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Descriptive Finding

The impact of the COVID-19 pandemic on mortality in Uruguay from 2020 to 2022

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Abstract

BACKGROUND
In 2020, as the SARS-CoV-2 virus spread globally, many countries around the world experienced substantial increases in mortality, including in Latin America. In that year, many non-pharmaceutical measures were implemented in Uruguay. The first COVID-19 vaccines were administered in February 2021. Uruguay has various characteristics that were pointed out as risk factors in the course of the pandemic, mainly an old population, high urbanization levels, and socioeconomic inequalities.

METHODS
We estimate the annual and monthly excess deaths and P-scores for 2020, 2021, and 2022. We also compute the sex-specific life expectancy gap between each one of those years and 2019, and we decompose the observed changes into the contributions from COVID-19 at different ages.

RESULTS
In contrast to what was observed in neighboring countries, Uruguay experienced a life-expectancy increase in 2020 as compared to 2019. However, life expectancy declined substantially in the country in 2021 and 2022. While most of the decline in 2021 is attributable to COVID-19, the cause-of-death profile of the losses in 2022 is more complex. Although both sexes were affected, women experienced a larger life-expectancy loss in 2022.

CONTRIBUTION
Previous studies about COVID-19 mortality in Latin America mention the particular case of Uruguay as a country that was barely affected by the pandemic in 2020. In fact, there

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were fewer deaths than expected that year. Here we extend the analysis until the end of 2022, showing that unlike the first pandemic year, there was a substantial mortality increase in Uruguay in 2021 and 2022.

1. Introduction

In 2020, as the SARS-CoV-2 virus spread globally, many countries around the world experienced substantial increases in mortality, including in Latin America (Castro et al. 2021; Lima et al. 2021; Pesci et al. 2021; dos Santos et al. 2021). In the absence of a vaccine against the new coronavirus disease, local and national governments implemented non-pharmaceutical measures in an effort to prevent its fast spread.

In Uruguay, most preventive measures were implemented between March and December 2020 – before the first wave hit the country in early 2021 (Bengochea et al. 2022; Cabana et al. 2021). Those measures included teleworking, partial border closure, mobility restrictions, school and university closures, mandatory face mask use in public places, nonmandatory quarantine, massive distribution of hand sanitizing gels, home visits from medical staff to persons with suspected infection, virtual medical consultations, and delay of scheduled surgeries (Uruguay Presidencia 2021). Furthermore, there was large-scale COVID-19 testing, implemented as part of a “Test, Trace and Isolate” epidemiological surveillance strategy (Moreno et al. 2020). The first COVID-19 vaccines were administered in late February 2021; by the end of August about 71% of the population had received the complete vaccination protocol (PAHO 2023). After May 2021, activities progressively resumed as vaccination coverage rose.

Changes in behavior due to the above measures may have affected the spread of the SARS-CoV-2 virus in Uruguay and also affected exposure to other diseases. In any case, the total number of deaths registered in the country in 2020 was below the number for the previous year (34,807 in 2019; 32,638 deaths in 2020). However, the following year was marked by an unprecedentedly high number of deaths (41,168 in 2021). A considerable death toll was recorded again in 2022 (39,322 deaths), despite that the worst of the pandemic seemed relatively far off by then thanks to successful vaccination.

Within the Latin American region, Uruguay stands out for its small and aged population (16% above age 64 in 2023), which is highly concentrated in urban areas (96% in 2023), mainly in the capital, Montevideo (with almost half the population). Despite Uruguay being a middle-income country, some population groups experience socioeconomic inequalities and precarious living conditions. For instance, a large proportion of workers are not affiliated to social security (22% in 2023; however, this does not imply that these people are out of the health system, as all the population has access to at least basic medical insurance), and 10% is below the poverty line (INE 2023a). According to previous studies, some of these characteristics are major risk factors for COVID-19 mortality (Alfaro et al. 2022; Bonilla et al. 2023; Cid and Marinho 2022; Dowd et al. 2020; Shang et al. 2022).

Previous studies about COVID-19 mortality in Latin America mention the particular case of Uruguay as a country that was barely affected by the pandemic in 2020 (Guzmán 2021; Karlinsky and Kobak 2022; Silva-Ayçaguer and Ponzo-Gómez 2021). Due to their timing, some of those studies could only start to see that 2021 would be different. Here we extend the analysis for Uruguay, as we study the large mortality increase that followed in 2021 and 2022. To measure the impact of the health crisis on mortality, we focus on analysis of the monthly distribution of excess deaths from 2020 to 2022. We also estimate the life expectancy gap between 2019 and successive years up to 2022 and estimate the contribution of COVID-19 mortality to those changes. Finally, we compare the estimated excess deaths for Uruguay with those for other countries in 2020 and 2021.

