Online Resource 3. Complete age–period–cohort model coefficients

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

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This Online Resource provides the full set of coefficients estimated by the intrinsic estimator (IE) for the age–period–cohort model, including log-coefficients and relative risks for each effect, stratified by sex. These parameters complement the graphical summaries in the main text by providing exact numerical values for all estimated effects.

1. Model specification

The APC model was fitted to a Lexis table with 9 five-year age groups (40–44 to 80–84) and 5 quinquennial periods (2000–2004 to 2020–2024), yielding 13 implicit birth cohorts. The IE resolves the classical identification problem by projecting the parameter vector onto the orthogonal complement of the null space of the design matrix, producing the unique minimum-norm L^2 solution. Parameters were normalised under a sum-to-zero constraint.

The model explained 98.3% of total variance for both sexes (R^2 = 0.986 for men, 0.904 for women). All three effects showed interpretable patterns, detailed below.

2. Age effects

Coefficients increased monotonically from 40–44 (α = –0.342; RR = 0.710) to 80–84 (α = +0.327; RR = 1.387) for both sexes, indicating that the risk of suicide nearly doubles across this age range after controlling for period and cohort influences. The gradient was steeper in men (RR range: 0.686–1.670) and flatter in women (plateau between 55 and 84 years; RR 1.019–1.128).

3. Period effects

The highest period risk corresponded to 2005–2009 (β = +0.055; RR = 1.057), followed by 2000–2004 (RR = 1.028) and 2020–2024 (RR = 1.020). The period 2015–2019 carried the lowest contextual risk (β = –0.117; RR = 0.890), 11% below the grand mean. The pandemic quinquennium thus rebounded to levels comparable to the early 2000s but did not exceed the 2005–2009 peak.

4. Cohort effects

Generations born before 1935 carried elevated risk, peaking at ~1920 (γ = +0.306; RR = 1.358). A sustained decline followed through cohorts born 1935–1975, with the lowest values around 1945–1955 (RR ≈ 0.85–0.87). From the ~1960 cohort onwards, risk stabilised near the grand mean (~1980: RR = 1.004). In men, the pattern was more pronounced (peak ~1920: RR = 1.470; nadir ~1945: RR = 0.792). In women, the ~1975 cohort exhibited a moderately elevated risk (RR = 1.084), the highest among female cohorts born after 1955.

5. Full coefficient table

Table S4 presents the complete set of APC coefficients on the logarithmic scale and as rate ratios (RR = exp(coefficient)), stratified by sex. The sum-to-zero constraint ensures that RR = 1.000 corresponds to the grand mean risk across all levels of each effect.

Table S4. Age–period–cohort model coefficients (intrinsic estimator) for suicide mortality, Andalusia, 2000–2024

	Both sexes		Men		Women	
	Coef. (log)	**RR**	**Coef. (log)**	**RR**	**Coef. (log)**	**RR**
Model R^2	0.983		0.986		0.904	
Age effects (α)						
40–44	-0.342	0.710	-0.377	0.686	-0.367	0.693
45–49	-0.138	0.871	-0.167	0.846	-0.168	0.845
50–54	-0.038	0.963	-0.091	0.913	+0.027	1.028
55–59	-0.032	0.968	-0.111	0.895	+0.121	1.128

	Both sexes		Men		Women	
	Coef. (log)	**RR**	**Coef. (log)**	**RR**	**Coef. (log)**	**RR**
60–64	-0.030	0.971	-0.080	0.923	+0.067	1.069
65–69	-0.046	0.955	-0.110	0.896	+0.115	1.121
70–74	+0.079	1.082	+0.089	1.093	+0.102	1.108
75–79	+0.220	1.246	+0.334	1.397	+0.019	1.019
80–84	+0.327	1.387	+0.513	1.670	+0.084	1.087
Period effects (β)						
2000–2004	+0.027	1.028	+0.031	1.031	+0.017	1.017
2005–2009	+0.055	1.057	+0.045	1.046	+0.096	1.101
2010–2014	+0.014	1.014	+0.034	1.034	-0.057	0.944
2015–2019	-0.117	0.890	-0.129	0.879	-0.077	0.926
2020–2024	+0.020	1.020	+0.020	1.020	+0.021	1.022
Cohort effects (γ)						
~1920	+0.306	1.358	+0.386	1.470	+0.312	1.366
~1925	+0.203	1.225	+0.274	1.315	+0.086	1.090
~1930	+0.109	1.116	+0.178	1.195	-0.092	0.913
~1935	+0.081	1.084	+0.069	1.071	+0.128	1.136
~1940	-0.017	0.983	-0.016	0.984	-0.015	0.985
~1945	-0.164	0.849	-0.233	0.792	-0.002	0.998
~1950	-0.159	0.853	-0.183	0.832	-0.132	0.876
~1955	-0.138	0.871	-0.144	0.866	-0.162	0.850
~1960	-0.081	0.922	-0.085	0.918	-0.110	0.896
~1965	-0.069	0.933	-0.089	0.915	-0.051	0.950
~1970	-0.036	0.964	-0.066	0.936	-0.000	1.000
~1975	-0.039	0.962	-0.093	0.911	+0.081	1.084
~1980	+0.004	1.004	+0.004	1.004	-0.042	0.959

Coef. (log): coefficient on the logarithmic scale, centred under the sum-to-zero constraint ($\Sigma\alpha = \Sigma\beta = \Sigma\gamma = 0$*). RR: rate ratio = exp(coefficient); RR = 1.000 indicates risk equal to the grand mean. APC model fitted with the intrinsic estimator (IE). Age range: 40–84 years (9 quinquennial groups). Periods: 5 quinquennia (2000–2004 to 2020–2024). Birth cohorts: 13 (~1920–~1980). Source: INE. Authors' calculations.*

Summary

The intrinsic estimator APC model revealed three distinct temporal dimensions of suicide risk in Andalusia. The age effect is the dominant component, with a near-doubling of risk from age 40–44 to 80–84 (RR = 1.387 for both sexes), particularly steep in men (RR = 1.670). Period effects showed a clear inverted-U pattern, with contextual risk peaking in 2005–2009 (RR = 1.057), reaching a nadir in 2015–2019 (RR = 0.890), and rebounding modestly in the pandemic quinquennium (RR = 1.020). Cohort effects identified pre-1935 birth cohorts as carrying the highest generational risk (peak ~1920: RR = 1.358), with a secular decline in cohort-specific risk through generations born 1935–1975 and stabilisation thereafter. In women, a notable exception is the ~1975 cohort (RR = 1.084), which warrants monitoring in future surveillance. The high model fit ($R^2 = 0.983$) supports the validity of the APC decomposition as a framework for understanding the interplay of biological ageing, contextual period influences, and generational risk factors in suicide mortality.