

Online Resource 4. Provincial disparities in suicide mortality

Article: Age–period–cohort effects on suicide mortality in Andalusia, Spain (2000–2024): demographic masking and sustained pandemic excess

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Authors: Carlos Romero-Olóriz¹, Esperanza López Hidalgo², María Victoria Villalba Soria², Miguel Guerrero Díaz^{3*}

¹ Andalusian Emergency Health Centre 061 (CES-061), Provincial Service of Malaga, Malaga, Spain. ² Institute of Legal Medicine and Forensic Sciences of Malaga, Malaga, Spain. ³ Clinical Management Unit of Mental Health, University Hospital Virgen de la Victoria, Malaga, Spain.

* **Corresponding author:** Miguel Guerrero Díaz. Coordinator of Community Mental Health Unit Marbella, Centro de Salud Las Albarizas, Avenida Las Albarizas s/n, 29600-Marbella (Malaga), Spain. Email: miguel.guerrero.diaz.sspa@juntadeandalucia.es. ORCID: 0000-0002-3066-5930

This Online Resource presents the analysis of interprovincial disparities in suicide mortality across the eight Andalusian provinces over the period 2000–2024. Because the publicly available INE tables do not disaggregate deaths simultaneously by age, sex, and province, this analysis relied on crude rates and should be interpreted as descriptive of crude mortality patterns rather than age-adjusted risk. The resource is structured around four complementary perspectives: (1) overall provincial burden and variability, (2) temporal trends by province, (3) period-specific patterns and shifts, and (4) geographic clustering of temporal trajectories.

1. Provincial overview and burden

Marked and persistent differences were observed across the eight provinces. Jaén exhibited the highest mean crude rate over the entire period (11.67 per 100,000; CV = 9.1%), followed by Granada (10.78; CV = 11.8%) and Málaga (10.18; CV = 12.6%). At the lower end, Huelva recorded the lowest rate (7.02; CV = 23.4%), followed by Cádiz (7.44; CV = 16.2%) and Sevilla (7.56; CV = 13.3%). The ratio between the highest and lowest provincial rates (Jaén/Huelva) was 1.66. Smaller provinces exhibited greater year-to-year variability, as reflected in higher coefficients of variation.

Table S5 summarises the key descriptive indicators for each province, including the total number of deaths, mean crude rate, minimum and maximum rates with their corresponding years, the coefficient of variation, the estimated annual percentage change (EAPC) from Prais–Winsten regression, and the mean male-to-female rate ratio.

Table S5. Suicide mortality by province (both sexes), Andalusia, 2000–2024

Province	Deaths	Mean rate	Min (year)	Max (year)	CV%	M/F	EAPC (95% CI)	p
Jaén	1,888	11.67	9.96 (2017)	13.83 (2009)	9.1	4.68	–0.15 (–0.65 to +0.36)	0.572
Granada	2,413	10.78	9.13 (2011)	14.42 (2012)	11.8	3.18	+0.02 (–0.61 to +0.65)	0.955
Málaga	3,929	10.18	7.35 (2019)	11.93 (2007)	12.6	3.27	–0.94 (–1.56 to –0.31)	0.007
Córdoba	1,909	9.76	7.40 (2018)	12.35 (2021)	11.6	4.49	+0.03 (–0.62 to +0.68)	0.930
Almería	1,518	9.21	5.66 (2012)	12.74 (2008)	18.4	3.40	–0.93 (–1.94 to +0.08)	0.083
Sevilla	3,547	7.56	5.83 (2018)	8.95 (2000)	13.3	3.59	–0.06 (–0.83 to +0.72)	0.884
Cádiz	2,255	7.44	5.70 (2007)	9.68 (2008)	16.2	3.80	+0.98 (+0.18 to +1.79)	0.025
Huelva	891	7.02	2.53 (2010)	9.60 (2022)	23.4	4.90	+1.26 (–0.23 to +2.77)	0.111
Andalucía	18,350	9.03	7.61	10.14	8.3	3.54	—	—

Rates per 100,000 population (crude). CV%: coefficient of variation. M/F: male-to-female rate ratio (period mean). Provinces ordered by descending mean rate. EAPC: estimated annual percentage change (Prais–Winsten regression); bold = $p < 0.05$. Source: INE. Authors' calculations.

