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Mortality inequality in Chile

Gedeão Locks

German Institute for Economic Research (DIW)

Correspondence
Gedeão Locks, German Institute for Economic Research (DIW), Mohrenstraße 58, 10117 Berlin, Germany.
Email: glocks@diw.de

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Abstract

This paper analyses trends in mortality inequality in 330 Chilean communes from 1990 to 2010 for different age groups and both genders. Chile had substantial inequalities in local-level mortality rates in 1990 but by 2010 these disparities had significantly decreased, especially among infants, children and the elderly. The only exception was Chilean men aged 20–39, for whom inequality in mortality remained persistently high. Robust economic growth and targeted health interventions in the 1990s contributed to declining mortality rates and mortality inequality. From 2000 to 2010, efforts to expand safety nets and improve health-care access continued, with a greater impact on adults aged 49 years and above. Despite these advances, child mortality remains significantly higher than in developed countries, and the increasing number of female suicides in younger age groups represents a concerning trend.

KEYWORDS
Chile, income inequality, mortality inequality, welfare

JEL CLASSIFICATION
H75, I14, O54

1 | INTRODUCTION

Latin America is often cited as the world's most unequal region, characterised by high and persistent levels of socio-economic inequalities (De Ferranti et al., 2003; Lustig, Lopez-Calva and Ortiz-Juarez, 2013). The COVID-19 pandemic has further worsened existing inequalities, with Latin America being the most affected region globally. Despite comprising only 8.4 per cent of the world's population, it accounted for more than 25 per cent of global cases and a third of worldwide deaths (OECD, 2020). Understanding how mortality inequality has evolved in recent decades is crucial to addressing it. However, there is scant evidence of mortality inequality in the region as previous research has primarily focused on rich countries (Currie, Schwandt and Thuilliez, 2020; Redler et al., 2021).

This paper aims to fill this gap in the literature by examining trends in mortality inequality by small geographical areas in Chile between 1990 and 2010. Following the method used by Currie and Schwandt (2016), I use a ranking based on the fixed poverty rate across 330 Chilean communes (*comunas*) and group 5 per cent of the population into 20 groups to analyse changes in mortality inequality for all age groups. This geographical approach allows for an examination of all deaths, regardless of the availability of information on income and education for the entire population.

The analysis of mortality inequality in Chile is interesting for several reasons. First, Chile is considered to be the most developed country in Latin America.[1] This means that such a study can offer insights into policies within middle- and high-income countries while shedding light on specific characteristics of the Latin American context, including high levels of income inequality and poverty (Flores et al., 2020; MDSF-UNDP, 2020). Second, from 2000 to 2015, Latin American countries experienced a sharp drop in poverty rates and income inequality (Lustig et al., 2013). Although these improvements are well documented, much less is known about how mortality inequality changed in Chile during the period that saw falling income inequality. Lastly, Chile's specific features, including concentrated poverty in older cohorts (above the age of 65) and a well-rated health-care system,[2] add further interest to the analysis (OECD, 2013). I find strong and overall reductions in mortality rates for all age groups and both genders over the 1990–2010 period. The greatest drop in mortality for younger cohorts (ages 0–9) is concentrated in the period from 1990 to 2000, when Chile's economy experienced rapid growth and the country implemented successful health policy interventions (Jadresic and Zahler, 2000; Jiménez and Romero, 2007). However, improvements for the young were modest between 2000 and 2010, while older age groups (above the age of 50) continued to experience substantial declines in mortality rates during the decade 2000–10. The same patterns are observed for inequality in mortality. The main exception was among men aged 20–49, for whom a noticeable gap in mortality rates persisted in 2010. By 2010, there was no evidence of a poverty gradient in mortality for ages above 50 in Chile.

The examination of mortality rates by causes of death confirms the overall decline in mortality experienced in the country. Mortality gains among children and youth (ages 0–19) in both genders were driven by substantial reductions in respiratory diseases and mortality by external causes. This sharp decline is associated with the extended free access to specialised care for acute respiratory infections in the 1990s (Jiménez and Romero, 2007). Moreover, I find that disparities in mortality rates among men aged 20–49 found in the aggregate analysis were mostly driven by inequality in external cause mortality among young adults (aged 20–39), specifically a notable increase in suicides in more disadvantaged areas. This finding is in line with previous studies, indicating a concerning rise in suicide rates among young adults under the age of 39 for both genders (Bustamante et al., 2015). For adults older than 50, improvements in cancer, respiratory and cardiovascular diseases mortality curbed mortality inequality and mortality rates during the period 1990–2010.

These findings align with previous research, indicating that the 1990s saw a notable decline in mortality rates and mortality inequality as a result of the impact of economic growth and targeted health interventions (Bossert and Leisewitz, 2016). Subsequently, from 2000 to 2010, the expansion of safety nets, including the 'Chile Solidario' cash transfer programme, along with reforms enhancing access to public health care, continued to drive improvements, with a more significant impact among adults older than 49 (Atun et al., 2015).

The remainder of the paper is organised as follows. Section 2 provides background and an overview of the related literature. In Section 3, I discuss the data and methods while in Section 4 I report the main results for changes in mortality inequality in Chile by gender and age. I discuss the main findings

[1] According to the United Nations Human Development Index, Chile was ranked 40th, the highest among Latin American countries (United Nations Development Programme, 2013).

[2] Chile's health system is ranked 33rd in the world by the World Health Organization; Brazil is ranked 125th, Colombia 102nd, Argentina 98th and Peru 87th (World Health Organization, 2000).

and provide additional analysis on the leading causes of death in Sections 5 and 6, and I conclude in Section 7.

2 | BACKGROUND

Chile is an upper-middle-income country with nearly 20 million inhabitants and a gross domestic product per capita of US$23,492 at purchasing power parity in 2016 (taken from the World Bank's International Comparison Program[3]). It is South America's richest and most developed country. Throughout the 20th century, Chile experienced booms and busts, with alternating moments of economic growth and downturns. Following the political instability in the 1970s, a dictatorship was established, which lasted nearly 20 years. After the restoration of democracy in 1990, a growing demand for increased social spending in areas such as health and education resulted in the return of programmes that had been abandoned by the authoritarian regime. For instance, the re-establishment of free primary care visits and several improvements in the targeting and accessibility of health care (Jiménez and Romero, 2007).

Moreover, the country has experienced a significant educational expansion in recent years. Data show a remarkable reduction in the illiteracy rate (from 16.4 per cent in 1960 to 2.2 per cent in 2012), an increase in schooling years (from 6.4 in 1980 to 9.7 in 2010), and a rise in primary school attendance (from 80 per cent in 1960 to 99.1 per cent in 2003) (United Nations Development Programme, 2013).

Recent studies have documented the protective effect of education for adults and children in Chile. However, mortality decreased more rapidly among the more educated, leading to widened educational disparities in mortality (Sandoval and Turra, 2015). Using data from the National Socioeconomic Characterization Survey (CASEN), another study found a strong income gradient and observed threshold effects of income inequality on poor self-rated health (Subramanian et al., 2003). The authors concluded that more unequal communities were associated with a higher probability of reporting poor health, even after accounting for other factors.

2.1 | Health system in Chile

The health system in Chile is characterised by a strong segregation between public and private health systems. Rich people are predominantly covered by private insurance, while the poor rely mostly on the public sector. However, according to the World Health Report 2000, Chile's health system is highly rated among Latin American countries, 33rd in the world (World Health Organization, 2000).

In Chile, public health insurance is provided through the National Health Fund (Fondo Nacional de Salud, FONASA), which is funded by compulsory contributions (7 per cent of an individual's gross income), the government's health budget and co-payments (Vásquez, Paraje and Estay, 2013). In 2015, more than 80 per cent of the population were covered by public insurance while the private system (Instituciones de Salud Previsional, ISAPRE) covered around 20 per cent. Private health expenditures account for 52 per cent of total health expenditures and the compulsory contribution to private health care is also 7 per cent of an individual's gross income but is scaled up depending on the health plan.

Previous studies indicate a high level of disparity in health access across age, gender and location in Chile (Arteaga, Astorga and Pinto, 2002; Mardones, 2004). The average user of private health care (ISAPRE) is urban, male and under 60 years old, while the public sector (FONASA) covers the poorer and older population in rural locations. According to the 2015 CASEN, a national coverage survey, 34 per cent of people younger than 49 were covered by the ISAPRE, but this fraction declines to 12 per cent for older people (above 70). Moreover, primary-level and outpatient medical care coverage points to important disparities in the provision of public health services. Data on hospital discharges show

[3] See https://www.worldbank.org/en/programs/icp.

significant inequality in access to highly complex medical care depending on the place of residence (Arteaga et al., 2002).

2.2 | Health system reform in Chile

In response to significant inequalities and growing public dissatisfaction, Chile initiated a health reform process in the early 2000s (Sandoval Orellana, 2004). The AUGE (Universal Access with Explicit Guarantees) reform aimed to address health access disparities, emphasise health prevention, and provide timely care for health issues with a significant disease burden. The funding for the reform was secured through a 1 per cent increase in value-added tax. The main focus of the AUGE reform was to create a list of 56 priority health conditions, which accounted for nearly 80 per cent of the disease burden.

Each condition on the list was assigned a specific level of quality care based on predefined protocols, and financial protection was guaranteed if the treatment costs exceeded a certain threshold. The initial list of 25 conditions started in 2005, and it was gradually expanded until 2007 (Aguilera et al., 2015).

There has been limited empirical research to track the effects of these policy changes in Chile, and the existing body of evidence is unclear regarding the impacts of the reform (Unger et al., 2008). Frenz et al. (2014) use repeated cross-sectional household survey data to analyse measures of health-care inequalities over the 2000–09 period. According to their findings, the Chilean health system became more equitable after the implementation of AUGE and other reform measures. However, Paraje and Vásquez (2012) document an increase in the average number of visits to general practitioners and higher spending per beneficiary of public health insurance due to the reform. They suggest that there are still significant obstacles (e.g., inadequate medical human resources) to the equitable utilisation of health-care services. Additionally, Koch, Pedraza and Schmid (2017) find that out-of-pocket expenditures remained a burden for low-income households despite the reform efforts.

3 | DATA AND METHODS

I use data from the Statistics Department of the Health Ministry (Departamento de Estadísticas e Información de Salud, DEIS) in Chile. The system in Chile consists of death certificates issued by doctors and health professionals, and it is mandatory to obtain a death certificate. For my analysis, I gather counts of deaths for the years 1990–92, 2000–02 and 2009–11. From these data, I construct three-year mortality rates based on gender, age group and commune.

