



Early View

Research letter

International trends in chronic obstructive pulmonary disease mortality, 1995–2017

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RESEARCH LETTER

International trends in chronic obstructive pulmonary disease mortality, 1995–2017

Running title: Chronic obstructive pulmonary disease mortality trends

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In our international study over 1995–2017, COPD mortality rates declined in most countries.

Yet, in women, they remained stable in North America and increased in 6 countries in

Europe. The number of deaths increased or remained stable in most countries.

To the editor:

Since 2016, chronic obstructive pulmonary disease (COPD) has been the third-leading cause of death worldwide, with an estimated 3 million deaths (5.3% of all deaths), but with large regional variations

(http://www.who.int/healthinfo/global_burden_disease/projections/en/). Observed data from high-income countries[1-4] (HICs) and modeled data in two global studies[5,6] have reported declines in COPD mortality rates since the 1990s. Globally, since 2006, modelled COPD mortality rates decreased by 21%.[7] Yet, little is known about observed trends in COPD mortality in Latin America, and more recently in Oceania and Europe.

Mortality data can be expressed in many ways, for different purposes. Absolute death counts are useful to clinicians and for local use; crude mortality rates allow comparisons with other conditions, and regional healthcare planning. Finally, standardized mortality rates are valuable for comparison between countries and/or period by adjusting for differences in the demographic composition. For our study, COPD death counts were extracted from the World Health Organization mortality database (http://www.who.int/healthinfo/mortality_data/en/) between 1995 and 2017, using ICD-10 codes of chronic bronchitis (J40-J42), emphysema (J43), and other COPD (J44).[4] No redistribution of ill-defined codes was performed.

Countries with at least 2 million inhabitants in 2010 and vital statistics covering >90% of their national population, a proportion of ill-defined causes of death <10% since 2000, data until at least 2013, for >10 continuous years by sex and <5% of unknown age at COPD death were selected. Corresponding population data were obtained from the United Nations population 2017 revision estimates (<https://esa.un.org/unpd/wpp/Download/Standard/Population/>).

COPD age-standardized mortality rates were computed for ages 50 to 84 using the world standard population, corrected for unknown age at death. The Joinpoint Regression Program version 4.7.0.0 (<https://surveillance.cancer.gov/joinpoint/>) was used to model

temporal changes in mortality rates. It performs a linear regression of the observed rates vs. years and then iteratively tests (with a Monte Carlo Permutation) whether break points (so-called joinpoints) would improve the fitness of the model. The selected model is the most parsimonious one and provides an estimation of the annual percent change in rates based on the slope of the linear trend between two joinpoints (or the first/last observation).

Twenty-four countries (six in Latin America and the Caribbean; two in North America, Asia and Oceania; and twelve in Europe), covering 12% of the world's population, were included in this study. In total, close to 3.36 million COPD deaths (56% male) were analyzed.

Throughout 1995–2017, in Latin America and the Caribbean, Asia and Oceania, COPD mortality rates, in both sexes, have been declining or remained stable (figure 1a). For instance, rates declined by -5.2% and -5.6% per year in Costa Rica, in men and women, respectively. The exceptions were the increasing rates observed among Cuban (+1.5% per year) and Australian (+2.4% per year since 2009) women. In Europe, mortality rates have also been declining among men in most countries but remained stable in Hungary (since 2005) and increased in Czechia and Croatia. Meanwhile, among women, COPD mortality rates have been increasing in half of the studied countries, from +2% per year in Austria to +4.2% or +4.8% per year in Czechia and Hungary, respectively.

During the most recent two years (circa 2016), COPD mortality rates were highest in Hungary and Kyrgyzstan among men (141 and 135 deaths per 100,000 person-years, respectively) and in the USA and Hungary among women (75 and 71, respectively). COPD mortality rates were lowest among men in Italy, Costa Rica and Israel (32, 39 and 39, respectively) and among women in Latvia, Spain, and Lithuania (6, 9 and 10, respectively). Despite the observed convergence between males and females in 18 out of 24 countries over the whole study period, COPD mortality rates remained twice as high in men as in

women in their respective countries —except in the USA, New Zealand and the UK where rates almost matched.

Finally, assessing changes in absolute number of deaths between 2000 and 2015, the number of COPD deaths increased by >10% in eleven countries, particularly in Latin America, North America, Eastern and Southern Europe (almost doubling in Czechia and Croatia), and decreased by >10% in six countries (even 40% and 50% in Lithuania and Kyrgyzstan, respectively). In the other seven countries COPD deaths were more or less stable (Figure 1b).