A consistent geographical pattern emerged: inland and eastern provinces (Jaén, Granada, Córdoba) had systematically higher rates, whereas south-western coastal provinces (Huelva, Cádiz) and Sevilla registered the lowest values. Málaga constituted a partial exception, with a relatively high mean rate despite its coastal and metropolitan character. Interprovincial differences were statistically significant across all four historical periods (Kruskal–Wallis test: $H = 50.29$, $p < 0.001$ in the pre-crisis period; $H = 29.56$, $p < 0.001$ in the recession; $H = 31.67$, $p < 0.001$ in the recovery; $H = 28.28$, $p < 0.001$ in the pandemic/post-pandemic period).

2. Temporal trends by province

Trend analysis by province revealed that only two of the eight provinces showed significant EAPCs for both sexes combined: Málaga, with a significant decline (EAPC = -0.94% , 95% CI -1.56 to -0.31 , $p = 0.007$), and Cádiz, with a significant increase (EAPC = $+0.98\%$, 95% CI $+0.18$ to $+1.79$, $p = 0.025$). The remaining six provinces exhibited non-significant trends, with point estimates ranging from -0.93% (Almería) to $+1.26\%$ (Huelva).

Sex-stratified analysis revealed additional significant trends. In men, Málaga (EAPC = -0.96% , $p = 0.013$) and Almería (EAPC = -1.35% , $p = 0.034$) were the only provinces with significant declines; no province showed a significant increase. In women, Cádiz was the province with the most pronounced and significant increase (EAPC = $+2.93\%$, 95% CI $+1.94$ to $+3.93$, $p < 0.001$), while no other province reached significance. Figure S7 displays the EAPC point estimates and their 95% confidence intervals for each province, stratified by sex.