On 27 February 2010, Chile was hit by a massive earthquake, generating a tsunami that caused nearly 500 deaths. Even though I compute three-year mortality rates, it is crucial to consider the potential impact of this event on mortality trends due to the size and concentration of the damage. To address this concern, I provide a robustness check in the online Appendix (Figure A.4) in which I remove deaths from 2010 and replace them with deaths from the year 2012. While the overall mortality trends remain relatively unaffected, there is a slight reduction in mortality rates due to this change.

Chile is divided into 16 regions, 53 provinces and 346 communes. The communes are the smallest administrative areas of Chile. To allow for international comparison, these data are organised using the same age groups found elsewhere in the literature (Baker, Currie and Schwandt, 2019; Banks et al., 2021; Bertoli and Grembi, 2021). Poverty rates by communes are calculated by the Ministry of Social Development combining data from CASEN, a national household survey conducted on a two-year basis, Census data and administrative registers. These estimates are the official poverty rates and serve as a basis for the distribution of public funds in Chile. Poverty rates are available for years 2009 and 2011. Overall, changing the benchmark year for poverty rates does not alter the core findings. Figure A.2 in the online Appendix shows the poverty rates for the years 2009 and 2011 by commune in Chile. It can be seen that there is a strong relation between poverty rates across years, which indicates

that the poverty ranking is stable over the period. In my estimations, I use the 2009 poverty rates in order keep the largest number of communes.

I follow Currie and Schwandt (2016) and rank Chilean communes according to their poverty rates. Then I group communes into 20 bins, each representing 5 per cent of the population, and I calculate the three-year mortality rate for each age group and gender in 1990, 2000 and 2010. Specifically, I run the following regression

$$\text{Mortality}_{avt} = \alpha + \beta \text{Rank}_{avt} + \epsilon_{avt}, \quad (1)$$

where Mortality is the mortality rate for age group a, ventile v and year t, and Rank is the rank of the ventile. The slope β represents the relationship between poverty rank and mortality. A value of zero indicates that there is no poverty gradient in mortality rates whereas a larger value of β means a strong association between poverty levels and mortality rates (Baker et al., 2019).

4 | RESULTS

Communes with a high (low) poverty rate are considered poorer (richer) areas. Figure 1 shows a map of the distribution of poverty for communes in Chile using poverty rates for the year 2009. The poorest areas are in the centre of the country, namely La Araucanía and Bío-Bío, with pockets of poverty spread across other regions. Ranking communes by their poverty rate and dividing them into ventiles of the overall population results in groups that contain an average of 900,000 people each (see Figure A.1 in the online Appendix).

For clarity, I present most results graphically, using mortality rates on the y-axis and poverty ranks on the x-axis. The figures illustrate the association between mortality and the share of the population living in poverty, both by age group and Census year. The slopes of the regression lines indicate the strength of the poverty gradient on mortality rates. Steeper lines suggest higher levels of mortality inequality, while lower lines indicate lower mortality rates. To ensure that my findings are not affected by changes in the age structure of the population, I apply the age-specific mortality rates in 2000 and 2010 to the 1990 population. Clear and consistent patterns emerge across all age groups and both genders in Table 1 and Figure 2.

First, mortality rates have shown a sharp decline over time, with the most significant drop occurring between 1990 and 2000 (Aguilera et al., 2020). This period coincided with a robust economic performance in Chile, where the average economic growth between 1990 and 1998 exceeded 7 per cent per year, higher than any other Latin American country in the same period (Jadresic and Zahler, 2000). Secondly, there has been a substantial reduction in mortality inequality, with the most significant shift observed among children (aged 0–4) and adults aged 50–79. Thirdly, for older individuals aged 65–79 and 80+, improvements are concentrated in the 2000–10 period. Lastly, men had considerably higher mortality rates than women in 1990, regardless of whether they lived in poorer or wealthier areas. However, the decline in mortality rates during this period was more pronounced for men than women, leading to a smaller gender gap in mortality rates.

Examining the results for children aged 0–4, the greatest reductions in under-five mortality rates occurred up until the 2000–10 decade, and mortality fell faster in the poorest areas of Chile. For both genders, Chile narrowed the existing gradient in mortality, and advances were more modest in the 2010–20 decade. Mortality inequality among males aged 5–19 was still significant but very small, although virtually non-existent for females. Mortality inequality was most persistent in Chile among men aged 20–49, as seen from the coefficients in Table 1. Figure 3 breaks down the 20–49 age group into three smaller groups to gain more insight into the changes in inequality. Table 2 reports the coefficients for inequality in mortality over the 1990–2010 period for the decomposed age groups: 20–29, 30–39 and 40–49. The persistent gaps in mortality were mainly influenced by high inequality

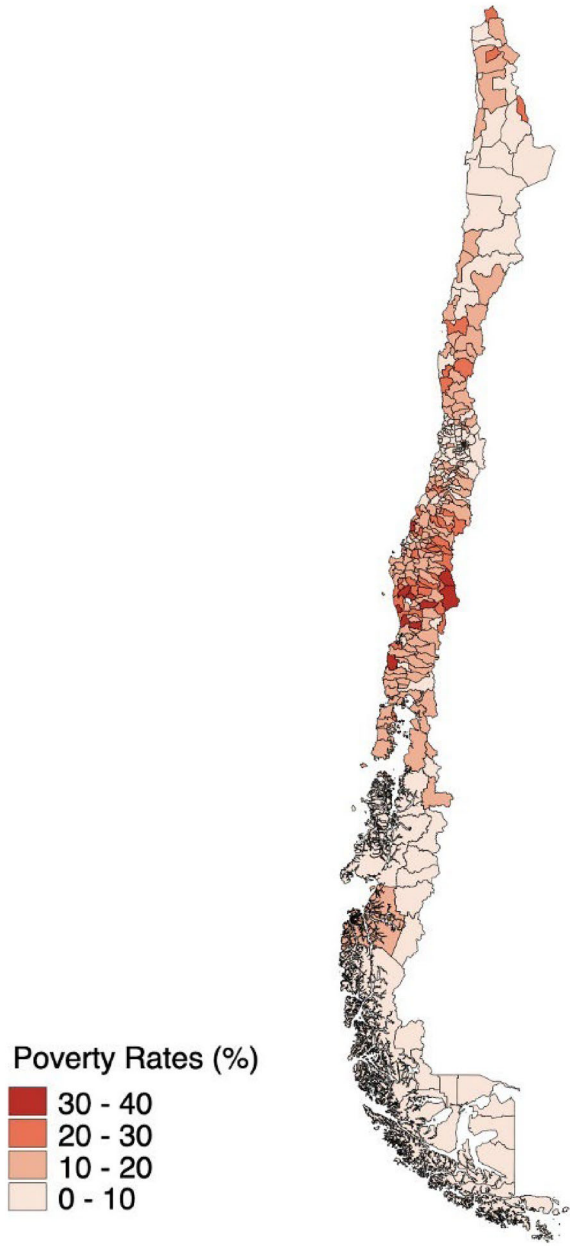

FIGURE 1 Poverty rates in Chile (2009). *Note*: Poverty rates by communes are calculated by the Ministry of Social Development (Ministerio de Desarrollo Social) combining data from CASEN and administrative registers.

in mortality among men aged 20–39, while within the 40–49 age group, the inequality in mortality decreased substantially.

The relationship between mortality rates and poverty was very strong in the 1990s at ages 65–80+, especially among women. This result is consistent with previous studies that point out inequalities in access to health insurance and health care for the elderly in Chile during the 1990s and early 2000s (Mardones, 2004). However, these cohorts experienced the most significant reductions in mortality inequality, and essentially muted the poverty gradient in mortality rates in 2010. This evidence lends

TABLE 1 Mortality rates in Chile.

Age	Deaths per 1,000 in 2010		Percentage change 1990–2010		Regression slopes	
	Richest	Poorest	Richest	Poorest	1990	2010
Panel A. Females						
0–4	4.178	5.392	−10.6	−41.2	0.033***	0.010
5–19	0.957	1.243	−32.4	−50.9	0.004*	0.001
20–49	1.393	2.582	−38.3	−38.8	0.014***	0.004
50–64	6.481	11.332	−55.4	−54.1	0.074***	0.017
65–79	28.137	40.099	−58.9	−59.0	0.175***	0.021
80+	165.906	222.941	−44.2	−24.7	0.145	0.314
Panel B. Males						
0–4	4.302	6.359	−29.4	−41.0	0.029***	0.009
5–19	1.061	2.302	−46.1	−35.9	0.011***	0.006*
20–49	2.746	7.009	−43.5	−28.1	0.037***	0.024**
50–64	12.740	16.550	−53.8	−53.8	0.094**	0.031
65–79	53.461	66.003	−52.4	−50.3	0.165*	0.064
80+	267.649	233.321	−22.7	−30.7	0.295	−0.040

Note: Death counts for Chile come from the Statistics Department of the Health Ministry (DEIS). Population counts, by gender and age, and poverty rates come from the National Census (2010). Death rates are calculated using a population-weighted average of three-year age group death rates. 'Richest' ('Poorest') refer to the 5 per cent of the population living in communes with lowest (highest) poverty rates. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.001$.

support to the idea that the health system reforms during the 2000s were effective in reducing regional disparities in access to health care among the elderly in Chile (Frenz et al., 2014).

By 2010, mortality rates for the population older than 65 were still high in Chile, which could be attributed to the relatively high poverty rates among the elderly (above the age of 66) in Chile (17 per cent), in comparison with other similar countries, such as Brazil, where the poverty rate for individuals above age 66 is 7 per cent (OECD, 2013). Nevertheless, by 2010, Chile experienced substantial reductions in mortality rates that were relatively consistent across poorer and richer areas, resulting in lower inequality in mortality throughout the country.

The findings presented in this section are robust to the use of alternative measures to classify Chilean communes. Figure A.3 in the online Appendix reproduces Figure 2, using illiteracy rates as an alternative to poverty rates. The results lead to similar conclusions: a decline in overall inequality among the young, steep slopes for men in the 20–49 age group, and parallel downward shifts for adults above the age of 50.

5 | ANALYSIS BY CAUSE OF DEATH

In this section, I examine the main causes of death in Chile to understand the dynamics behind the overall mortality patterns documented in the previous section. Table 3 presents the age-adjusted mortality rates for the leading causes of death in Chile by age group from 1990 to 2010, and their change in percentage during the period.[4] Figures 4–7 display the evolution of respiratory, cardiovascular, external cause and cancer mortality, respectively.

[4] See Table A.1 in the Appendix for the ICD9 and ICD10 codes used for mortality classification.

