowest (highest) level. Overdispersion is accounted for by inflating standard errors when the Chi-squared-based parameter exceed one. RII are calculated separately by sex, age group (30+, 30–69, 70–84, 85+), cause of death, and region.

4. Preliminary results

In 2019, inequalities in mortality are most pronounced at ages 30–69: the national RII for all-cause mortality at this age is 2.1 (2.0–2.2) compared with 1.3 at 30+, 1.3 at 70–84, and 1.2 at 85+. To illustrate regional patterns, we present results for the year 2019 and the 30–69 age group. We show results on all-cause mortality, as well as on two leading causes of death, accounting for a substantial proportion of mortality and health disparities in Italy: (1) all cancers, and (2) diseases of the circulatory system. Among men, national RII for all-cause mortality is 2.4 (2.3–2.5), ranging from 1.7 (1.2–2.5) in Bolzano to 2.7 (1.3–5.7) in Valle d'Aosta. Low mortality and low inequality characterize Bolzano and Marche, while Calabria combines high mortality with low inequality. By contrast, Friuli and Valle d'Aosta show high inequality despite average mortality. Campania and Sicilia stand out for very high mortality but RII close to the national level. For cancer mortality, male inequality is slightly lower (national RII 2.1, 2.0–2.2) and regional variation is smaller, ranging from 1.5 (0.9–2.4) in Trento

to 2.3 (0.8–6.6) in Valle d'Aosta. Circulatory male mortality reveals the sharpest regional disparities: national RII 2.2 (2.0–2.3), from 1.0 (0.3–3.8) in Valle d'Aosta to 3.5 (2.2–5.8) in Friuli Venezia-Giulia (FVG). Emilia Romagna and Trento show high inequality despite relatively low mortality, while Calabria combines high mortality with low inequality. Female patterns diverge. For all-cause mortality, the national RII is 1.8 (1.7–1.9), ranging from 1.2 (0.9–1.6) in Marche to 2.8 (1.5–5.1) in Molise. Abruzzo exhibits high inequality with average mortality, while Campania combines high mortality with average inequality. Female cancer mortality inequalities are smaller (national RII 1.4, 1.3–1.5), with regional estimates from 0.9 (0.3–2.5) in Valle d'Aosta to 2.3 (1.0–5.0) in Molise; Trento is notable for high inequality despite low mortality. Circulatory mortality among women shows the widest gaps: national RII 2.7 (2.4–3.0), ranging from 0.8 (0.2–2.8) in Trento to 4.5 (1.7–11.4) in FVG. Several southern regions (Abruzzo, Basilicata, Calabria) combine high mortality with high inequality. Campania and Sicilia consistently stand out for very high mortality but only average inequality, while Bolzano and Piemonte show low inequality with low to average circulatory diseases-mortality. Overall, the extent of mortality disparities differs by cause of death and regional context. Some regions consistently perform well across causes, while others repeatedly emerge as critical cases. Differences in healthcare system performance likely contribute to these disparities, highlighting the need for region-specific strategies to reduce to socioeconomic inequalities. Reducing disparities requires prioritizing regions with both high mortality and high inequality, while learning from more equitable regions. Finally, expanding healthcare access and supporting education are key to advancing health equity.