2. Methods and data

First, we estimated the expected number of annual and monthly deaths from 2020 to 2022. This measure, which indicates the number of deaths that should have been observed under normal conditions, allows estimation of the number of excess deaths. This became a preferred measure with which to evaluate the impact of the pandemic, because COVID-19 death counts quantify only the direct effect of the pandemic whereas excess death counts also include changes in mortality from other causes – those that resulted from different behaviors and disruptions in the health system during the crisis (Lima et al. 2021). Furthermore, during the first months of the pandemic, it became evident that COVID-19 deaths could be severely underreported in some countries due to insufficient availability of tests, misdiagnosing, and comparability issues between countries and across time (García et al. 2021; Shang et al. 2022). Nevertheless, in Uruguay, COVID-19 death counts can be considered of good quality for three reasons. First, they come from death certificates, and coverage of the Civil Registration and Vital Statistics System in Uruguay is complete (all births and deaths are registered) (Del Popolo and Bay 2021; Karlinsky 2024). Second, most COVID-19 deaths occurred in hospitals (91.5% in 2020, 89% in 2021, and 86.6% in 2022), where laboratory tests to confirm contagion with the SARS-CoV-2 virus were routinely performed. Third, Uruguay did not suffer from a lack of tests in 2020; on the contrary, there was an abundance of test kits and tests were widely administered (Ballesté 2020).

For estimating the expected number of monthly and annual deaths, we used a generalized additive model (GAM) with a negative binomial distribution (WHO 2023a). Such models capture the trend and seasonality of mortality, as they include the year and the month as independent variables. We also used an Auto-Regressive Integrated Moving Average model (ARIMA) to estimate the annual number of expected deaths in 2020–2022. Both methods produced almost equal mean numbers of deaths.

Using data for the period 2015–2019, the World Health Organization (WHO) published the number of annual and monthly expected and excess deaths for 2020 and 2021 for each country and world region (WHO 2023b). For those years, this allowed us to compare excess mortality figures for Uruguay with those for other countries. We chose Uruguay's neighboring countries (Argentina and Brazil), countries in the Americas with a life expectancy similar to Uruguay's in 2019 (Chile, Costa Rica, and the United States), countries with a mortality experience similar to Uruguay's in 2020 according to studies mentioned above (Australia and New Zealand), and European countries with strong cultural ties to Uruguay (Spain and Italy). However, at the moment of writing this article, estimates for 2022 were not available. For this reason, we decided to apply this method for Uruguay using data for more years (1997–2019) in the estimation of the expected number of deaths in 2020–2022. The data were obtained by adapting the R code available in Msemburi et al. (2023) to our Uruguayan data.

Monthly and annual deaths from 1997 to 2020 (total and by cause of death) come from official tables published by Uruguay's Ministry of Public Health (MSP for its acronym in Spanish). Data for 2021 and 2022 were processed from MSP's anonymized microdata files (MSP 2023). For the annual estimates of expected deaths, we also used the annual death counts from 1900 to 1996 corrected by the Uruguayan statistics office (INE 2023b). Population estimates for mortality rates were obtained from the 2022 revision of the World Population Prospects (UN 2022).

Cause-of-death data provided by the MSP are death counts by underlying cause of death, as stated in the death certificate. For the analyses involving COVID-19 deaths, we redistributed deaths with an ill-defined cause of death. The proportion of these deaths has increased in the country (from 6.5% in 1997 to 9.9% in 2019). However, during the pandemic they increased more rapidly, reaching 12.4% in 2022 (MSP 2023). Because of the monthly and age distribution of these deaths (concentrated in the oldest age groups and peaking in the winter months), we believe that most of them correspond to deaths from respiratory and cardiovascular diseases. Moreover, since the Uruguayan health system did not collapse during the pandemic, most COVID-19 deaths occurred in health institutions. Since we took into account the share of COVID-19 deaths at home in the redistribution, the share of ill-defined deaths recoded as COVID-19 deaths is relatively small. After we reassigned these deaths, the increase in the number of COVID-19 deaths was only 1.5% in 2020, 2.2% in 2021 and 2.9% in 2022 (that is, 3, 121, and 67 additional deaths relocated to the cause COVID-19, respectively).