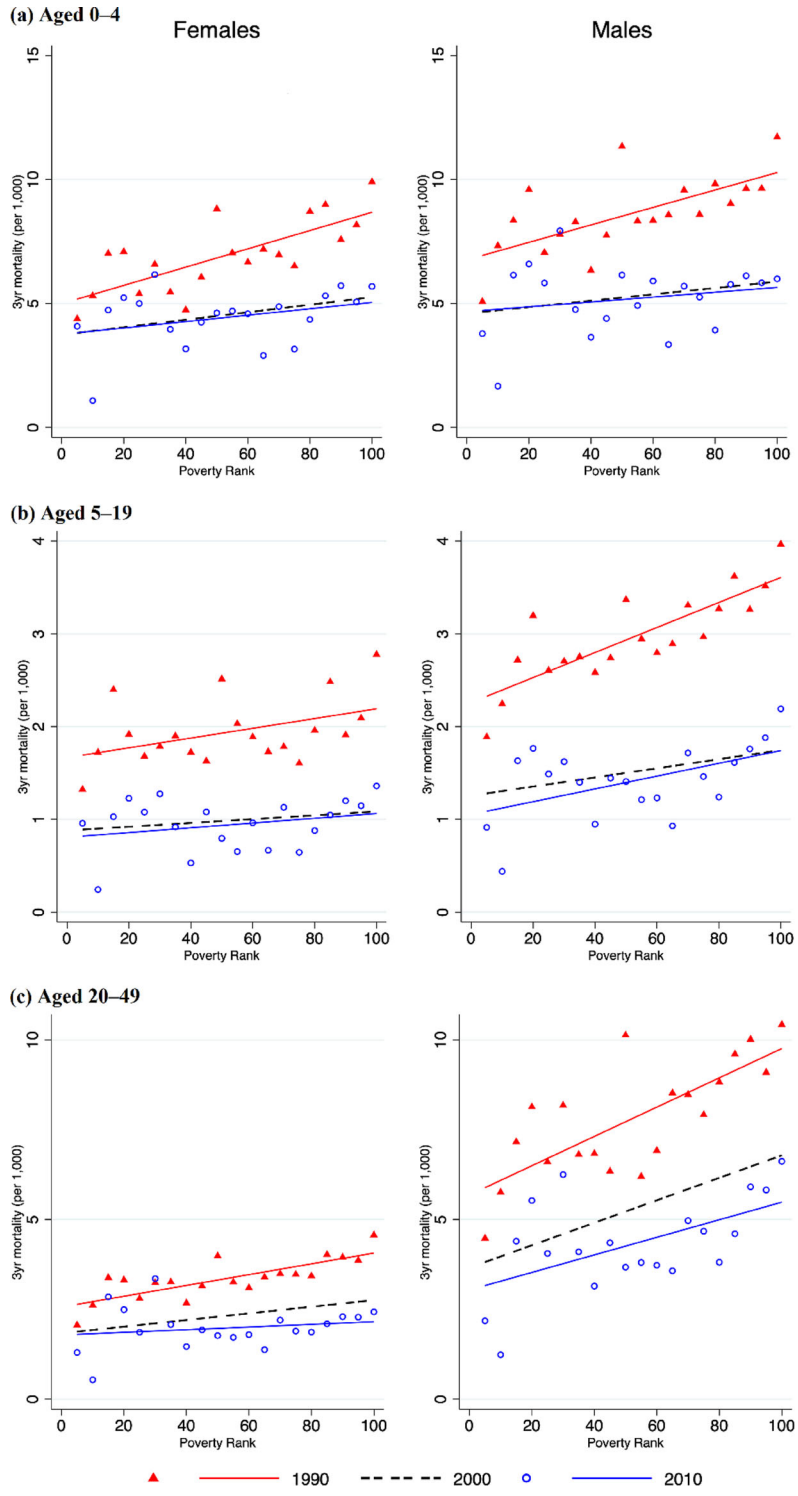

FIGURE 2 Trends in mortality rates per 1,000 in Chile (1990–2010). *Note*: This figure displays gender- and age-specific three-year mortality rates, plotted across groups of communes ranked by their poverty rate. Each bin represents a group of communes encompassing approximately 5 per cent of the overall population in the respective year. Lines represent linear fits.

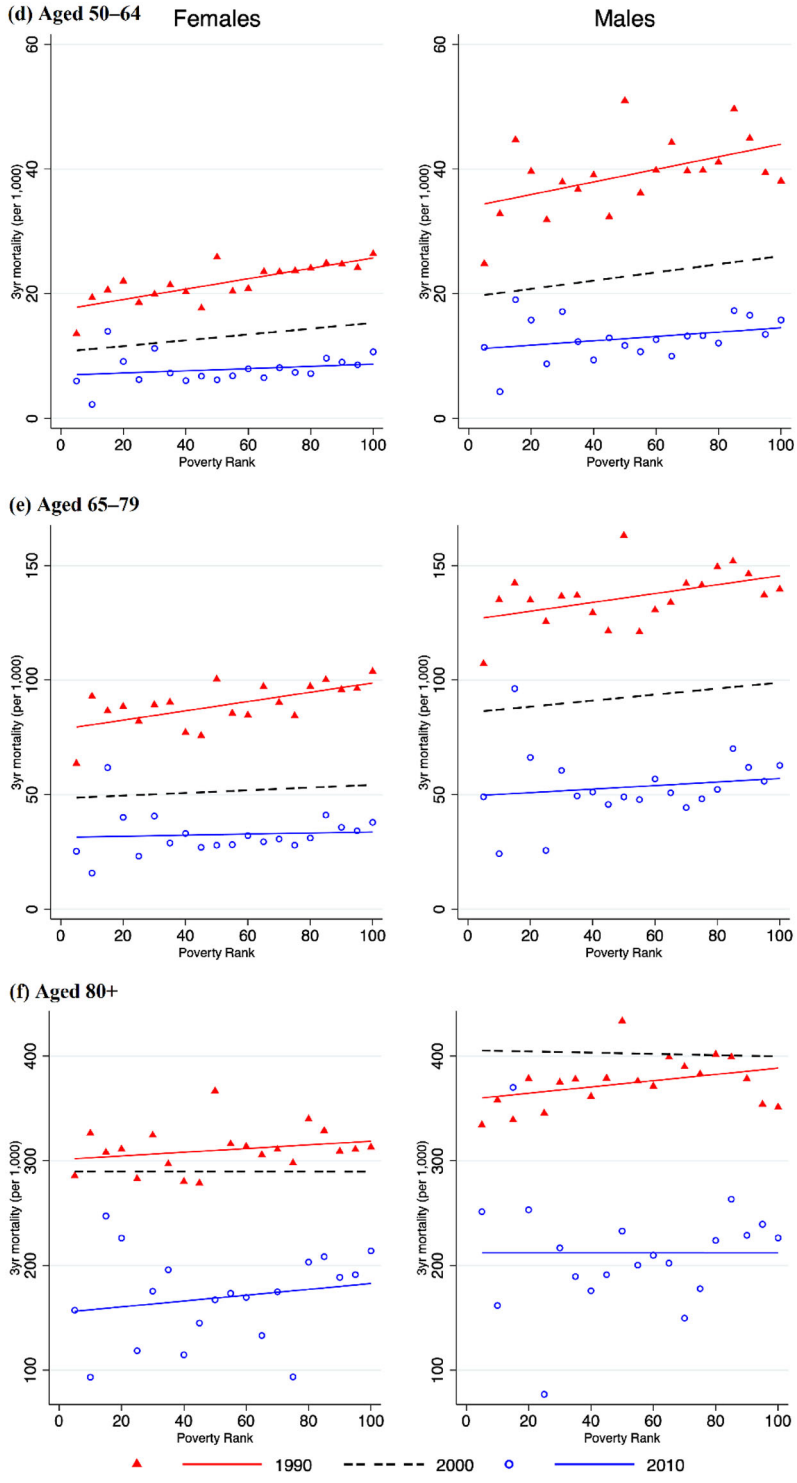

FIGURE 2 Continued

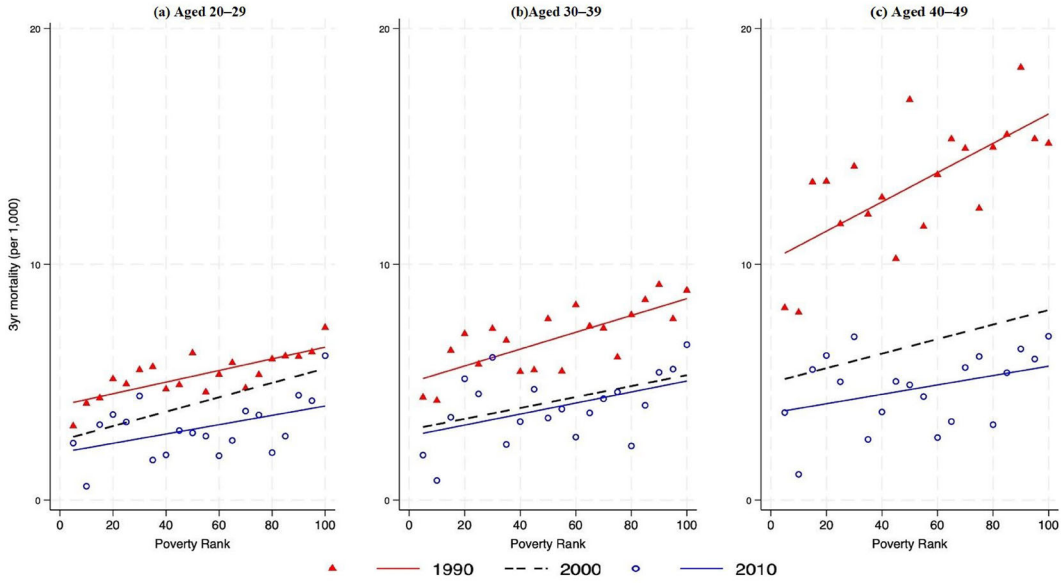

FIGURE 3 Male mortality rates per 1,000 in Chile (1990–2010). *Note*: This figure displays three-year male mortality rates for age groups 20–29, 30–39 and 40–49, plotted across groups of communes ranked by their rate of poverty. Each bin represents a group of communes with about 5 per cent of the overall population in the respective year. Lines are linear fits.

TABLE 2 Mortality rates in Chile, men aged 20–49.

Age	Deaths per 1,000 in 2010		Percentage change 1990–2010		Regression slopes	
	Richest	Poorest	Richest	Poorest	1990	2010
20–29	2.418	6.127	−43.5	−28.1	0.025^{***}	0.02^{**}
30–39	1.911	6.592	−56.2	−25.9	0.036^{**}	0.023^{**}
40–49	3.714	6.952	−54.5	−54.1	0.062^{***}	0.021

Note: Death counts for Chile come from the Statistics Department of the Health Ministry (DEIS). Population counts, by gender and age, and poverty rates come from the National Census (2010). Death rates are calculated using a population-weighted average of three-year age group death rates. 'Richest' ('Poorest') refer to the 5 per cent of the population living in communes with lowest (highest) poverty rates. $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.001$.