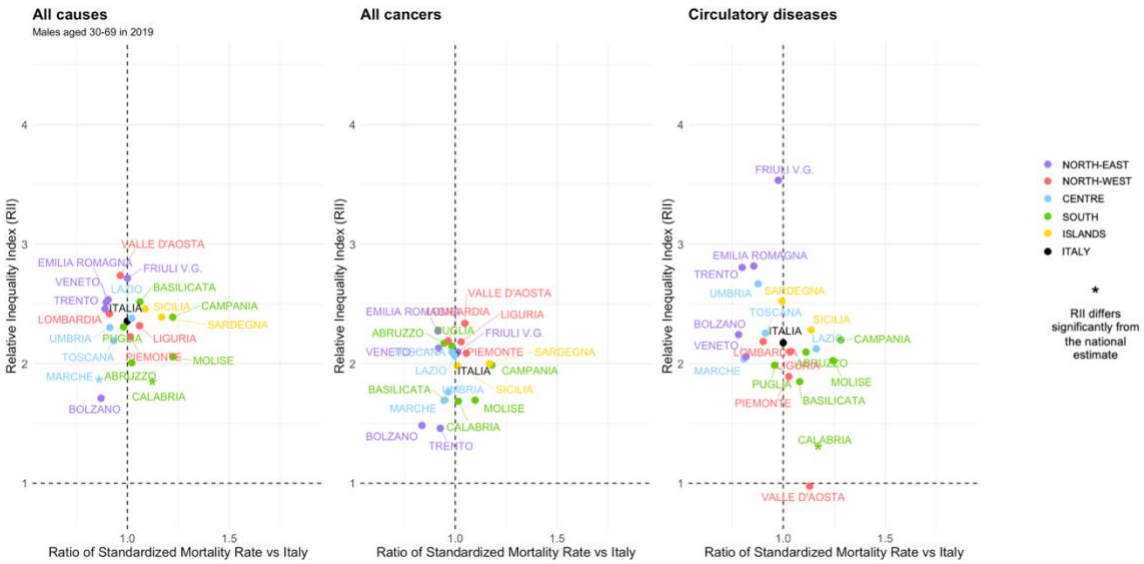

Figure 1. RII and ASMR ratios (compared to the national average) by region for all-cause, all-cancer, and circulatory disease mortality among females aged 30–69. *RII differs significantly from the national estimate.

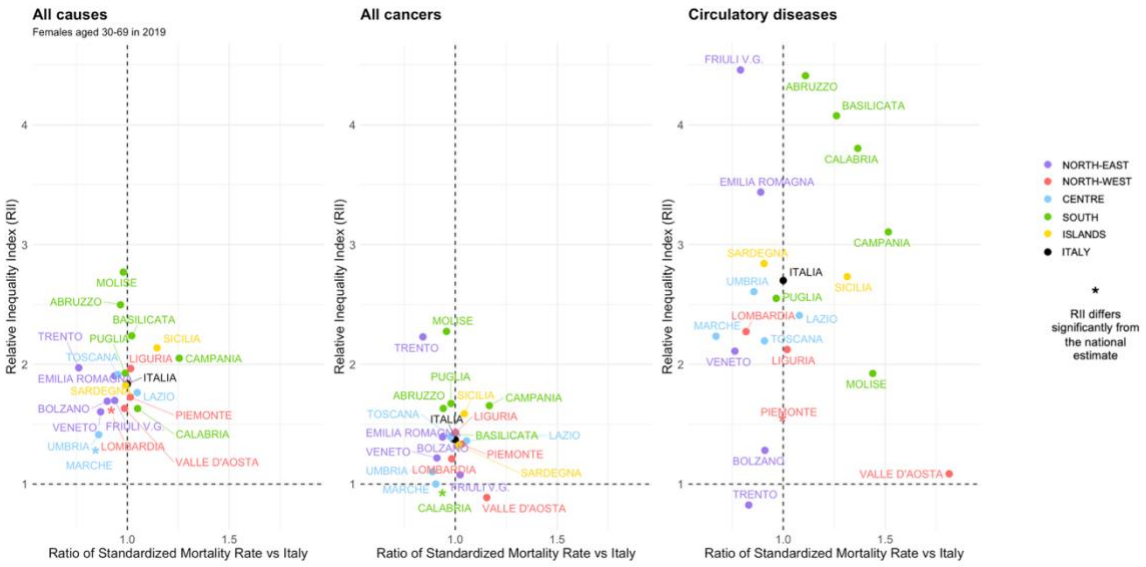

Figure 2. RII and ASMR ratios (compared to the national average) by region for all-cause, all-cancer, and circulatory disease mortality among females aged 30–69. * RII differs significantly from the national estimate.

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