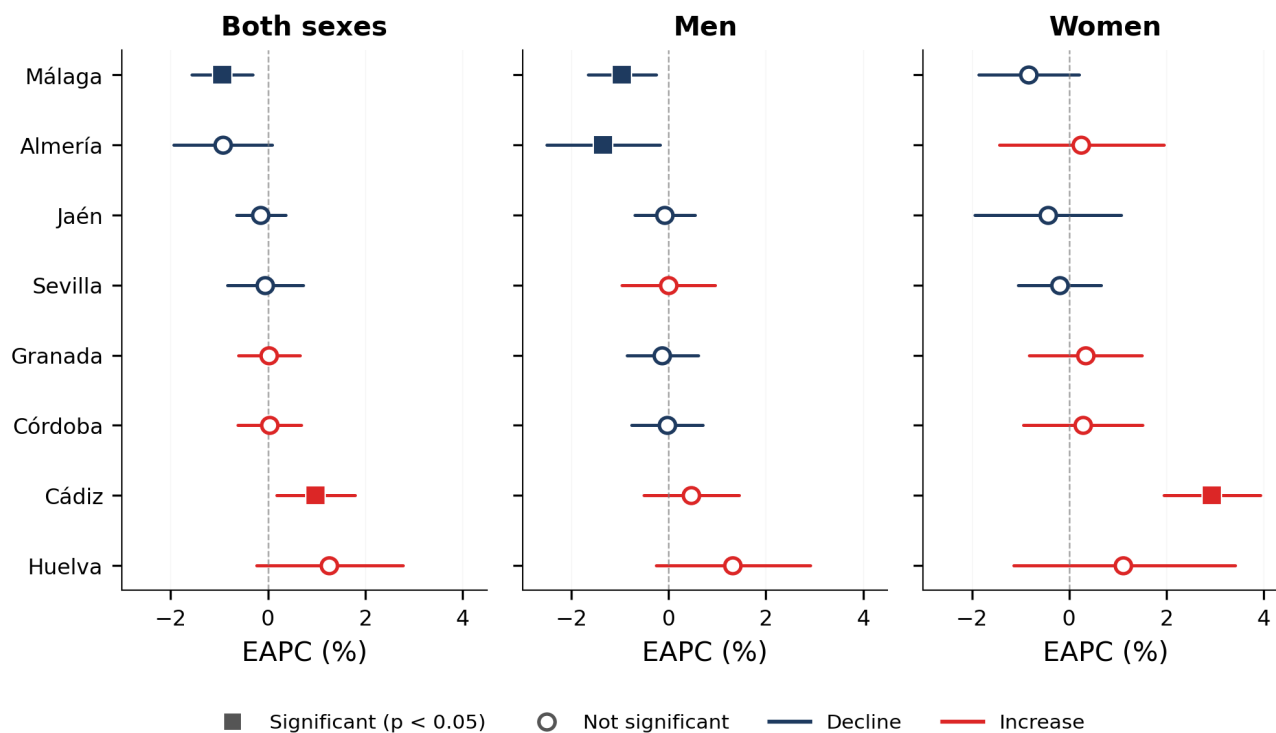


Figure S7. Estimated annual percentage change (EAPC) in crude suicide mortality rates by province and sex, Andalusia, 2000–2024. Forest plot displaying the EAPC (Prais–Winsten regression) and its 95% CI for each Andalusian province, stratified by sex. Provinces are ordered from largest decline to largest increase (both sexes). Filled squares = significant ($p < 0.05$); open circles = non-significant. Dark blue = decline; red = increase. **Both sexes:** only Málaga (-0.94% , $p = 0.007$) and Cádiz ($+0.98\%$, $p = 0.025$) showed significant trends. **Men:** Málaga (-0.96% , $p = 0.013$) and Almería (-1.35% , $p = 0.034$) declined significantly. **Women:** Cádiz showed the largest significant increase ($+2.93\%$, $p < 0.001$). Source: INE. Authors' calculations.

3. Period-specific patterns

All provinces experienced rate increases when transitioning from the recovery to the pandemic/post-pandemic period. The largest relative increases were observed in provinces with historically lower rates: Huelva (+34.3%), Cádiz (+27.0%), and Sevilla (+9.0%). In contrast, provinces with higher baseline rates (Jaén, Granada) showed more modest relative increases or even slight declines (Almería -8.0%, Málaga -8.8%), suggesting a partial convergence pattern. Figure S8 displays the mean crude rate for each province across the four historical periods.