During the 1990s, perinatal infections were the primary cause of death among infants and children (aged 0–4) in Chile. However, despite being a major cause of child mortality, this particular cause showed only modest improvements during the analysed period. Most of the improvements among boys and girls (aged 0–19) came from significant declines in mortality due to respiratory diseases and external causes.

These improvements are likely associated with the implementation of a programme to address acute respiratory infections, which was gradually expanded to cover all regions of the country. The programme offered universal and free access, with a particular focus on children, and achieved full coverage of the demand for specialised care by the late 1990s (Jiménez and Romero, 2007). Figure 4 shows robust advances in mortality inequality for respiratory diseases over the analysed period for children and young people (below the age of 19).

Among women aged 20–49, cancer was the leading cause of death in 1990, but it was substantially reduced (−40 per cent) by 2010. For men, improvements were concentrated on reducing mortality from external causes, which nevertheless remained a significant cause of death for this cohort. While respiratory disease was not a leading cause of mortality for this group, its mortality rate decreased

TABLE 3 Mortality rates by cause of death in Chile (1990–2010).

Age group	Females			Males		
	1990	2010	Percentage change	1990	2010	Percentage change
0–4						
Respiratory	0.962	0.167	−82.7	1.243	0.189	−84.8
Perinatal infections	1.731	1.480	−14.5	2.237	1.989	−11.1
Congenital anomalies	1.621	1.459	−9.9	1.611	1.500	−6.9
External causes	1.424	0.303	−78.7	2.032	0.415	−79.6
5–19						
Respiratory	0.219	0.027	−87.6	0.269	0.043	−83.9
Perinatal infections	0.355	0.125	−64.8	0.458	0.149	−67.4
Congenital anomalies	0.323	0.163	−49.5	0.312	0.157	−49.6
External causes	0.450	0.236	−47.5	1.199	0.619	−48.4
20–49						
Cancer	1.102	0.687	−37.6	0.799	0.533	−33.2
Cardiovascular	0.418	0.258	−38.3	0.728	0.531	−27.1
Respiratory	0.162	0.066	−59.1	0.391	0.166	−57.5
External causes	0.576	0.381	−33.9	3.944	1.897	−51.9
50–64						
Cancer	7.955	3.502	−56.0	9.386	3.547	−62.2
Cardiovascular	5.316	1.541	−71.0	9.736	3.208	−67.0
Respiratory	1.328	0.360	−72.9	3.134	0.716	−77.1
External causes	0.993	0.343	−65.4	5.600	1.701	−69.6
65–79						
Cancer	22.485	10.973	−51.2	31.505	17.130	−45.6
Cardiovascular	31.075	9.307	−70.0	46.404	15.850	−65.8
Respiratory	9.220	2.857	−69.0	16.772	4.853	−71.1
External causes	2.230	0.700	−68.6	7.258	2.444	−66.3
80+						
Cancer	37.325	26.587	−28.8	56.159	47.231	−15.9
Cardiovascular	132.639	60.313	−54.5	139.467	67.962	−51.3
Respiratory	50.698	24.698	−51.3	67.351	33.264	−50.6
External causes	6.360	4.306	−32.3	10.105	5.544	−45.1

Note: This table shows three-year age-adjusted mortality rates and their changes over the 1990–2010 period for the six leading groups of causes of death in Chile.

significantly from 1990 to 2010. Moreover, Figure 4 shows that, for females, slopes have flattened over time, indicating reduced mortality inequality. In contrast, mortality inequality due to respiratory diseases has slightly increased for men. In Figures 5, 6 and 7, we observe a slight reduction in mortality inequality for males, which is much more modest compared with females. This pattern, noticeable across all major causes of death and in overall mortality, indicates that disparities in mortality rates within the 20–49 age group are persistent over time.

For both men and women aged 50–79, there was a significant reduction in mortality rates due to cardiovascular diseases, respiratory diseases and cancer. These findings are likely linked with the

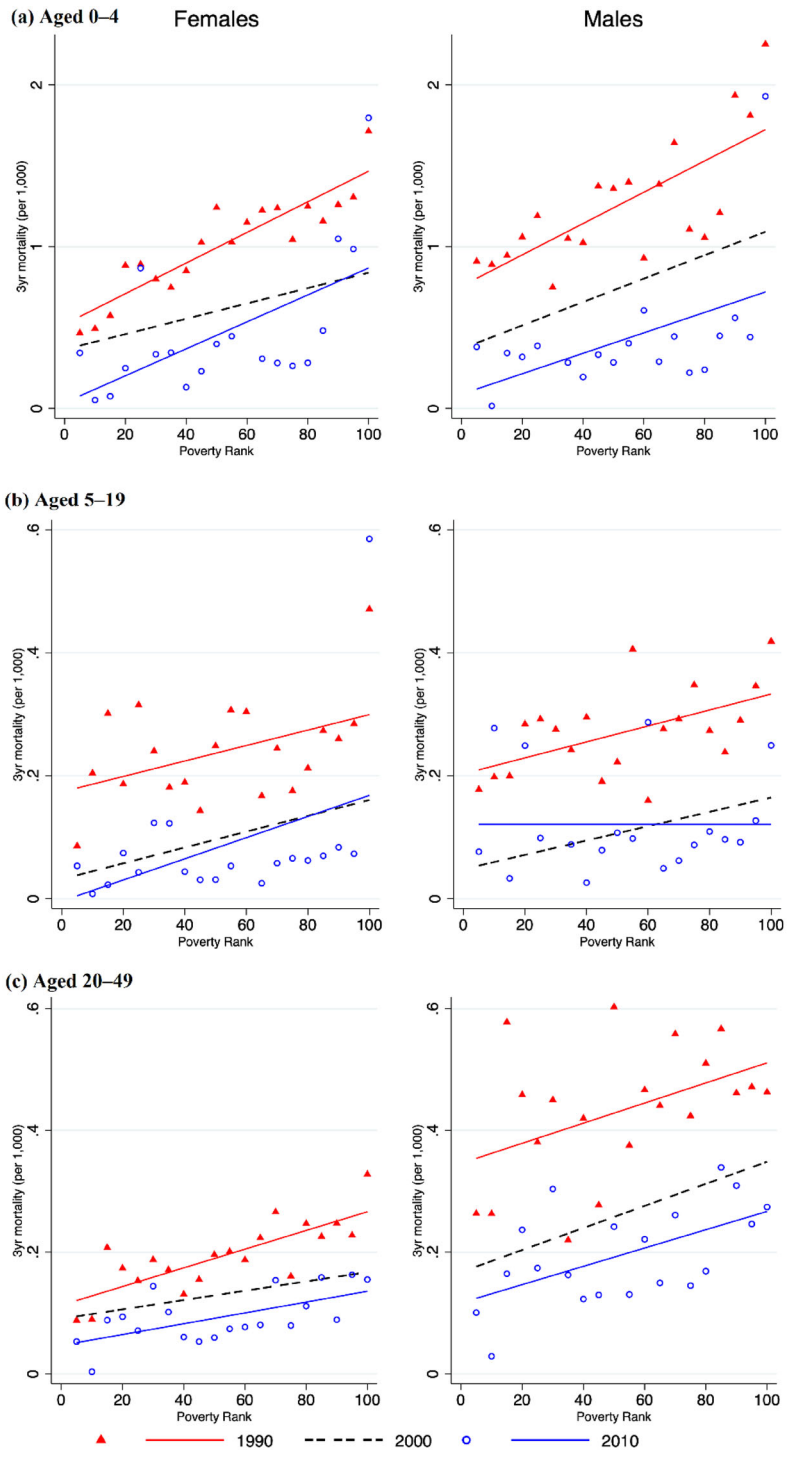

FIGURE 4 Respiratory disease mortality rates per 1,000 in Chile (1990–2010). *Note*: This figure displays gender- and age-specific three-year respiratory disease mortality rates, plotted across groups of communes ranked by their poverty rate. Each bin represents a group of communes encompassing approximately 5 per cent of the overall population in the respective year. Lines represent linear fits.