After estimating the number of expected deaths, we obtained the annual and monthly excess deaths by subtracting these deaths from the observed ones in 2020, 2021, and 2022. To obtain the percent difference between the observed and the expected deaths, we computed monthly and annual P-scores (Muellbauer and Aron 2020):

$$Pscore_{(t)} = \left(\frac{excess\ deaths_{(t)}}{expected\ deaths_{(t)}}\right) * 100, \quad (1)$$

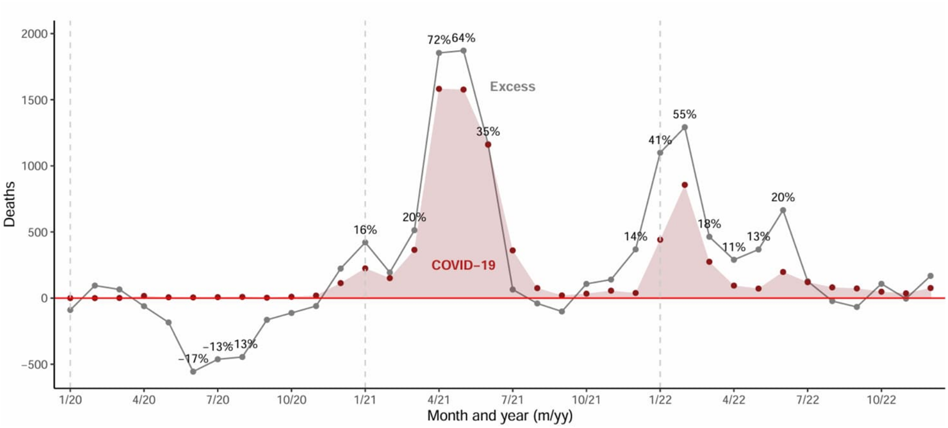
where t is any measure of time (a month or a year). For example, a monthly P-score of 50% means that the observed number of deaths exceeded by 50% the expected number for that month. Because of Uruguay's southern location and population structure, mortality rates usually peak in winter (June–August), when circulatory and respiratory deaths are at their highest levels among the elderly, and reach the lowest levels in summer (December–February). P-scores are suitable to compare between different mortality levels as they provide the relative difference between two measures. However, they depend on the method used for estimating the expected number of deaths. Some studies use the average number of deaths for the pre-pandemic years as an estimate of the expected number of deaths in 2020. However, that approach does not capture the trend in mortality. As previously mentioned, the models used here for estimating the expected number of deaths in 2020–2022 take into account the trend and seasonality of mortality.

In addition, to examine the changes in life expectancy during the pandemic, we calculated the gap in life expectancy at birth (e_0) between 2019 and each year from 2020 to 2022. Then, using the method proposed by Shkolnikov et al. (2001), we decomposed those differences into the contributions by age and cause of death. For example, if the difference in life expectancy between two populations (or the same population at two different points in time) is X number of years, this method calculates the contribution of each age group and each cause of death to that total gap of X years. Since the method is additive, the sum of all age- and cause-specific contributions adds up to the total difference of X years. By adding all the age-specific contributions from the cause COVID-19, we could estimate the part of the life expectancy gap that could be directly attributed to COVID-19 in each pandemic year when compared to 2019. We combined COVID-19 confirmed and suspected deaths, as the latter are very few: only 11 (5.8% of the confirmed and suspected deaths combined), 77 (1.4%), and 19 (0.8%) in 2020, 2021, and 2022, respectively. Life expectancy estimates for females and males were obtained through the computation of sex-specific quinquennial life tables using the procedure described in Preston, Heuveline, and Guillot (2001: 49).

3. Results

There was no excess mortality in 2020 in Uruguay, similar to what was observed for countries like Australia and New Zealand in that year (Karlinsky and Kobak 2021). On the contrary, there were fewer deaths than expected (–5.2% in total for 2020), mainly from April until November (Figure 1). However, toward the end of the year, the number of COVID-19 deaths rose rapidly, representing about 50% of the estimated excess deaths in December 2020 and January 2021.