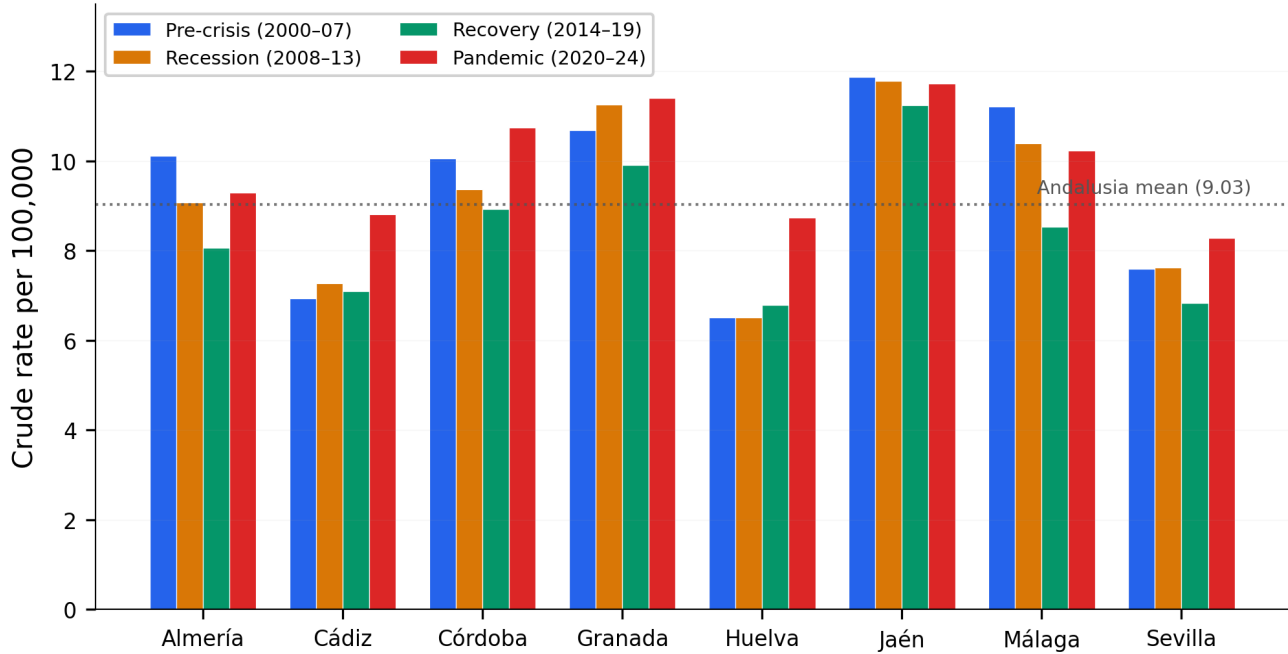


Figure S8. Mean crude suicide mortality rate by province and historical period, both sexes, Andalusia, 2000–2024. Grouped bar chart for the four historical periods: pre-crisis (2000–2007, blue), economic recession (2008–2013, amber), recovery (2014–2019, green), and pandemic/post-pandemic (2020–2024, red). Horizontal dotted line = overall Andalusian mean (9.03 per 100,000). Jaén exhibited the highest rates across all periods; Huelva and Cádiz registered the lowest. All provinces experienced rate increases from the recovery to the pandemic period, with the largest relative increases in provinces with historically lower rates (Huelva +34.3%, Cádiz +27.0%), suggesting partial convergence. Source: INE. Authors' calculations.

The period-specific analysis reinforces the finding that interprovincial disparities, while persistent, show a tendency toward narrowing during the pandemic era. Notably, the provinces that were previously below the regional mean (Huelva, Cádiz, Sevilla) experienced the steepest pandemic-associated increases, while those above the mean (Jaén, Granada, Málaga) showed more moderate changes. This convergence pattern may reflect differential vulnerability to pandemic-related stressors or, alternatively, differential effectiveness of pre-existing mental health infrastructure.

4. Geographic clustering of temporal trajectories

To assess the degree of temporal synchrony across provinces, Spearman rank correlations were computed between all pairs of provincial crude rate time series. The mean interprovincial correlation was low ($\rho = 0.236$), indicating considerable heterogeneity in temporal evolution. Sevilla showed the highest correlation with the regional aggregate ($\rho = 0.849$, $p < 0.001$), consistent with its large population weight, whereas Jaén followed an independent trajectory ($\rho = 0.139$, $p = 0.507$). Figure S9 presents the full correlation matrix.