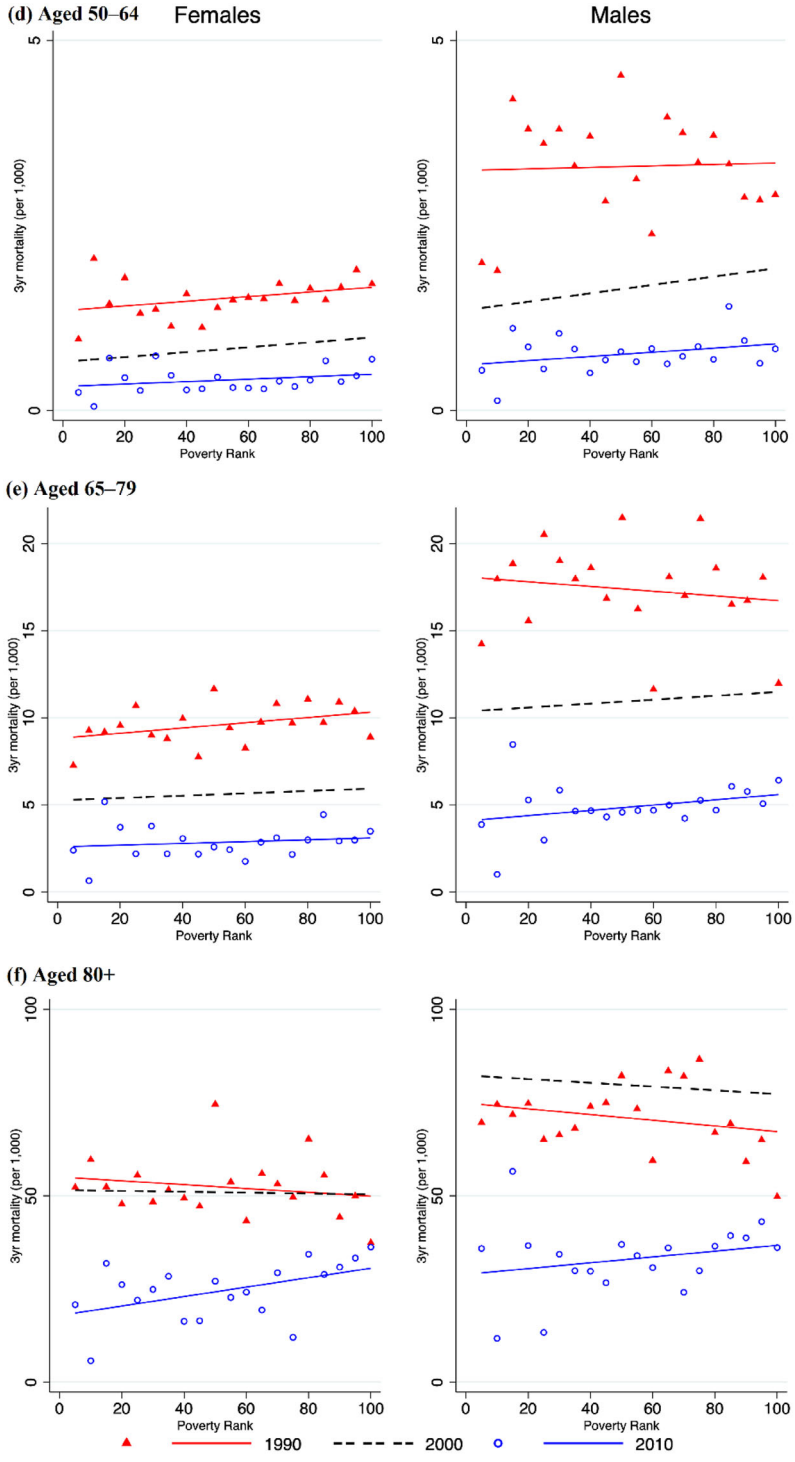

FIGURE 4 Continued

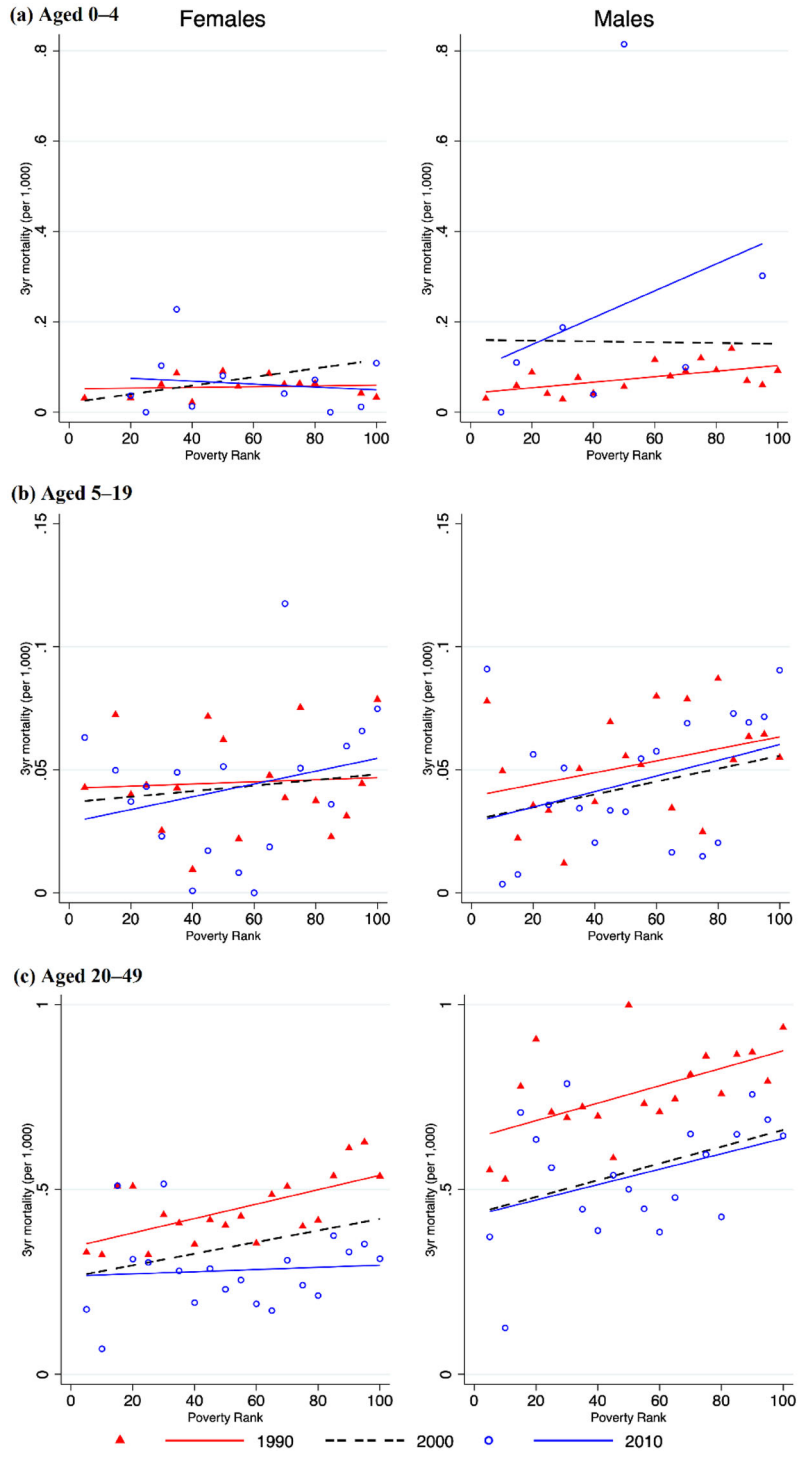

FIGURE 5 Cardiovascular disease mortality rates per 1,000 in Chile (1990–2010). *Note*: This figure displays gender- and age-specific three-year cardiovascular disease mortality rates, plotted across groups of communes ranked by their poverty rate. Each bin represents a group of communes encompassing approximately 5 per cent of the overall population in the respective year. Lines represent linear fits.