In this international study, with few exceptions (mainly among European women), COPD mortality rates have been, for some markedly, declining. For instance, mortality rates were halved in fifteen years in both sexes in Costa Rica, Kyrgyzstan and Lithuania. Nevertheless, COPD death counts increased in almost half and remained stable in a quarter of the studied countries.

COPD may result from longstanding exposure to tobacco smoking, occupational chemical substances, indoor and outdoor air pollution, with a role played by genetic susceptibility, poverty, stunting, and bronchial infections such as tuberculosis.[1,8,5,9,10] The contribution of these factors depends on the socio-economic level of the countries. Tobacco smoking and second-hand smoking are leading risk factors in HICs, while poverty, environmental exposures and early-life events predominate in low- and middle-income countries.[11] As evidence, in 2012, in Kyrgyzstan —where 3% of women smoked— the female COPD mortality rate was about 70 per 100,000, similar to that in the UK with a decreasing yet very high female smoking prevalence of 20%.[12] The declines in the COPD mortality rates in the highest income nations likely reflect previous declines in smoking prevalence in addition to recent progress in the diagnosis and management.[13] In fast growing economies, such as in Latin America, declines in poverty probably also contribute.[5,14] The narrowing of the

gender gap in COPD mortality rates in three quarters of the countries (mostly HICs) was previously reported in Europe.[3] The same phenomenon was observed in tobacco-related cancer mortality,[15] supporting the strong association between tobacco smoking and COPD mortality in HICs. In countries where women have been smoking as much and as long as men (e.g. USA, New Zealand and the UK)[12] female mortality from COPD became very similar to that of men.

In spite of declining COPD mortality rates in the majority of the countries studied, the number of COPD deaths has actually been increasing, or at the minimum stabilizing, due to population growth and ageing (e.g. in Colombia, Mexico, Venezuela and the USA). The number of COPD deaths will probably further grow due to greater exposure to risk factors such as outdoor air pollution in the growing urban populations,[16,17] and the benefits of additional declines in mortality from cardio-vascular disease and acute infection.[13]

The strengths of this study include the extensive international coverage of COPD mortality, with up-to-date high-quality observed data. Nevertheless, several limitations are worth mentioning. Firstly, under-diagnosis and underreporting of COPD are universal,[13] probably more so in older people, especially in middle-income countries. However, restricting the analysis to ages 50–69 led to similar conclusions (data not shown), supporting the robustness of our analysis on ages 50–84. Secondly, expanding the analysis to the contributing causes of death mentioned on the death certificates would give a better picture of the mortality attributable to COPD and should be pursued.[13] Therefore, our study most likely underestimates the true mortality burden of COPD. We also acknowledge the reduced global reach of our study due to the scarcity of high-quality mortality registration in most low- and middle-income countries such as China and India (population coverages of 4% and 8%, respectively) and some HICs including Germany and Japan (proportions of ill-defined causes of death of 11% and 16%, respectively). Another populated country, the Russian Federation, combines COPD and asthma deaths in reporting to the WHO mortality

database, and was therefore excluded. Increasing high-quality and availability of mortality data in low- and middle-income countries, with escalating issues related to urbanization and higher exposure to air pollution than in HICs, would offer valuable insight. Finally, comprehensive information on differences in diagnostic practices and access to treatment for COPD could elucidate disparities between countries with otherwise similar profiles of risk factor exposure.

In most of the studied countries, declines in COPD mortality rates were observed, but were not mirrored by reductions in the number of COPD deaths. Necessary steps to curtail the future burden are to regionally tailor primary prevention measures to decrease exposure to the main COPD risk factors, to cope with multi-morbidity,[18] and to expand access to diagnosis and treatment.[11,19]

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Figure title and footnote

Figure 1 Trends in chronic obstructive pulmonary disease (COPD) mortality by region and sex, ages 50–84