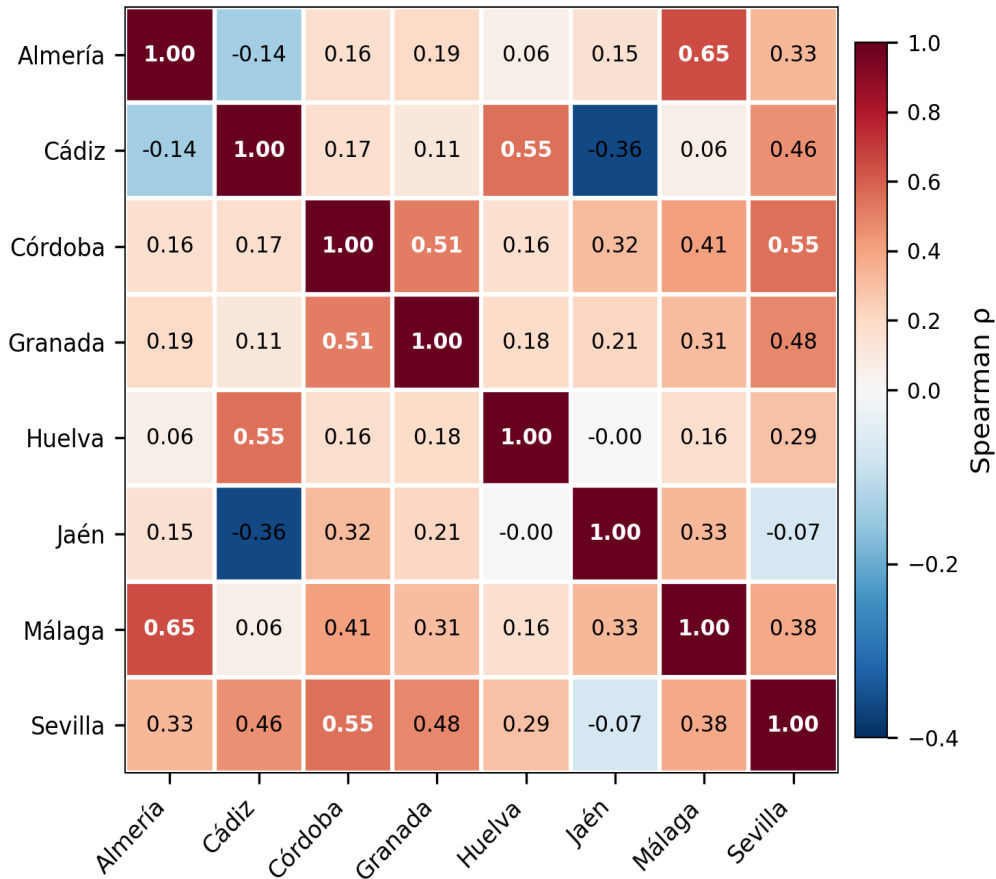


Figure S9. Interprovincial Spearman correlation matrix of crude suicide mortality rate time series (both sexes), Andalusia, 2000–2024. Colour scale from dark blue (negative correlation) to dark red (positive correlation), with numerical values annotated in each cell. The mean interprovincial correlation was low ($\rho = 0.236$), indicating considerable heterogeneity in temporal evolution. The strongest correlations identified geographically coherent clusters: an eastern-coastal axis (Almería–Málaga, $\rho = 0.65$), a Guadalquivir valley axis (Córdoba–Sevilla, $\rho = 0.55$; Córdoba–Granada, $\rho = 0.51$), and a western-Atlantic axis (Cádiz–Huelva, $\rho = 0.55$). Jaén showed near-zero or negative correlations with most provinces (range: -0.36 with Cádiz to $+0.33$ with Málaga), confirming its independent temporal trajectory. Source: INE. Authors’ calculations.

Three geographically coherent clusters emerged from the correlation analysis. First, an eastern-coastal axis linking Almería and Málaga ($\rho = 0.65$), the strongest pairwise correlation in the matrix. Second, a Guadalquivir valley axis involving Córdoba with both Sevilla ($\rho = 0.55$) and Granada ($\rho = 0.51$). Third, a western-Atlantic axis connecting Cádiz and Huelva ($\rho = 0.55$). Jaén stood apart from all clusters, with near-zero or negative correlations with most provinces (range: -0.36 with Cádiz to $+0.33$ with Málaga), confirming its independent temporal trajectory. These patterns suggest that suicide mortality dynamics in Andalusia are shaped by sub-regional factors—potentially related to economic structure, urbanisation, or health service organisation—rather than following a single regional trend.

Summary

This analysis reveals a 1.66-fold interprovincial disparity in crude suicide rates that persisted across all four historical periods (all Kruskal–Wallis $p < 0.001$). Inland eastern provinces (Jaén, Granada, Córdoba) consistently exhibited higher rates than south-western coastal provinces (Huelva, Cádiz). Only Málaga showed a significant overall decline (EAPC = -0.94% , $p = 0.007$), while Cádiz exhibited a significant increase (EAPC = $+0.98\%$, $p = 0.025$), driven primarily by women (EAPC = $+2.93\%$, $p < 0.001$). The pandemic/post-pandemic period was associated with universal rate increases across all provinces, with a partial convergence pattern

whereby provinces with historically lower rates experienced the largest relative increases. Low interprovincial temporal synchrony ($\rho = 0.236$) and geographically coherent correlation clusters point to the importance of sub-regional determinants. These findings support the main text's conclusion that aggregate regional trends may obscure substantial geographic heterogeneity, and underscore the need for province-specific prevention strategies.