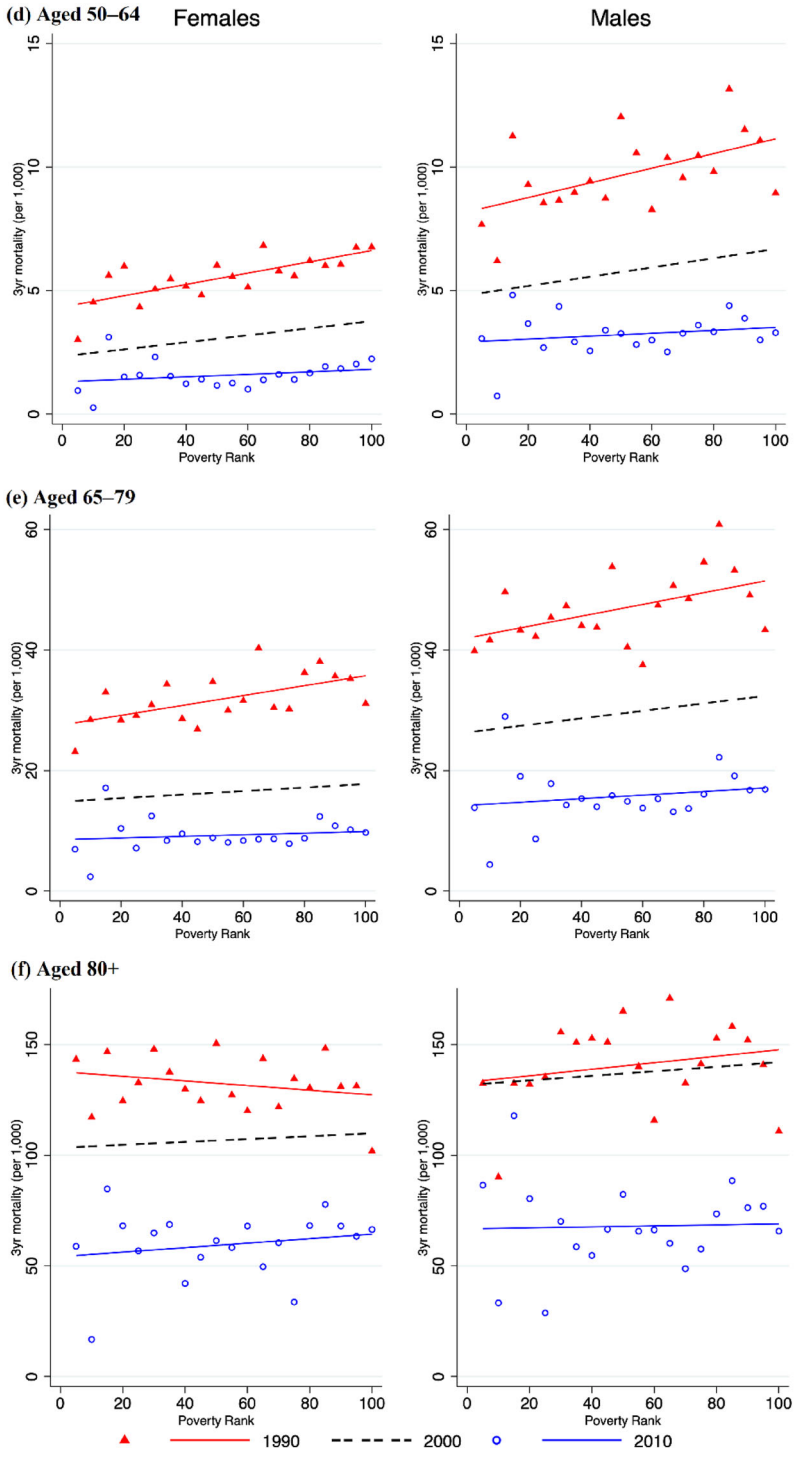

FIGURE 5 Continued

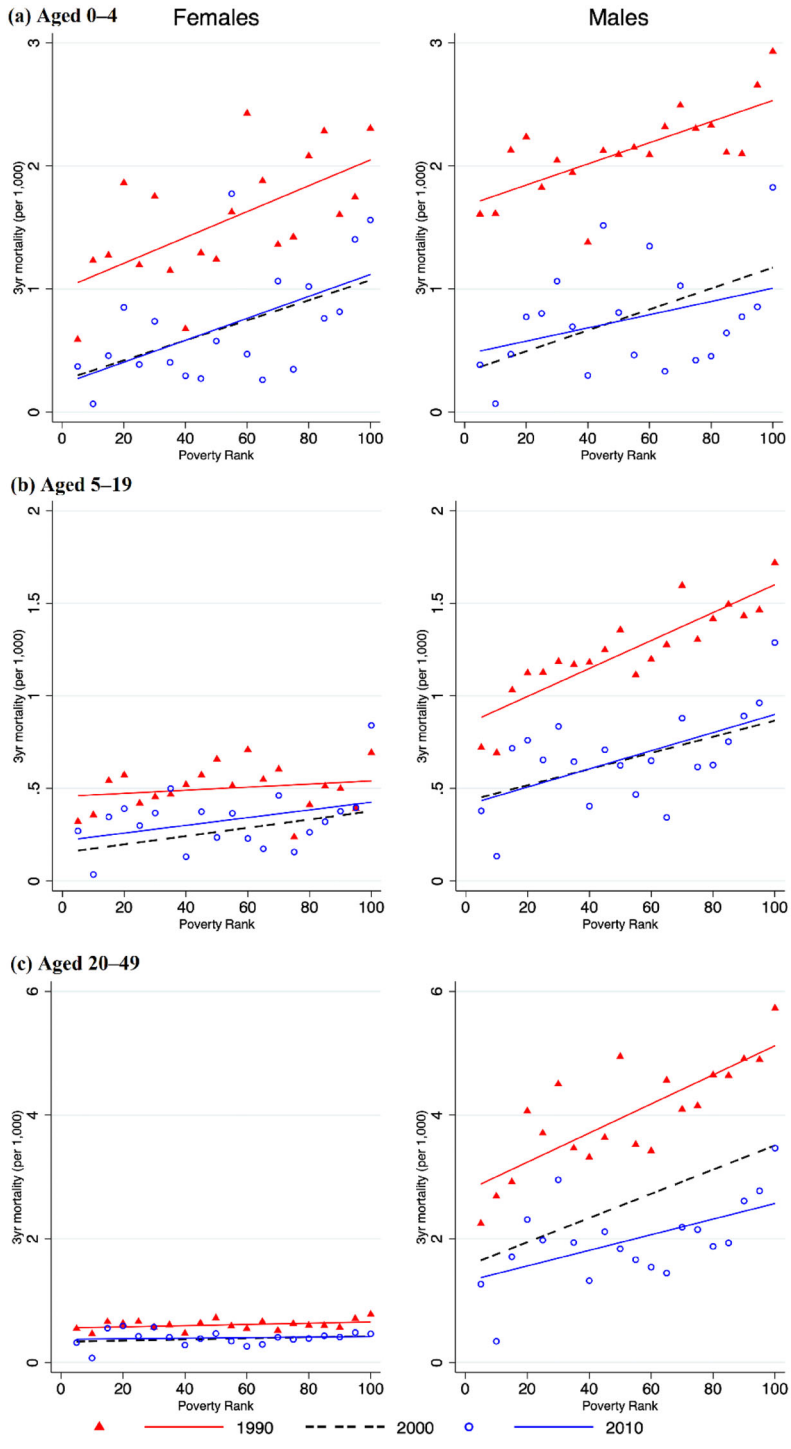

FIGURE 6 External cause mortality rates per 1,000 in Chile (1990–2010). *Note*: This figure displays gender- and age-specific three-year external cause mortality rates, plotted across groups of communes ranked by their poverty rate. Each bin represents a group of communes encompassing approximately 5 per cent of the overall population in the respective year. Lines represent linear fits.

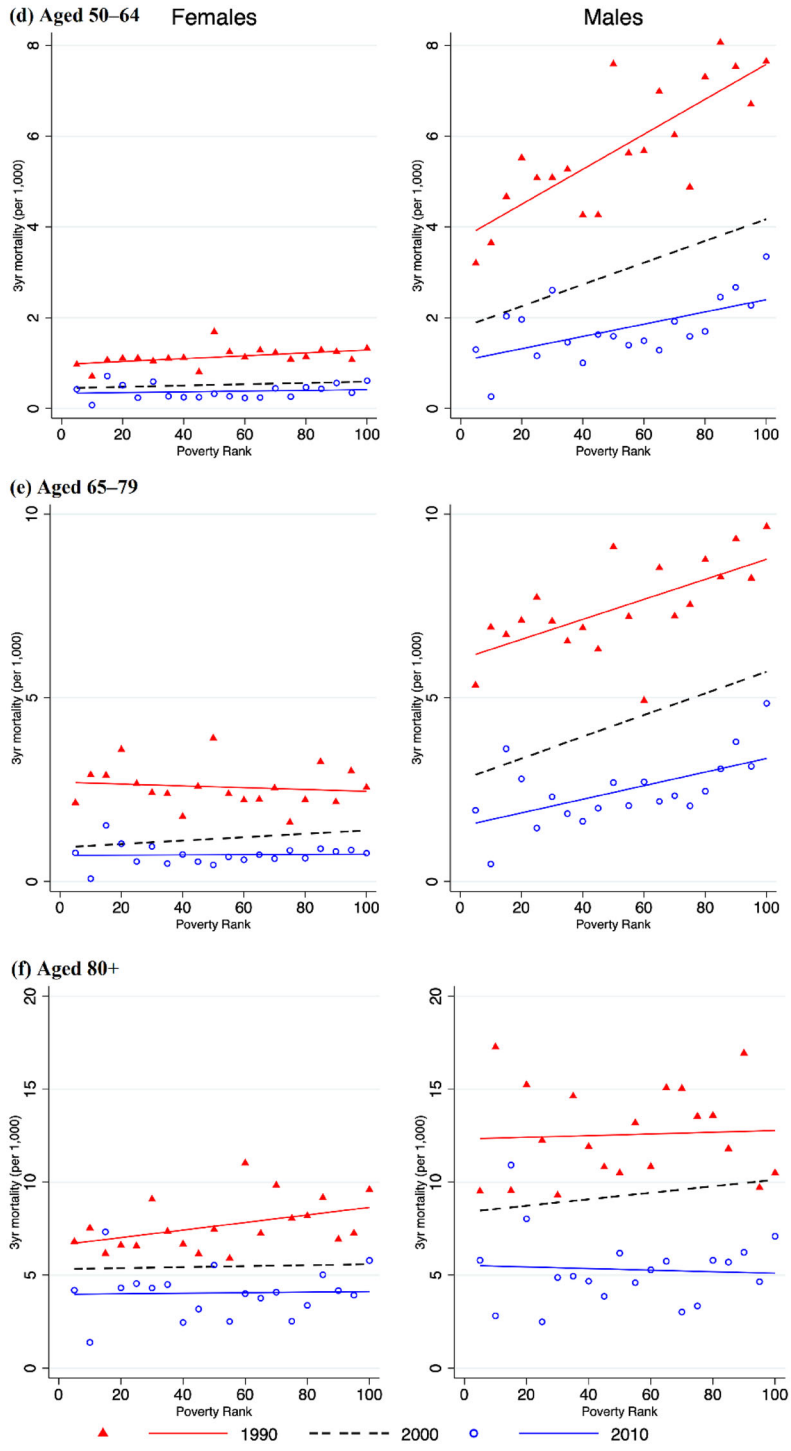

FIGURE 6 Continued

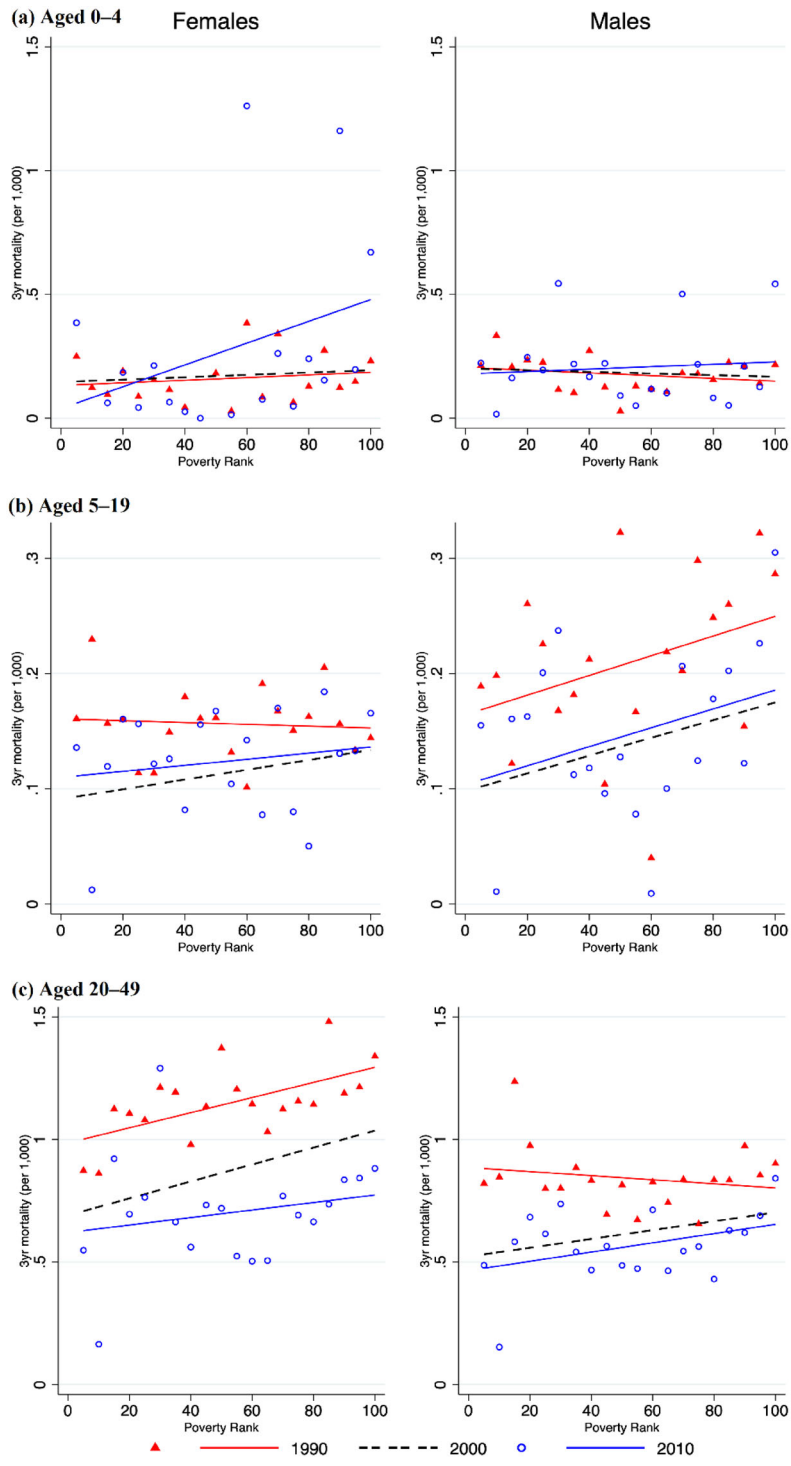

FIGURE 7 Cancer mortality rates per 1,000 in Chile (1990–2010). *Note*: This figure displays gender- and age-specific three-year cancer mortality rates, plotted across groups of communes ranked by their poverty rate. Each bin represents a group of communes encompassing approximately 5 per cent of the overall population in the respective year. Lines represent linear fits.