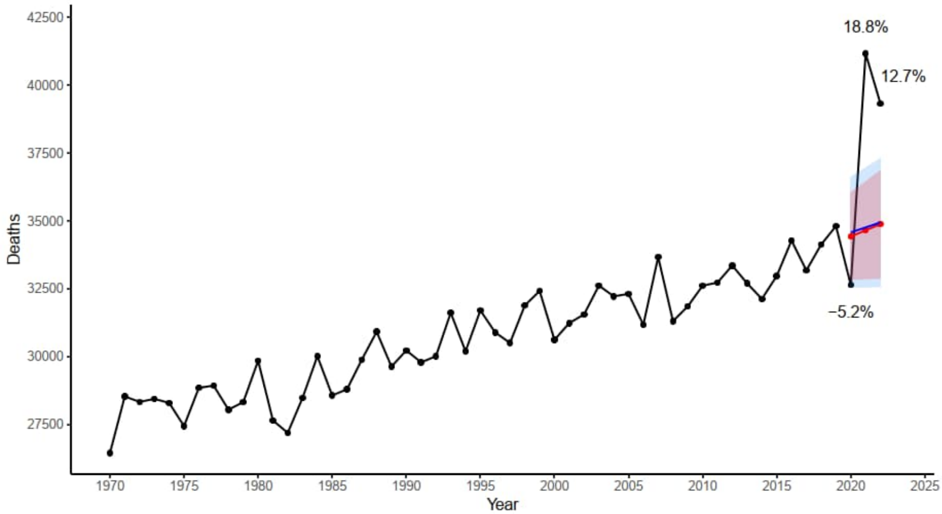
Figure 1: Monthly estimates of excess deaths and COVID-19 death counts, from January 2020 until December 2022, and P-scores (in %) for selected months



Source: Own estimates based on vital statistics on deaths (MSP 2023).
Notes: The gray line indicates the monthly estimated excess deaths. The red area shows the monthly COVID-19 death counts. The percentages near the estimated excess deaths indicate the P-score for each month. We show only P-scores below –10% or above 10%.

The years 2021 and 2022 were marked by very high mortality, as the observed number of deaths was 18.8% and 12.7% above the expected values, respectively (Figure 2). Although these figures are considerably smaller than the ones calculated for other Latin American countries (Karlinsky and Kobak 2021), they are unprecedented in Uruguay's recent history, at least since 1900. The mortality increase in 2021 and 2022 was concentrated in two main periods. The first and most intense peak was recorded in April and May 2021; the second peak occurred in January and February 2022. The most prevalent variants in those periods were Gamma (Rego et al. 2021) and Omicron, respectively. There were two other smaller peaks, one in January 2021 and another in June 2022. The latter is more pronounced in the excess deaths curve than in the COVID-19 curve (Figure 1), which could be partly due to an increase in respiratory diseases in the month of June. The mortality increase in January of both years is unusual but might be related to seasonal mobility during Christmas and the summer holidays.

Figure 2: Total observed number of deaths (1970–2022) and number of expected deaths (2020–2022), Uruguay



Source: Own estimates based on vital statistics on deaths (MSP 2023).
Notes: Expected deaths according to a GAM model (red) and an ARIMA model (blue), with respective 95% confidence intervals. For the years 2020–2022, the percentages indicate the annual P-scores – that is, the relative difference between the observed and the expected number of deaths.

Figure 1 also shows that COVID-19 death counts and the total number of excess deaths follow a similar evolution over time: Starting from December 2020, both curves tend to increase and decrease in the same months. However, the ratio between both measures changes. In the first peak, COVID-19 deaths represent about 84% of the total excess deaths, while the corresponding percentages for the second peak are 40% and 66% in January and February 2022. As mentioned previously, that relation is even smaller in June 2022 (30%). Furthermore, in some months the number of COVID-19 deaths exceeds the number of excess deaths from all causes, which could indicate that in those months there were fewer deaths than expected from causes other than COVID-19.

In terms of life expectancy, the previous results imply that, compared to 2019, there were gains in 2020 but considerable losses in 2021 and 2022. Table 1 shows that in 2020 gains in e_0 occurred despite small negative contributions from COVID-19 (0.86 years for women and 0.89 years for men). There were only 188 COVID-19 deaths in that year, representing only 0.6% of all deaths. Gains in 2020 were mainly due to mortality reductions among the elderly (ages 65+), although there were also substantial improvements among men aged 35–64. The largest life expectancy loss is observed in 2021 (females: –1.93 years; males: –2.06 years). The contribution of COVID-19 to those gaps is –1.96 years for females and –1.90 years for males. Although the age group 65+

contributes the most to that result, it is noteworthy that in 2021 the negative contribution from ages 35–64 is also quite substantial (39% and 43% of the total negative contribution from COVID-19 for females and males, respectively). The decline in life expectancy in 2022 was also important; women experienced a larger total loss compared to men (–1.34 and –0.66 years, respectively) as well as a larger negative contribution from COVID-19 (–0.7 years compared to –0.56 years for males). This is because in 2022 females of advanced age experienced more negative contributions from other causes, especially respiratory and cardiovascular diseases. In both 2021 and 2022, men in the age groups 25–34 and 35–64 experienced larger losses from COVID-19 compared to women. However, this male disadvantage was reversed in the oldest age category, as females above the age of 64 suffered the largest life expectancy losses attributed to COVID-19.