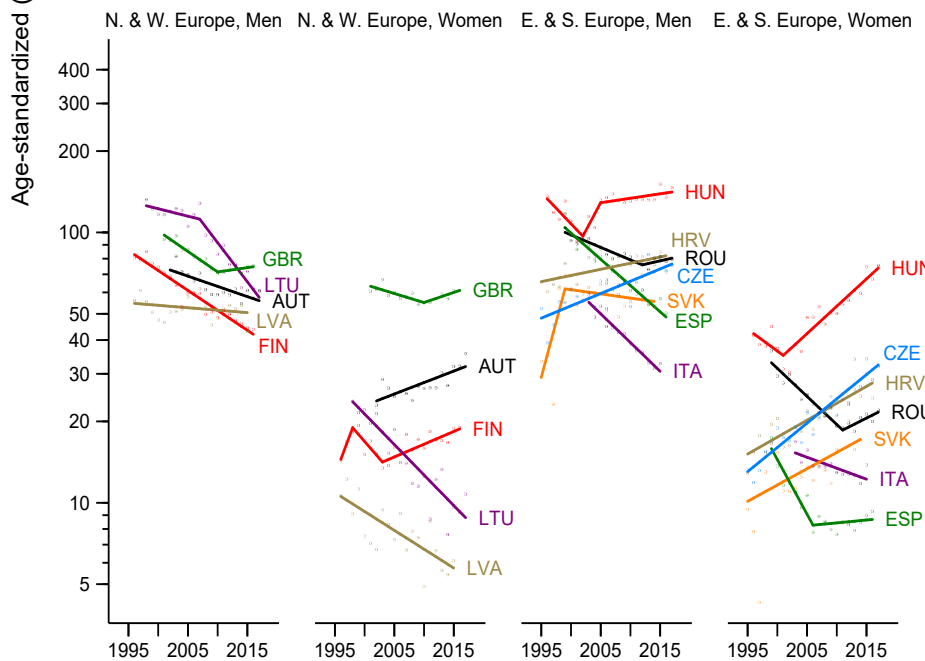
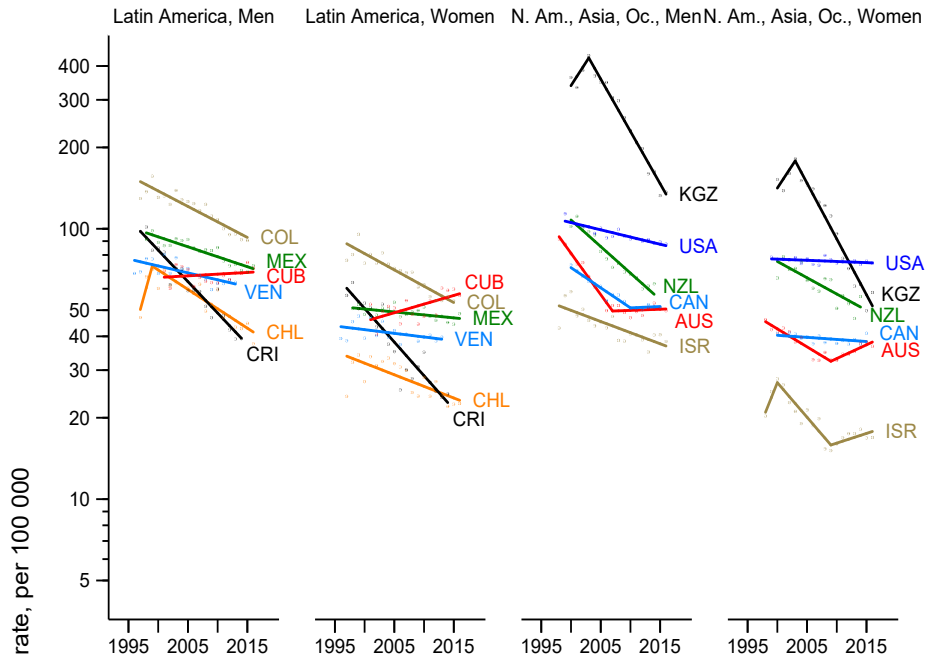
a) Age-standardized mortality rates; b) Number of deaths.

Death counts were smoothed with a moving average of 30% of the values.

Country names: AUS: Australia; AUT: Austria; CAN: Canada; CHL: Chile; COL: Colombia; CRI: Costa Rica; CUB: Cuba; CZE: Czechia ; ESP: Spain ; FIN: Finland ; GBR: United Kingdom of Great Britain and Northern Ireland; HRV: Croatia; HUN: Hungary; ISR: Israel; ITA: Italy; KGZ: Kyrgyzstan; LTU: Lithuania; LVA: Latvia; MEX: Mexico; NZL: New Zealand; ROU: Romania; SVK: Slovakia; USA: United States of America; VEN: (Bolivarian Republic of) Venezuela.