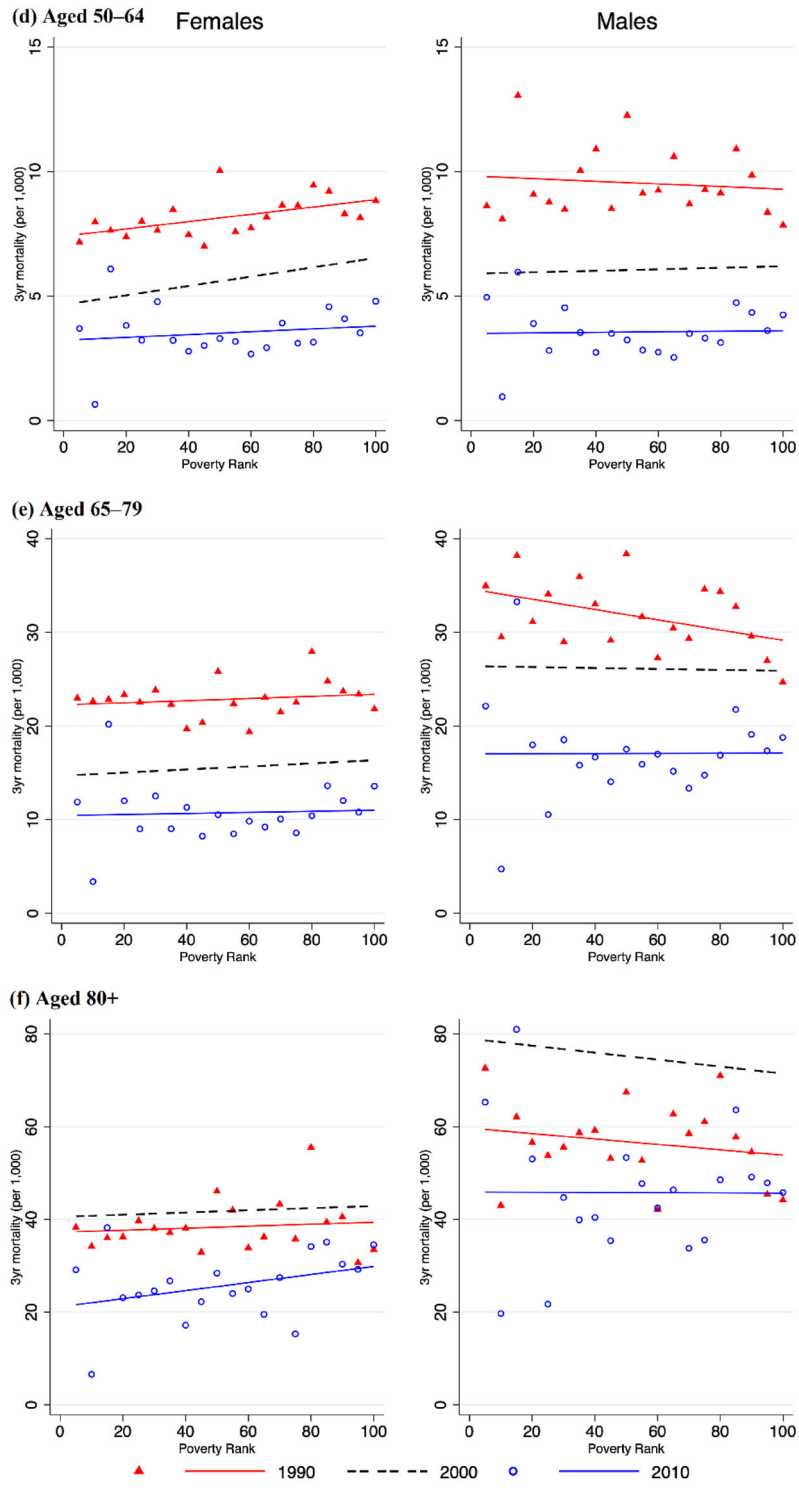

FIGURE 7 Continued

AUGE reform and the efforts to prioritise care for these causes of death. This result is also consistent with previous evidence showing that reductions in unmet medical needs between 2000 and 2010 were stronger among older cohorts (Frenz et al., 2014). Moreover, these reductions are associated with the implementation of smoke-free legislation in 2006, as previous studies indicate that enforcing these laws led to a decline in the incidence of myocardial infarction (Nazzal and Harris, 2017).

Regarding mortality inequality among adults aged 65–79, Figure 6 illustrates persistent disparities in mortality rates due to external causes over time for males. This trend is consistently observed across all demographic groups, except for children below the age of 4. For females above the age of 5, the period from 1990 to 2010 was marked by a stabilisation in mortality rates from external causes. This likely stems from the initially low and uniformly distributed rates observed in the 1990s, as indicated by the flat lines. It is also worth noting that among women aged 50–64, as depicted in Figure 7(d), cancer mortality declined more rapidly in more advantaged areas, particularly between 1990 and 2000, while more disadvantaged areas lagged behind.

For the oldest cohort, aged 80 and older, there were significant reductions in cardiovascular and respiratory disease mortality for both genders, while cancer mortality is not as clear. The very small increase in cancer mortality rates may be a result of both the ageing population and improvements in diagnostic capabilities leading to more reported cases. Despite these advances, mortality due to respiratory diseases declined faster in more advantaged areas, leading to an increase in inequality in mortality for this cohort, particularly among women. During the 1990–2010 period, Chile experienced a notable overall decline in mortality rates for the leading causes of death. Child mortality saw a sharp decrease, with significant reductions in respiratory diseases observed across all communes. Additionally, considerable progress was made in addressing cardiovascular diseases and cancer among the middle-aged and older population groups. Inequality, however, increased for some of the main causes of death among older women above the age of 50. For men, mortality due to external causes continued to be a driving factor behind the gender gap in mortality in Chile. Men exhibit considerably higher mortality rates and greater mortality inequality across Chilean communes.

6 | SUICIDE MORTALITY

In this section, I focus on suicide mortality rates. Previous studies document that Chile has the highest suicide rates in South America (Bustamante et al., 2015). As depicted in Figure 6, Chile displays a persistent and pronounced disparity in mortality rates from external causes, particularly among men. In 2010, external causes was the third leading cause of death in Chile, following cardiovascular diseases and cancer. However, Figure A.2 in the online Appendix portrays a concerning trend: for men and women aged 20–49, suicides were the main external mortality cause in 2010. This shift is particularly striking for women, as suicides ranked below traffic accidents and other types of accidents during the 1990s. Given this alarming transition and the predominant role of suicide in mortality rates, a deeper examination into this trend is warranted.

Figure 8 displays the evolution of suicide mortality rates in Chile over the 1990–2010 period. The panels present a striking trend, indicating an increase in suicide mortality rates for some demographic groups over the period analysed. Past studies have highlighted that, in Chile, suicide rates are particularly high among men in rural areas. However, the trend since the 1990s also points to a marked increase in suicide rates in affluent areas.

Yet, the steep slopes, particularly for men, align with previous studies showing that suicide rates are strongly associated with poverty rates and urbanisation in Chile (Wiederkehr et al., 2022). For instance, mortality rates due to suicides in rural areas were twice as high as in urban areas, similar to figures reported for the United States (Bustamante et al., 2015; Hedegaard, Curtin and Warner, 2020). Moreover, previous research has identified a correlation between economic conditions and suicide rates in Chile, particularly during the 2008–09 crisis, with higher rates observed among both men and women aged 25–44 (Chang et al., 2013). According to Baeza et al. (2022), this specific age group

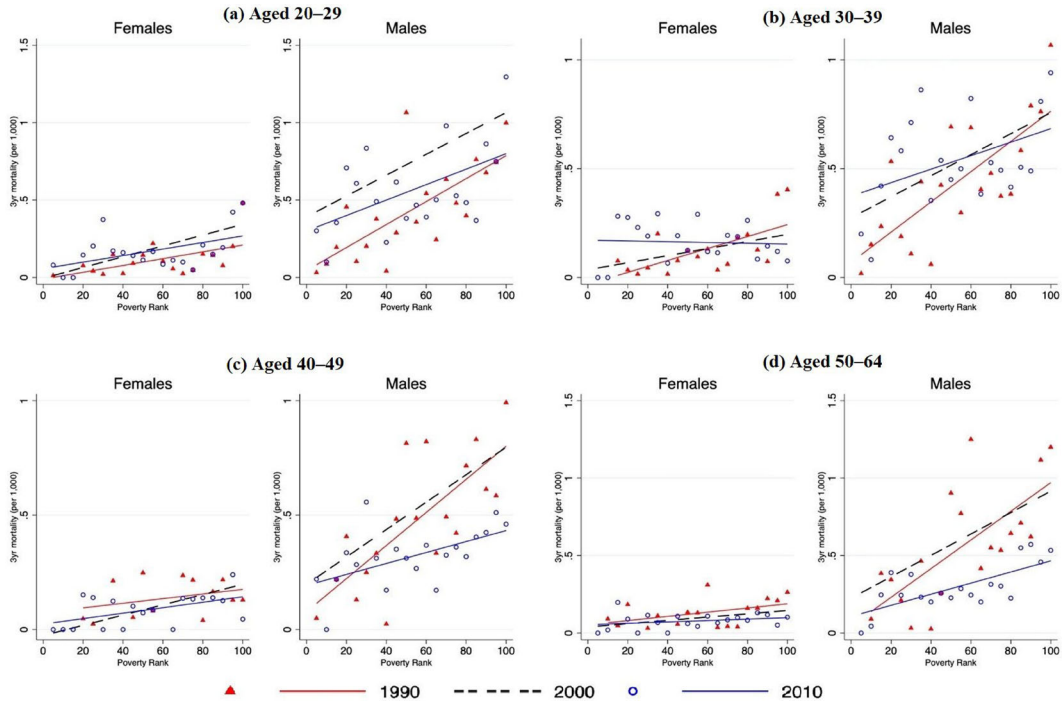

FIGURE 8 Suicide mortality rates per 1,000 in Chile (1990–2010). *Note*: This figure displays gender- and age-specific three-year suicide mortality rates, plotted across groups of communes ranked by their poverty rate. Each bin represents a group of communes encompassing approximately 5 per cent of the overall population in the respective year. Lines represent linear fits.

is particularly affected by unemployment and indebtedness. Lastly, the evolution of suicide mortality among middle-aged men (aged 40–64) shows a similarity to the trend observed in Canada, Spain and the United States (González and Rodríguez-González, 2018; Baker et al., 2019).

In summary, Chile has lower overall mortality rates compared with other countries in South America, but it has the highest suicide mortality rates. Suicide mortality rates are higher among men than women, but women aged 30–49 are experiencing a strong increase in suicide rates. This trend is alarming and highlights a need for targeted public policies to address and counteract this development (Otzen et al., 2014).