Finally, we compare the monthly excess deaths for Uruguay with those for other countries in 2020 and 2021 (Figure 3). We do not include 2022 due to limited data availability (see “Methods”). Due to the geographic spread of the virus from east to west, Italy and Spain show the highest P-scores in the spring months of 2020 in the Northern Hemisphere (Panel b). In those countries, 2020 was visibly worse than 2021. On the contrary, in Uruguay and other Latin American countries included in the figure (except Chile), the highest P-scores are observed in 2021 (see Panels a and c).

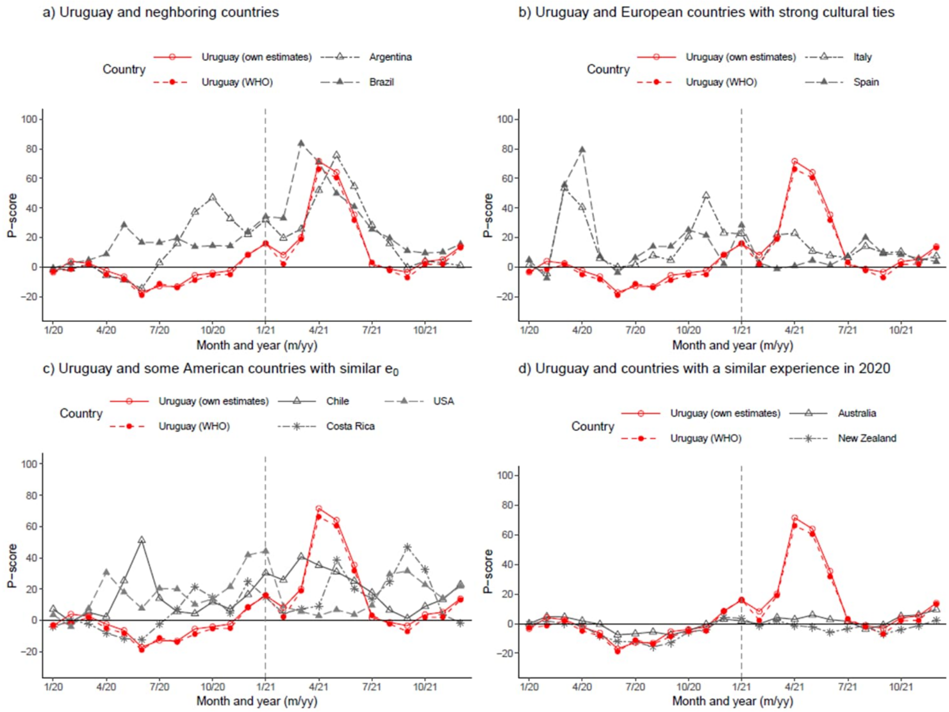
Although Uruguay, Argentina, and Costa Rica had similar negative P-scores in the first months of 2020, excess deaths rose rapidly in the latter two countries starting in June 2020, especially in Argentina. Uruguay’s excess deaths profile for 2020 more resembles those for New Zealand and Australia, which also had negative P-scores during most of the year (Panel d). However, Uruguay’s mortality experience in 2021 is more similar to the one observed in its Southern Cone neighbors (Argentina and Brazil), with P-scores reaching 65% or more in autumn (Panel a). One key difference is that while Argentina and Brazil had lower but still substantial P-scores before and after that autumn peak, Uruguay managed to return to normal (with no excess deaths) from July until November 2021, before the second wave hit the country.