Region names: N. Am.: North America; Oc.: Oceania; N. & W. Europe: Northern and Western Europe; E. and S. Europe: Eastern and Southern Europe.

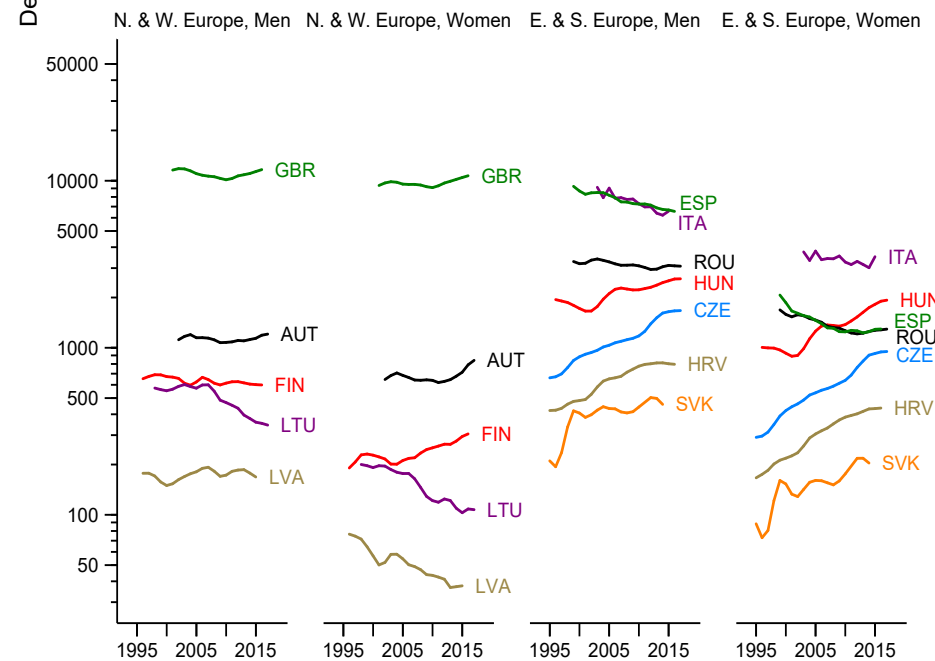
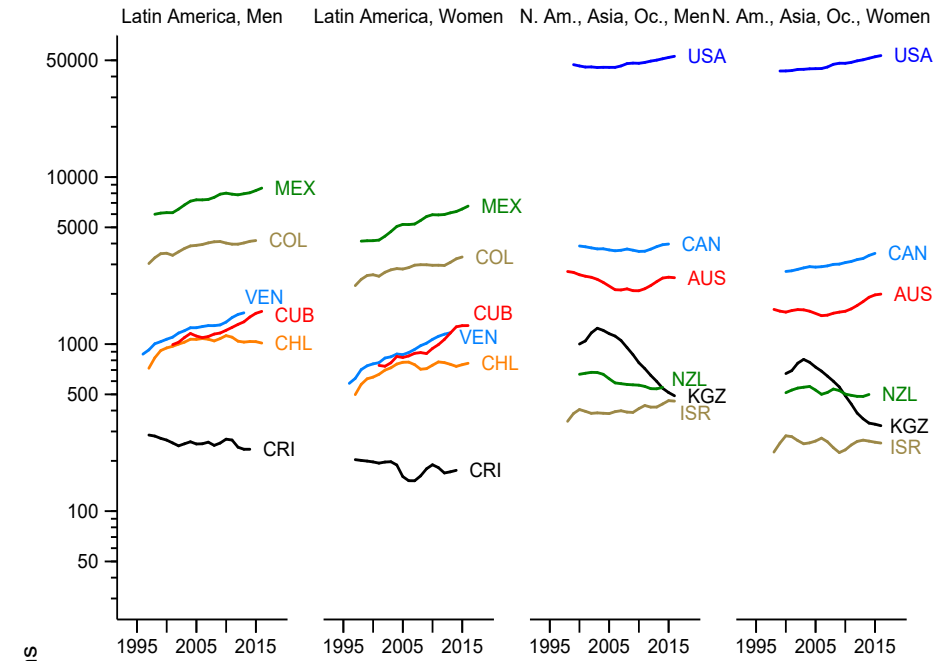
a) COPD mortality rate, ages 50-84



• observed mortality rate

— modeled mortality rate

b) Number of COPD deaths, ages 50-84



— number of deaths