7 | DISCUSSION AND CONCLUSIONS

This paper contributes to the ongoing debate on the connection between income inequality, poverty and health disparities. Chile provides an interesting case where mortality and poverty gaps were narrowed while income inequality remained persistently high (Flores et al., 2020), similar to results found for rich countries in this literature (Baker et al., 2021; Redler et al., 2021). Over the analysed period, significant declines in mortality rates were observed, benefiting all age groups and both genders. These improvements include mortality from the leading causes specific to each age group. In addition, there was a substantial reduction in overall mortality inequality. The only exception was men aged 20–39, for whom inequality in mortality was still significant in 2010, mostly due to external cause mortality.

The overall success of Chile during the analysed period supports the idea that the provision of public health insurance can be a critical policy in reducing inequality in mortality and mortality rates (Baker et al., 2021). Additionally, it indicates that implementing universal health coverage can be

effective, even in the Latin American context of high income inequality and poverty rates. Finally, anti-poverty programmes, such as Chile's cash transfer programme, have likely played a positive role by encouraging contact with the health system and facilitating the use of preventive health programmes among low-income families (Frenz et al., 2014).

The results presented remain consistent when using alternative measures to classify Chilean communes, such as substituting poverty rates with illiteracy rates. In addition, excluding deaths from the year of the earthquake (2010) and replacing them with deaths from the year 2012 shows relatively unaffected trends of inequality in mortality. However, it uncovers a more positive story concerning the reduction in mortality rates during the 2000s, particularly for child mortality.

Despite the significant advances in reducing inequality in mortality, there is still considerable room for improvements in reducing mortality rates. Specifically, Chile's mortality rates for young children (aged 0–4) remain significantly higher than those observed in developed countries (approximately four times higher than in Canada, France and Germany; see Baker et al., 2019; Currie et al., 2020; Redler et al., 2021) and have remained unaltered during the 2000–10 period. Finally, the rising number of female suicides, particularly among younger age groups, is worrying and calls for preventive action.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are publicly available at https://deis.minsal.cl, https://datasocial.ministeriodesarrollosocial.gob.cl and https://www.ine.gob.cl.

ORCID


Gedeão Locks https://orcid.org/0000-0002-0086-7224

REFERENCES

Aguilera, I., Infante, A., Ormeño, H., & Urriola, C. (2015), Improving health system efficiency. Chile: Implementation of the Universal Access with Explicit Guarantees (AUGE) reform. World Health Organization Case Study, https://iris.who.int/handle/10665/187657.

Aguilera, X., Delgado, I., Icaza, G., Apablaza, M., Villanueva, L., & Castillo-Laborde, C. (2020), Under five and infant mortality in Chile (1990–2016): trends, disparities, and causes of death. *PLoS One*, 15(9), e0239974, https://doi.org/10.1371/journal.pone.0239974.

Arteaga, O., Astorga, I., & Pinto, A. M. (2002), Desigualdades en la provisión de asistencia médica en el sector público de salud en Chile. *Cadernos de Saúde Pública*, 18, 1053–66.

Atun, R. et al. (2015), Health-system reform and universal health coverage in Latin America. *The Lancet*, 385 (9974), 1230–47, https://doi.org/10.1016/S0140-6736(14)61646-9.

Baeza, F., González, F., Benmarhnia, T., & Vergara, A. V. (2022), Effects of the Great Recession on suicide mortality in Chile and contributing factors. *SSM - Mental Health*, 2, 100104, https://doi.org/10.1016/j.ssmmh.2022.100104.

Baker, M., Currie, J., & Schwandt, H. (2019), Mortality inequality in Canada and the United States: divergent or convergent trends? *Journal of Labor Economics*, 37 (S2), S325–53, https://doi.org/10.1086/703259.

Baker, M., Currie, J., Miloucheva, B., Schwandt, H., & Thuilliez, J. (2021), Inequality in mortality: updated estimates for the United States, Canada and France. *Fiscal Studies*, 42 (1), 25–46, https://doi.org/10.1111/1475-5890.12263.

Banks, J., Currie, J., Krutikova, S., Salvanes, K. G., & Schwandt, H. (2021), The evolution of mortality inequality in 11 OECD countries: introduction. *Fiscal Studies*, 42, 9–23, https://doi.org/10.1111/1475-5890.12267.

Bertoli, P., & Grembi, V. (2021), Mortality inequality in the Czech Republic. *Fiscal Studies*, 42 (1), 171–91, https://doi.org/10.1111/1475-5890.12258.

Bossert, T. J., & Leisewitz, T. (2016), Innovation and change in the Chilean health system. *New England Journal of Medicine*, 374, 1–5, https://doi.org/10.1056/NEJMp1514202.

Bustamante, F., Ramirez, V., Urquidi, C., Bustos, V., Yaseen, Z., & Galynker, I. (2015), Trends and most frequent methods of suicide in Chile between 2001 and 2010. *Crisis*, 37, 21–30.
Chang, S-S., Stuckler, D., Yip, P., & Gunnell, D. (2013), Impact of 2008 global economic crisis on suicide: time trend study in 54 countries. *BMJ*, 347, f5239, https://doi.org/10.1136/bmj.f5239.
Currie, J., & Schwandt, H. (2016), Mortality inequality: the good news from a county-level approach. *Journal of Economic Perspectives*, 30 (2), 29–52.
Currie, J., Schwandt, H., & Thuilliez, J. (2020), Pauvreté, Egalité, Mortalité: mortality (in) equality in France and the United States. *Journal of Population Economics*, 33, 197–231.
De Ferranti, D., Ferreira, F. H. G., Perry, G. E., & Walton, M. (2003), *Inequality in Latin America and the Caribbean: Breaking with History?* Washington DC: World Bank.
Flores, I., Sanhueza, C., Atria, J., & Mayer, R. (2020), Top incomes in Chile: a historical perspective on income inequality, 1964–2017. *Review of Income and Wealth*, 66, 850–74, https://doi.org/10.1111/roiw.12441.
Frenz, P., Delgado, I., Kaufman, J. S., & Harper, S. (2014), Achieving effective universal health coverage with equity: evidence from Chile. *Health Policy and Planning*, 29, 717–31, https://doi.org/10.1093/heapol/czt054.
González, L., & Rodríguez-González, A. (2018), Changes in inequality in mortality: new evidence for Spain. Barcelona School of Economics Working Paper 1050.
Hedegaard, H., Curtin, S. C., & Warner, M. (2020), Increase in suicide mortality in the United States, 1999–2018. NCHS Data Brief No. 362, https://www.cdc.gov/nchs/data/databriefs/db362-h.pdf.
Jadresic, E., & Zahler, R. (2000), Chile's rapid growth in the 1990s good policies, good luck, or political change? IMF Working Paper WP/00/153.
Jiménez, J., & Romero, M. I. (2007), Reducing infant mortality in Chile: success in two phases. *Health Affairs*, 26, 458–65.
Koch, K. J., Pedraza, C. C., & Schmid, A. (2017), Out-of-pocket expenditure and financial protection in the Chilean health care system—a systematic review. *Health Policy*, 121, 481–94.
Lustig, N., Lopez-Calva, L. F., & Ortiz-Juarez, E. (2013), Declining inequality in Latin America in the 2000s: the cases of Argentina, Brazil, and Mexico. *World Development*, 44, 129–41.
Mardones, F. (2004), Inequality of health care for the elderly in Chile. *Revista Medica De Chile*, 132, 865–72.
MDSF-UNDP (2020), *Evolución de la pobreza 1990–2017: Cómo ha cambiado Chile?* Working Paper, Santiago: Ministerio de Desarrollo Social y Familia, Programa de las Naciones Unidas para el Desarrollo.
Nazzal, C., & Harris, J. E. (2017), Lower incidence of myocardial infarction after smoke-free legislation enforcement in Chile. *Bulletin of the World Health Organization*, 95, 674.
OECD (2013), Poverty rate (indicator), https://www.oecd.org/en/data/indicators/poverty-rate.html?oecdcontrol-8027380c62-var3=2013.
OECD (2020), COVID-19 in Latin America and the Caribbean: An Overview of Government Responses to the Crisis. Paris: OECD Publishing, https://doi.org/10.1787/0a2dee41-en.
Otzen, T. et al. (2014), Mortalidad por suicidio en Chile: tendencias en los años 1998–2011. *Revista Médica de Chile*, 142, 305–13.
Paraje, G., & Vásquez, F. (2012), Health equity in an unequal country: the use of medical services in Chile. *International Journal for Equity in Health*, 11, 1–16.
Redler, P., Wuppermann, A., Winter, J., Schwandt, H., & Currie, J. (2021), Geographic inequality in income and mortality in Germany. *Fiscal Studies*, 42 (1), 147–70, https://doi.org/10.1111/1475-5890.12259.
Sandoval, M. H., & Turra, C. M. (2015), El gradiente educativo en la mortalidad adulta en Chile. *Revista Latinoamericana de Población*, 9 (17), 7–35.
Sandoval Orellana, H. (2004), Better health for Chile: sanitary, political and financial basis for the need and timeliness of reforming the Chilean Health System. *Cuad Médico Sociales*, 44, 5–20.
Subramanian, S. V., Delgado, I., Jadue, L., Vega, J., & Kawachi, I. (2003), Income inequality and health: multilevel analysis of Chilean communities. *Journal of Epidemiology & Community Health*, 57, 844–48.
United Nations Development Programme (2013), Human Development Report 2013: The Rise of the South: Human Progress in a Diverse World. New York: United Nations, https://hdr.undp.org/content/human-development-report-2013.
Unger, J.-P., De Paepe, P., Cantuarias, G. S., & Herrera, O. A. (2008), Chile's neoliberal health reform: an assessment and a critique. *PLoS Medicine*, 5, e79, https://doi.org/10.1371/journal.pmed.0050079.
Vásquez, F., Paraje, G., & Estay, M. (2013), Income-related inequality in health and health care utilization in Chile, 2000–2009. *Revista Panamericana de Salud Pública*, 33, 98–106.
Wiederkehr, K., Mai, C., Cabezas, J. M., Rocha-Jiménez, T., Otzen, T., Montalva, N., Calvo, E., & Castillo-Carniglia, A. (2022), The epidemiology of violent deaths in Chile between 2001 and 2018: prevalence, trends, and correlates. *International Journal of Environmental Research and Public Health*, 19, 12791, https://doi.org/10.3390/ijerph191912791.
World Health Organization (2000), The World Health Report 2000: Health Systems: Improving Performance. World Health Organization, https://www.who.int/publications/i/item/924156198X.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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