Table 1: Life expectancy at birth from 2019 to 2022, gap between each pandemic year and 2019, and contribution of COVID-19 to those gaps (in years), by sex at selected ages

Year and measure	Females					Males				
	Value of indicator at age 0	Age contribution				Value of indicator at age 0	Age contribution			
		15–24	25–34	35–64	65+		15–24	25–34	35–64	65+
2019										
Life expectancy	81.14					73.43				
2020										
Life expectancy	81.99					74.32				
Gap with 2019	0.86	–0.01	–0.02	0.10	0.68	0.89	–0.02	0.01	0.31	0.49
Contribution COVID-19	–0.06	0	0	–0.02	–0.04	–0.07	0	0	–0.02	–0.05
2021										
Life expectancy	79.21					71.37				
Gap with 2019	–1.93	–0.04	–0.02	–0.76	–1.28	–2.06	0.01	–0.16	–0.89	–1.01
Contribution COVID-19	–1.96	–0.02	–0.4	–0.69	–1.21	–1.90	–0.01	–0.06	–0.84	–0.97
2022										
Life expectancy	79.79					72.77				
Gap with 2019	–1.34	–0.06	0	–0.19	–1.14	–0.66	0.02	–0.09	–0.10	–0.53
Contribution COVID-19	–0.70	0	–0.01	–0.12	–0.56	–0.56	–0.01	0	–0.14	–0.41

Source: Own estimates based on vital statistics on deaths (MSP 2023) and population estimates from World Population Prospects 2022 (UN 2022).
Notes: We include four large age categories, which represent different stages in the adult life course. We exclude ages 0–4 and 5–14, as their COVID-19 contributions are close to zero.

Figure 3: Monthly estimates of excess deaths in 2020 and 2021: Uruguay and other selected countries



Source: Own estimates based on vital statistics on deaths (MSP 2023) and excess death estimates (WHO 2023).

4. Conclusions and discussion

Despite its good performance during the first pandemic year, health conditions deteriorated in Uruguay in 2021 and 2022, causing an unprecedented mortality increase. Compared to 2019, life expectancy in 2021 declined by 1.93 years for women and 2.06 years for men. These values are smaller but not that far from life expectancy losses estimated for the United States in 2020 (Aburto et al. 2022). Nevertheless, within the Latin American context, the life expectancy loss in Uruguay is at the lower end, as some countries may have experienced losses as high as five or more years according to Lima et al. (2021).

The success of Uruguay in 2020, with fewer deaths than expected during most of the year while neighboring countries were experiencing a substantial rise in mortality, may be the result of the battery of preventive measures implemented by the government, among which a massive testing and isolation strategy is considered a key factor by some authors (Moreno et al. 2020). Not only were there few COVID-19 deaths, but mortality from other causes decreased, leading to gains in life expectancy in comparison with 2019. However, as shown in this study, the country did not manage to keep COVID-19 deaths at a low level, as the two following years were marked by very high mortality. Cyr et al. (2021) mention three factors that may have led to increased mortality in Uruguay in 2021: the geographical proximity to Brazil, “citizen fatigue with the restrictions of pandemic life,” and an early end of mobility restrictions. Another mechanism possibly related to at least part of the mortality increase in 2021 and 2022 is what Walkowiak, Domaradzki, and Walkowiak (2023) call the “reverse harvesting effect”: It is possible that, as a consequence of the preventive measures put in place in 2020, some frail individuals – who would have otherwise died – managed to survive at least until the next year, because in addition to slowing propagation of the SARS-CoV-2 virus, these measures had an impact on mortality from other causes, such as respiratory diseases. We showed in this article that in Uruguay most life expectancy gains in 2020 resulted from a reduction in mortality among the elderly. Furthermore, in separate analyses we have observed that the usual winter peak in mortality from respiratory diseases was much smaller in 2020 than in the previous years. It is possible that in 2021, as activities resumed progressively in the society, there were more individuals at high mortality risk. Previous studies that analyzed other high-mortality contexts have indicated that such harvesting effects may account for a small part of the increased (or decreased) mortality in certain years (Mussino et al. 2024; Rizzi, Søgaard, and Vaupel 2022; Toulemon and Barbieri 2008).

Finally, although increased mortality among the elderly (65+ years) explains most of the total life expectancy loss during the pandemic, in 2021 there were substantial negative contributions from younger ages (35–64), especially among men. These results are in line with previous studies, which show higher male COVID-19 mortality and sex differences that peak somewhere between the ages of 50 and 75 to the disadvantage of men (Pison and Meslé 2022; Torres et al. 2023). However, in Uruguay females aged 65 and above experienced larger life expectancy losses from COVID-19 than did men in 2021 and 2022, accounting for larger total losses associated with the disease in both years. The total life expectancy loss in 2022 was even larger for females, but part of that result is due to an increase in deaths from ill-defined causes, affecting mainly females of old age. As mentioned previously, that increase predates the pandemic – although it worsened during the COVID-19 crisis – and most of those deaths seem to be related to respiratory and cardiovascular diseases.

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